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The effectiveness of the logistics systems of the APEC countries

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Abstract. The Asia-Pacific Economic Cooperation Forum is an international union for collaboration in the field of regional trade, simplification and liberalization of investments, which serves the interaction of countries and their economic sectors with various stages of development. Transport and logistics systems are necessary to offset the shortcomings caused by issues with safety, usefulness and, most importantly, supply efficiency. The forum's management regularly works out strategies to solve these problems without noticeable losses for resource bases such as financial security and labor. Significant differences in the development of the association countries require an analysis of the effectiveness of logistics as a tool for the growth of the participating economies, ensuring conditions for constant progress and adaptation of the best foreign experience. The authors concluded that the degree of infrastructure quality affects the effectiveness of logistics services, confirmed the close relationship between the level of economic competitiveness of the country and the degree of its logistics efficiency, found out that the criteria for logistics efficiency are based on indicators of the pace of digitalization of transport activities. It is also established that Russia is one of the regions that can be characterized as catching up with the rest in terms of logistics efficiency, therefore, domestic transport industry specialists should study and, depending on the conditions, introduce technologies from the world's leading global players, creating a comparative advantage over other participants.

Keywords: APEC; transport systems; logistics efficiency; digitalization; competitiveness; Logistics Performance Index; diagnostic groups; correlation.

Эффективность логистических систем стран АТЭС

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Аннотация: Форум Азиатско-Тихоокеанского экономического сотрудничества - это международный союз для взаимодействия в области региональной торговли, упрощения и либерализации инвестиций, который служит сотрудничеству стран и их экономических секторов, находящихся на различных стадиях развития. Транспортно-логистические системы необходимы для устранения недостатков, связанных с проблемами безопасности, полезности и, самое главное, эффективности поставок. Руководство форума регулярно разрабатывает стратегии решения этих проблем без заметных потерь для ресурсной базы, такой как финансовая безопасность и рабочая сила. Существенные различия в развитии стран ассоциации требуют анализа

эффективности логистики как инструмента роста экономик-участниц, обеспечения условий постоянного прогресса и адаптации лучшего зарубежного опыта. Авторами сделан вывод о влиянии степени качества инфраструктуры на эффективность предоставления логистических услуг, подтверждена тесная взаимосвязь между уровнем экономической конкурентоспособности страны и степенью ее логистической эффективности, установлено, что критерии эффективности логистики базируются на показателях темпов цифровизации транспортной деятельности. Также установлено, что Россия является одним из регионов, который можно охарактеризовать как догоняющий остальные по эффективности логистики, следовательно, отечественным специалистам транспортной отрасли следует изучать и, в зависимости от условий, внедрять технологии ведущих мировых глобальных игроков, создающих сравнительное преимущество перед другими участниками.

Ключевые слова: АТЭС; транспортные системы; эффективность логистики; цифровизация; конкурентоспособность; индекс эффективности логистики; диагностические группы; корреляция.

Introduction

One of the most important international associations of the world economy is the Asia-Pacific Economic Cooperation (APEC), which includes the economies of various states. The main mission of APEC is the optimization of problematic aspects of transport and logistics systems, minimizing risks and increasing efficiency. These issues are regularly raised by the APEC working group in the field of transport, since the uneven economic development of the participating countries requires an in-depth analysis of their logistics systems in order to identify areas for improvement and exchange best practices. The aim of this article is to study the transportation efficiency based on the data, published by the World Bank every 3 calendar years regarding the logistics of all countries providing information. The purpose of our study is to analyze the most successful countries in the framework of regional cooperation, which will identify the strengths and weaknesses of the transport industries of various states for the subsequent exchange of best practices.

The conditionality of the creation of an association that monitors the logistics activity of participants in the Asia-Pacific region and studies the prospects for its development lies in the noticeable increase in financial investments and capital in freight and passenger transportation over the past few years. A distinctive feature of this cooperation is the different structuring of the economies and the level of development and dynamics. Within the framework of the organization's existence, there is a regular flow of applications from states to join the association, which determines the usefulness of mutual cooperation for many years, however, in order to become a participant in the collaboration, strict compliance of economic, political and social conditions is necessary[1].

APEC actively contributes to the development of transport infrastructure through conferences and meetings, as well as the development of strategic action plans. The main goal is to strengthen international transport links in order to ensure economic integration between the APEC countries, Europe, Central Asia and America, including providing transport logistics for the development of foreign trade cooperation [2].

At the moment, the research is aimed at improving logistics efficiency by optimizing supply chain management through control and coordination of operations of various modes of transport. In the work of Sergi and colleagues, an attempt was made to determine the impact of logistics efficiency of certain aspects of the competitiveness of the states [3]. Rashidi and Cullinan developed a methodology to identify problematic issues in transport and logistics systems that have a negative impact on the final results [4].

Modern digital technologies are the key to increasing the efficiency rate of the logistics sector in the era of Industry 4.0, where artificial (machine) intelligence comes out on top, capable of processing a significant amount of information on transportation in a short time

[5, 6]. In the field of data transmission APEC has established a system of rules governing cross-border confidentiality, which differs from EU standards in the field of data protection at the global level [7].

The relevance of the task of studying logistics within the APEC countries lies in the need to define criteria for classifying economies, identifying leaders and outsiders. In addition, the reliability of the assumption about the relationship between the level of economic competitiveness of the country and its degree of logistics efficiency will be tested, which is still the subject of many disputes among scientists and experts in this field. The novelty of the research lies in the analysis of this hypothesis, what will make it possible to assess the implementation of the best digital practices in the transport industry of the APEC countries and their subsequent adaptation for the progress of logistics in Russia. The article is intended for experts and developers of logistics infrastructure development programs both at the regional and national levels to integrate the best external experience, as well as for the business community, which is able to adopt the best methods of building supply chains of its goods and services from other participants in commercial activities.

The article has been prepared in English in order to increase of in-depth perception and representation of the scientific audience not only within the country, but also at the international arena.

Methods

The existing simplified approaches to the study do not allow us to fully explore the level of logistics of the country and its characteristics, as well as to compare the parameters with other countries, for which the Logistics Performance Index (LPI) was created by the analytical direction of the World Bank. LPI is considered to be one of the key criteria for studying the state of the national logistics sector, identifying both weaknesses and strengths of the flow of different types of transportation. For the most part, it reflects the level of infrastructural development and functioning of the logistics chain. This indicator is calculated on the basis of information from the reports of transport and logistics companies using the survey method.

Conducting a study to determine the level of efficiency of logistics processes in APEC countries by a selective type is irrational due to the need to define the LPI indicator and its dynamics, for which it is mandatory to diagnose and form appropriate calculation matrices. The basis of the diagnostic approach lies in the gradation of APEC member countries depending on the results of 6 factors and their nature of variability over time. Based on the data obtained, economies are classified as leaders, as well as those with potential, catching up or lagging behind, which reflects their level of development and competitiveness as of the date of information collection. The calculation of the index includes several indicators rated on a scale of up to 5 points, such as the effectiveness of customs clearance, the quality of infrastructure and others (Table 1) [8].

Table 1

The main indicators reflecting the effectiveness of logistics in the state

The name of the indicator	Interpretation	Ranking
Customs	Efficiency of customs procedures (efficiency, convenience and reliability of the process) state border control structures	From 0 to 5
Infrastructure	Efficiency of the commercial and transport framework (e.g. seaports, railways and highways, technologies)	
International shipments	Efficient organization of supplies at favorable rates	

Logistics Competence	Professional qualifications and standards for the provision of logistics services (for example, carriers, customs intermediaries)	
Tracking and Tracing	The ability to monitor transport goods	
Timeliness	Punctuality of transportation of goods to the destination within the prescribed or predicted time frame of transportation	

To search for the relationship between the level of logistics efficiency of the state and the competitiveness of its economy in the international arena, the use of a standard correlation type of mathematical analysis is proposed. The studied determinants are the LPI and the global competitiveness index. The correlation coefficient is interpreted depending on the nature of the level of interrelation of the criteria: from 0.1 to 0.3 - weak, from 0.3 to 0.5 - moderate, from 0.5 to 0.7 - noticeable, from 0.7 to 0.9 - high, 0.9 – pronounced [9, 10].

Results

The first stage of the analysis demonstrated that 3 APEC participants, namely Australia, Japan and Singapore, took places in the top 10 of the international ranking of logistics process efficiency in 2021 (Table 2). Australia has strengthened its position from seventh to fourth place for 2 years, Japan has made a breakthrough from twelfth to fifth place, and Singapore has slightly worsened its status by moving from fifth to seventh place. As for the deterioration in the rating, Hong Kong can be noted, which in the previous release of the World Bank was in the top ten, and in the current one takes only 12th place, displacing Japan from this position.

Table 2

Data on the logistics efficiency of the APEC countries (2021), points

Economy	Customs	Infrastructure	International shipments	Logistic Competence	Tracking and Tracing	Timeliness	**LPI Score**
Australia	3.71	4.18	3.88	4.08	4.09	4.25	4.03
Brunei	2.62	2.46	2.51	2.71	2.75	3.17	2.71
Canada	3.6	3.75	3.38	3.9	3.81	3.96	3.73
Indonesia	2.67	2.89	3.23	3.1	3.2	3.67	3.15
Japan	3.99	4.25	3.59	4.09	4.05	4.25	4.03
Republic of Korea	3.4	3.73	3.33	3.59	3.75	3.92	3.61
Malaysia	2.9	3.15	3.35	3.3	3.15	3.46	3.22
New Zealand	3.71	3.99	3.43	4.02	3.92	4.26	3.88
The Philippines	2.53	2.73	3.29	2.78	3.05	3.37	2.9
Singapore	3.89	4.06	3.58	4.1	4.08	4.32	4
Thailand	3.14	3.14	3.46	3.41	3.47	3.81	3.41
The United States	3.78	4.05	3.51	3.87	4.09	4.08	3.89
Chinese Taipei	3.47	3.72	3.48	3.57	3.67	3.72	3.6

Hong Kong	3.81	3.97	3.77	3.93	3.92	4.14	3.92
China	3.29	3.75	3.54	3.59	3.65	3.84	3.61
Mexico	2.77	2.85	3.1	3.02	3	3.53	3.05
Papua New Guinea	2.32	1.97	2.15	1.88	2.26	2.44	2.17
Chile	3.27	3.21	3.27	3.13	3.2	3.8	3.32
Peru	2.53	2.28	2.84	2.42	2.55	3.45	2.69
Russia	2.42	2.78	2.64	2.75	2.65	3.31	2.76
VietNam	2.95	3.01	3.16	3.4	3.45	3.67	3.27

Considering the dynamics of the rating of countries over 2 years, it is necessary to emphasize the positive trend of the level of Vietnam, Russia and New Zealand due to the increase in the volume and quality of international transportation, timely deliveries, as well as the introduction of technologies into the logistics infrastructure.

Papua New Guinea, Peru and Brunei showed low logistics efficiency in the world ranking, taking remote positions because of the lack of the resource base from a legal, financial and political point of view for the implementation of supply chain modernization programs. China and the Republic of Korea, on the contrary, occupy higher places among the economic leaders of the region due to the implementation of digitalization measures, and, as a result, optimization of logistics. The dynamics of changing positions in the rating indicates the different effectiveness of logistics systems in these countries.

A general analysis of the data showed that Papua New Guinea has the lowest quality of logistics services, equal to 1.88 points, while Singapore showed the highest result in timely delivery, equal to 4.32 points. Taiwan experienced the largest decrease in the score during the study period, especially in the indicator of on-time delivery, falling by 0.53 points. New Zealand, on the other hand, showed the maximum increase in the quality of logistics services by 0.8 points. The described dynamics is due to the special attention of the governments of the leading countries to the field of logistics, for example, various benefits and subsidies for both logistics enterprises and their employees, which leads to a high level of wages and competition for vacancies in the labor market.

After analyzing the APEC member economies according to the indicators determining the LPI, it was revealed that Japan, New Zealand, the USA, Chinese Taipei and Chile are the leaders in the efficiency of customs and border clearance with positive dynamics, the reason for which is the optimization of many control processes based on empirical studies of customs clearance, especially since the experience and significant volume of the customs flow of the listed countries make it possible to identify shortcomings leading to loss of time at the checkpoint and develop measures to eliminate them. Australia, Canada, the Republic of Korea, Singapore, Hong Kong and China also have high scores, but with negative dynamics. Thailand, Russia and Vietnam have the potential to improve the efficiency of customs and border clearance, although they start with low estimates.

Australia, Japan, New Zealand, Chinese Taipei and China are the leaders in the infrastructure quality index. Indonesia, the Philippines, Thailand, Chile, Russia and Vietnam are striving to reach the average level, while Canada, the Republic of Korea, Singapore, the United States and Hong Kong are showing negative dynamics, despite high scores. Brunei, Malaysia, Mexico, Papua New Guinea and Peru belong to the group of countries with lagging infrastructure development. These results mostly stem from the financial condition of states over the past decade, namely, the size and quality of taxation and the share of its transfer to the development of logistics infrastructure.

According to the analysis of the indicator of international transport organizations, the APEC economies are distributed as follows: the leading groups include the countries of Australia, New Zealand, the Philippines, and Thailand; regions with lost potential are Canada, Japan, the Republic of Korea, Malaysia, Singapore, the United States, Chinese Taipei, Hong Kong, China and Chile; catching up regions include Indonesia, Mexico, Russia and Vietnam; lagging regions are Brunei, Papua New Guinea and Peru. This parameter depends on the political activity of countries in the international arena, indulgences or even support in the work of branches of foreign companies on their territory, achieving their equality with resident organizations.

The assessment of the quality of logistics services and their dynamics show that some countries, such as Canada, Japan, New Zealand, Singapore, Thailand and Vietnam, are leaders in APEC. Countries such as Australia, the Republic of Korea, the United States, Chinese Taipei, Hong Kong and China have negative dynamics, although they are still at a high level of assessments. The explanation lies in the current level of technical endowment of the country and, consequently, its readiness to expand demand for transportation services, mainly with the participation of digitalization of processes.

The countries of Japan, New Zealand, Singapore, Thailand, Chinese Taipei and Vietnam are leaders within APEC due to high estimates on cargo tracking, while Australia, Canada, the Republic of Korea, the United States, Hong Kong and China show negative dynamics and are among the regions losing potential. Indonesia, the Philippines and Russia are showing positive dynamics, although they have insufficient points, that places them in the group of catching up regions. As part of other criteria for evaluating logistics efficiency, the above distribution is tightly correlated with the level of technological, and specifically digital, development of transportation, which allows some countries to break ahead in the international ranking, creating a vector of development for competitors.

Japan, New Zealand, Thailand and Chile stand out for their timely deliveries and positive dynamics within APEC, which makes them the leading regions. Indonesia, the Philippines, Mexico, Peru, Russia and Vietnam lag behind according to the indicator and are considered as developing economies. This is due to differences in the organization of logistics supply chains in order to reduce time and financial costs.

New Zealand and Japan have shown high diagnostic results and are in the leading group according various indicators. Thailand also performed well on four indicators, joining the leaders, but on two other indicators it was in the group of catching up regions (Fig. 1).

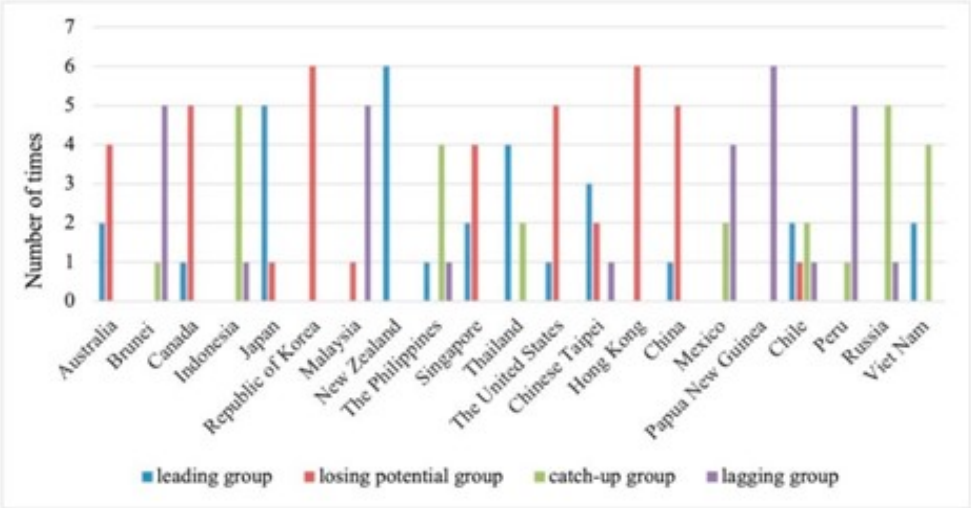

Fig. 1. Ranking of APEC by diagnostic groups according to logistics efficiency indicators (2021)

The Republic of Korea and Hong Kong have lost most of their logistics capacity across all six indicators. Canada, the United States and China are among the group of countries with high scores on five of the six criteria. Indonesia and Russia have the best chance of catching up with the leaders or surpassing the averages. Papua New Guinea lags behind other APEC regions in logistics, while Brunei, Peru and Malaysia have mixed results on various indicators.

Discussion

The socio-economic level of development is inextricably linked to the stage of progress in the field of transport. Current trends in the structure of commodity exchange set the vector for improving transport logistics, which in turn affects the efficiency of supply chains of goods and services. From the point of view of economic theory, the pace of development of transport should be relatively ahead of the pace of development of industrial achievements in order to offer the latter various prospects for improvement and a field of action for rational movement forward, laying growth points. In many countries, transport policy at the legislative level is fixed as an essential component of determining the level of welfare and security of the state, which is embedded in their strategic planning programs in the medium and long term. Thus, in Russia, both transport programs in general and individual modes of transport, have been formed in order to achieve a higher level of its efficiency.

The expansion of the geography of foreign economic partnership has become the main trend at the international level in modern conditions. The main task of exporters in this case is to minimize the transport costs of supplies, which will set the necessary transaction efficiency, and as a result, increase the average volume of high-value-added shipments. It is difficult to overestimate the role of transport in the process of expanding production activities and the efficiency of the money-commodity-money mechanism, especially at the international arena, which serves to level the spatial boundary between production and consumption. Experts note that the effectiveness of this process can be formed in absolutely different ways. And, the scientific community has agreed on the following criteria for determining the proper quality of the provision of transport services in the conduct of foreign trade: dynamism, efficiency, regulation and concomitant of all stages of logistics operations, taking into account the current infrastructure for this process. As for the APEC member countries, they are also distinguished by their involvement in the progress of commodity international relations.

It is believed that it is not possible for the State to achieve the status of a competitive economy at the international level without an effectively functioning transport and logistics system. To confirm this hypothesis, a correlation analysis was carried out (Figure 2), which revealed a very close relationship between the level of development of the transport and logistics system of the APEC countries and their competitiveness indicator, which reflects a correlation coefficient of 0.92.

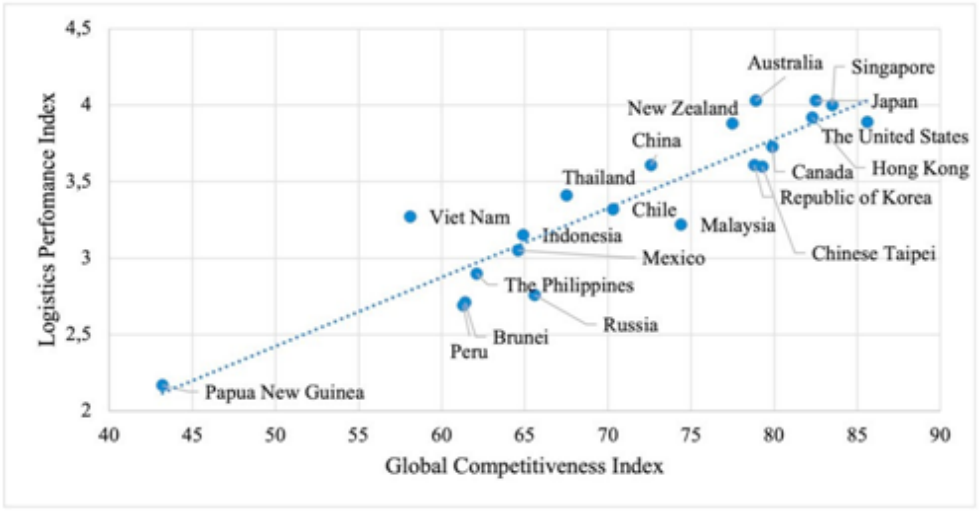

Fig. 2. Correlation of logistics efficiency and competitiveness of APEC economies

In order to maximize the usefulness of using logistics systems, and as a result of competitiveness, APEC countries should study the experience of leading countries for further analysis and early implementation into their own processes. Global technological progress makes it possible to build models of rationalization and optimization of transport routes using the most up-to-date mathematical and metric tools, that helps to reduce logistics costs and, as a result, increase the marginality of activities. In addition, it serves the partnership development and unification of the involved territories, their rapprochement with the global logistics community and strict adherence to rules and standards in the field of coordination of digitalization of supplies. The country's competitiveness on the world stage is largely ensured by transport and logistics support, which should be reflected in subsidizing digitalization as the main direction of the transport industry's expenses. And finally, as already mentioned, the development of digitalization serves as a guarantee of the country's comparative advantages, and, consequently, a significant incentive for the implementation of its strategic development programs and improving the efficiency of logistics supply chains.

As for the APEC countries themselves and the endowment of digitalization, active improvement of the leading countries according to this indicator is observed thanks to the sufficiency of the resource base and the endowment for moving forward. For example, Singapore has approved the Smart Mobility program, which is divided into the following areas of digital status formation in the medium term: timely planning, rationalization of funds and provision of data online. The implementation of these vectors is realized through the use of various kinds of tools, such as ground sensors, demand management, mathematical modeling, building predictive values of necessary indicators, multimodal transportation and research. Part of the program has already been implemented, for example, in Singapore you can find unmanned autonomous trains, robot loaders and other technologies without human involvement.

Data analysis has shown that South Korea has some of the best indicators within the framework of the APEC association, but despite it, there are weaknesses that require improvements to achieve proper efficiency. Among the many advanced countries, the results of this state are among the most advanced in terms of digitalization of logistics. In the future, in the coming years, the country's leadership plans to launch unmanned vessels, develop autonomous transportation technologies, as well as create three-wheeled courier

electric vehicles. Moreover, one of the most important goals is the introduction of the Internet of Things in loading and unloading operations, smart routing for the transportation of risky goods and autonomous cargo vehicles.

Let's move on to the values of China, where the level of development of the transport and logistics system is also highly valued despite constant variability. As in any advanced country, digitalization of transport logistics processes is aimed at progress and innovation. If we look ahead to the future, we plan to create analytical information processing organizations, cybersecurity departments, autonomous trains, smart vehicles and ships, but also mechanisms for their operation. It is worth noting that blockchain technology has reached its maximum perfection precisely in China, according to local law all business processes must be accompanied by electronic document management, and especially those related to the turnover of dangerous goods.

The described best practices and the resulting strategic vectors for further development Russia's logistics policy should clearly follow the principles developed for building a digital transport association within the country in order to confirm standards of reliability and efficiency. Nowadays, the Association of Digital Transport and Logistics has already been established in Russia, aimed at ensuring the expansion of the use of smart technologies in logistics, and the largest national players have already submitted algorithms for implementing digitalization strategies to the government. If we draw a parallel with other industries within the state, the Russian transport industry is characterized by the great presence of smart technologies in terms of the intensity of use, however, in order to solve new tasks and accept challenges, it is necessary to develop and integrate new models and tools for managing operations.

According to the forecasts of many analytical agencies, the coming years in Russia can be characterized by a technological breakthrough due to the resource endowment of IT and the sufficiency of the number of specialists and their proper qualifications for the implementation of all government-approved programs for the introduction of artificial intelligence in key sectors of the state, the list of which includes the logistics system. This will undoubtedly give an impetus to the development of business processes and increase the economic well-being of the country by reducing supply costs and their timeliness, creating a competitive advantage for the industry on the world stage.

Conclusion

The current stage of international economic relations requires the organization of associations to enable the exchange of experience between participating countries in order to maximize the efficiency of production processes. The transport and logistics systems of these countries should develop and be effective, which should confirm the necessity and usefulness of the existence of such international associations. Foreign trade processes have a close connection with operations in the field of transport (about 60-70%), which once again confirms the requirement to pay attention to improving transport and logistics systems. If we turn to the domestic policies of the countries, the role of transport can be traced in strengthening business communications in the regions, optimizing labor migration and generating rational supply chains, which ultimately contribute to a significant digital endowment of the state.

The degree of infrastructure quality directly affects the effectiveness of the provision of logistics services, since the very presence of infrastructure does not yet indicate the groundwork for achieving the targets. Experts predict a favorable future to Russia in the field of digitalization of logistics processes and see significant potential in it. Various modes of transport, including sea and rail, provide transport links between the regions of Western Europe, Southeast Asia and North America through the routes of the Trans-Siberian Railway. Positive plans for the future also flow through the Northern Sea Route, which is

noted in the reduction of the required time resource for delivery. The very significant size of Russia in terms of area does not prevent the malfunctioning of logistics links between the European part of Russia, Siberia and the Far East due to the developed level of infrastructure. Despite this, there are guidelines for further progress in the field of transport, since Russia's place in the logistics efficiency rating is only the seventh, which indicates the need to continue working on improving supply procedures.

After conducting a study based on the logistics data of the APEC countries, it was revealed that Russia is one of the regions that can be described as catching up with the rest in terms of logistics efficiency, which means that domestic transport industry specialists should study and implement technologies of leading global players, creating a comparative advantage over other participants, depending on the country's conditions. The interdependence between competitiveness and efficiency of logistics has been verified by the conducted correlation analysis between the level of development and efficiency of logistics with the competitive status of the state. Taking into account the main trends of Industry 4.0, the implementation of programs to achieve the necessary optimal or even high levels of criteria for logistics efficiency is based on indicators of the pace of transport operation digitalization.

States characterized by high positions in the logistics efficiency rating have a special role in the development of digitalization of the logistics sector, introducing robot loaders, autonomous transport and creating smart infrastructure along with the introduction of blockchain technologies into daily activities. A number of countries, including Russia, have approved programs to expand the use and improvement of digital solutions, especially in the transport industry, which should be combined with the integration of successful practices of leading states, taking into account the specifics of their own economies. The result of the study demonstrated that an increase in the country's competitiveness is not possible without an increase in the efficiency of its logistics environment, which can currently be achieved only through innovations using digitalization.

As for the directions of further research, as an assumption, a promising task is to predict the economic effect of the introduction of digitalization into logistics supply chains, taking into account inflationary costs and other various amendments. As a result, the scientific community will be presented with an adequate accurate model for building a future trend of efficiency from the operation of a technological solution, which will contribute to the growth of competition in the industry, thereby increasing the pace of its evolution and, most importantly, will create additional comfort for consumers of goods and services. The rationality and calculation of each digital introduction will make it possible to "close the gaps" in the stability of business and will serve as a guarantee for the confidence of the transport sector in the future.

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