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Digitalization of Labor as a Key Factor in the Development of Logistic Activities in the Conditions of COVID-19

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***Abstract*— Efficiency, optimization, speed and timeliness have always played a decisive role in logistics and supply chain management. Covid-19 has triggered supply chain disruptions, increased logistics costs and decreased productivity. The purpose of the article is to show the role of new digital solutions and modern information technologies in the digitalization of labor activity in the field of logistics as a key factor in reducing and neutralizing negative trends. The objectives of the study are to identify tendencies and trends in the use of digital solutions (as one of the aspects of the fourth industrial revolution) to increase labor productivity and efficiency of logistics activities in the post-pandemic period. The promising areas of application of digital technologies in logistics for increasing labor productivity, eliminating existing gaps in the management of logistics systems, as well as overcoming the consequences of the pandemic, have been identified. Funding: The reported study was funded by RFBR, project number 20-010-00877.**

Keywords—digitalization of labor, digital innovation, logistics, logistics outsourcing, logistics providers

I. INTRODUCTION

Over the past decades, there have been significant changes in organizational forms, tools, technologies for managing logistics of companies and supply chains. This is mainly the result of the business digitalization paradigm caused by the growth of logistics costs in recent years. The spread of COVID-19 in 2020 and the restrictive measures introduced at the state level to prevent the spread of coronavirus have had a strong negative impact on the efficiency of the global economy in the very first months. The coronavirus has also severely disrupted logistics activities as air travel has been reduced, seaports have been closed and workers have been exposed to the risk of infection. According to the National Bureau of Economic Research (NBER) estimates, the drop in GDP from restrictions in 64 studied countries of the world can reach 31.2%, and a third of this decline is due precisely to gaps in global supply chains. However, after the lifting of restrictive measures, the size of the global logistics market may grow from USD 2,734 billion in 2020 to USD 3,215 billion in 2021, which will amount to 17.6% on an annualized basis [1]. In these conditions, logistics providers need to quickly increase capacity, diversify routes, increase network flexibility and resiliency, reduce costs and increase labor productivity. There is a new stage in the digital transformation of logistics activities and, in particular, the work of employees involved in all functional areas of modern logistics. Only large or specialized companies will be able to afford significant investments in increasing labor productivity in the field of logistics, which increases the relevance of the logistics outsourcing use.

II. MATERIALS AND METHODS

Efficiency, optimization, speed and timeliness have always been critical in logistics, especially now, with a series of accelerating paces of evolution in the digital environment, where digital transformations are shaping the industrial revolution in the economy known as Industry 4.0. Even in the middle of the twentieth century, scientists talked about the

transformation of information into the most important productive force and resource that determines success in business (P. Drucker, A. Toffler, etc.). Industry 4.0 technologies have had an impact on manufacturers even before the pandemic, although their implementation differs from country to country. This trend is also typical for the logistics sector.

In traditional logistics, the main object of research is the material flow, in relation to which the logistics system is formed. However, the digitalization of the economy made it possible to single out the information value chain and recognize information as a strategic economic resource. This made it possible to introduce into the object of management not only "logistic material flow", but also "logistic information flow". The use of modern technical and technological solutions helps organizations to more efficiently manage their resources, build optimal routes for the movement of goods, achieve a reduction in transport travel time and provide a higher level of service, carry out regulation, planning and forecasting.

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These advantages are especially relevant for companies that specialize in the provision of logistics services, i.e. from logistics providers that work in an outsourcing format and take over the management of material and information flows of other organizations whose main field of activity is not related to the movement of goods.

In connection with the relevance of this topic, there is an active growth in research on digital technologies in logistics. Among them, it is worth highlighting works that consider the impact of Internet of Things (IoT) technologies on logistics and supply chain management [2-5], the digital transformation of logistics and the impact of IT technologies on it [6-12, etc.], the formation of the concept of Logistics 4.0 [13-15] and the search for new forms and methods of organizing supply chains and logistics management [16]. However, the impact of digital transformations [17] is ambiguous not only on the economies of different countries [18, 19], but also on the labor market and productivity. On the one hand, they contribute to the creation of a new workforce (virtual, not real, with higher productivity and efficiency) [20], and on the other, they affect the composition of existing (created and lost) jobs [21] and labor productivity [22].

Examining digital innovation in supply chains, for example for the Internet of Things, is a relatively new and complex issue. Most research on the implementation of innovations in the field of logistics uses only one research method: quantitative or qualitative. On the contrary, a mixed research method using quantitative and qualitative methods, simultaneously or sequentially, is rarely used to understand the research topic of interest. Even though a single method (qualitative or quantitative only) may not be enough to describe the complex decision-making behavior of digital adoption across multiple supply chain organizations, there are still few mixed studies in the literature. Although the information systems research community encourages methodological diversity, mixed-method research is very limited [23]. Similarly, mixed research methods are rarely used in disciplines related to supply chain management [24].

In our research we used methods of economic and marketing analysis, expert assessments, as well as empirical methods (generalization of results), a graphical method. PwC's research report “Overview of Transport and Logistics Trends in 2019” [25], which is based on a survey of 1,239 heads of transport and logistics companies from 85 countries, was used to assess the drivers of changes in logistics. To analyze the market of applied information and communication technologies, we used IDC studies "The Russian Infrastructure Market in 2019" [26], the National Center for Public-Private Partnership of the VEB RF "Crisis and Infrastructure: Is It Worth Cutting Costs on Infrastructure Projects" [27], CNews Analytics "Market of engineering and IT infrastructure 2019" [28], "Largest IaaS providers in Russia" [29], etc.

III. Results

The dynamics of the world market for logistics services is influenced by global shifts in the economy. So, for example, under the influence of the economic crisis of 2008-2009 the growth rate of the world market of transport and logistics services (TLS) decreased by 12.0% (from $ 3390 billion to $ 2983 billion). According to Armstrong & Associates Inc. the value of the global TLS market in 2018 amounted to 9,044.4 billion US dollars, which is 10.7% of the volume of world GDP [30]. However, in 2019, under the influence of certain factors, including the crisis in the automotive industry and weakening economic growth in a number of regions, there was a slowdown in growth in all major segments of the TLS market.

A similar situation has developed in the Russian TLS market, the growth rates of which, according to the analytical agency M. A. Research, in comparable prices decreased by 2%. The positive dynamics in nominal terms was largely supported by the increase in tariffs (on average by 4.9%) against the background of a sharp decline in traffic volumes.

Nevertheless, under the influence of the ongoing processes (the development of the New Silk Road, the demand for the delivery of groupage cargo in the Chinese direction, the demand for the import of environmentally friendly products and goods, the growth of online commerce, due to which the delivery service on the “last mile” is in demand, and etc.) Russian warehouse and terminal infrastructure is forced to develop, because already today there is a shortage of consolidation centers within the country.

In addition, there is another tendency on the Russian market: an increase in demand for logistics outsourcing, which accounts for more than 30% of the global TLS market. Comprehensive service is becoming more and more in demand on the part of customers, covering the entire range of services from cargo transportation to order management.

One of the reasons for the acceleration of these processes is the growth of capital and current business costs for logistics

activities carried out on their own. The share of logistics costs in Russia's GDP is quite high, about 16%, while the share of revenues from logistics services is about 3% of GDP. A large number of time-consuming logistics operations with a low level of labor productivity in this area presents the management of companies with a choice: to invest large sums of funds in the automation of logistics operations and the development of new digital solutions or to transfer the entire function to a logistics provider.

Currently, three levels of logistics providers are distinguished: from 3 PL to 5 PL (the first two levels, 1PL and 2PL, imply the use of its own logistics solutions by the company).

3PL (Third Party Logistic) is a complex logistics outsourcing. Here, to perform logistic functions, the company engages an external contractor who provides a full range of services for handling cargo, from transportation and warehousing to packaging and forwarding. At the same time, the hired provider is not integrated into the client's business activities. He simply provides a range of services for the delivery of goods and does not take part in the planning of the entire logistics chain of the enterprise.

4PL (Fourth Party Logistic) is an integrated logistics outsourcing. With this type of service, the company delegates the tasks of managing the logistics business processes at the enterprise to a third-party provider who plans and designs the entire supply chain and becomes a single supplier of logistics services with the ability to attract 3PL contractors on a contractual basis. The difference between this type of company and 3PL providers lies in the application of a systematic approach to the management of all logistics business processes of the customer and the transfer of commercial information about the company's activities to the provider for a more complete and conscious management of material flows.

5PL (Fifth Party Logistic) is "virtual" logistics. In general, such providers are not physical objects, but information superstructures, systems that stand above partner companies. In 5PL logistics, there are no intermediary links (both 3PL and 4PL), but the resources of 2PL contractors (product manufacturers) are involved, which makes the 5PL provider an exclusively information integrator in the supply chain. Striking examples of 5PL providers are marketplaces such as eBay, Aliexpress, Amazon, etc. [31, p. 38-39].

And, if five years ago we said that 3PLs are just beginning to develop on the Russian market, now, as a result of the changes taking place, the 3PL and 4PL markets are growing. So, for example, due to the introduction of mandatory labeling of some of the goods (which affects the logistic schemes during import), the logistics operator must have the appropriate infrastructure to handle such goods. Therefore, major players in this industry were forced to invest in the development of warehouse complexes, consolidated warehouses, marking equipment, etc., as well as to offer their clients a range of services related to the full import cycle.

Leaving aside the rise in logistics costs due to the spread of COVID-19, it should be noted that costs in this sector have increased significantly in recent years. Several reasons contributed to this. First, the industry has problems with a shortage of staff. For example, there is a shortage of drivers in Europe, whose work is characterized by low or average wages. Therefore, trucking companies are forced to compensate for this with other advantages, which leads to lower profitability and higher costs along the entire supply chain. Secondly, an increase in the load on ports and railways is expected in the near future. Already, many ports and warehouses are facing congestion due to the lack of new capacities. Thirdly, it is a factor of speed and time. Fourth, the use of hybrid supply chain models (combination of paper and IT technologies), which is associated with risks, lack of transparency, inefficient processes and suboptimal resource allocation, etc.

Therefore, in order to remain competitive (especially when in the post-pandemic period the struggle for the client will intensify through the use of price dumping in the transportation market), PL-providers need to be on the cutting edge of modern digital technologies that can significantly increase employee productivity. The main ways of development in this case are such areas of digitalization as: platform solutions or "uberization"; Internet of Things; automation software (WMS, TMS); Big Data; Robotization. Let's consider some of them.

Platforms or aggregators are already successfully used in passenger transportation services and are starting to enter the market of logistics companies. So, the domestic solution "TRAFFIC" brings together freight carriers, forwarders and shippers, providing everyone with the necessary tools for work. The platform functions include insurance, factoring, transaction monitoring, a quality rating system for suppliers and carriers, remote conclusion of contracts using an electronic digital signature and much more. During the first four months of testing the aggregator, 1.2 thousand freight carriers with a total vehicle fleet of 52 thousand units were connected to it [32].

Another similar solution could be the digital platform of the transport complex of Russia (DPTC), which should enter commercial operation by 2024. The Ministry of Transport, the Digital Transport and Logistics Association, as well as the country's leading transport operators are involved in the work on this project. It is assumed that this will not be just a digital platform, but a single space that unites many platforms and operators based on blockchain technology and cloud storage, where the interaction between suppliers and customers is carried out in real time regarding the delivery of goods at specific times to a predetermined location. This will lead to the fact that the previously spent time for completing all the necessary procedures will be reduced from several hours to several minutes, and thus business processes will be optimized, labor productivity will increase and total logistics costs will decrease. Examples of such services are GoCargo (customer of X5 Retail Group) and iCanDeliver.

The Internet of Things is also gaining momentum in logistics. Thanks to the use of this technology, it becomes possible to control the movement of assets, monitor the position of goods in space and the temperature regime inside and outside the container, control various parameters of freight

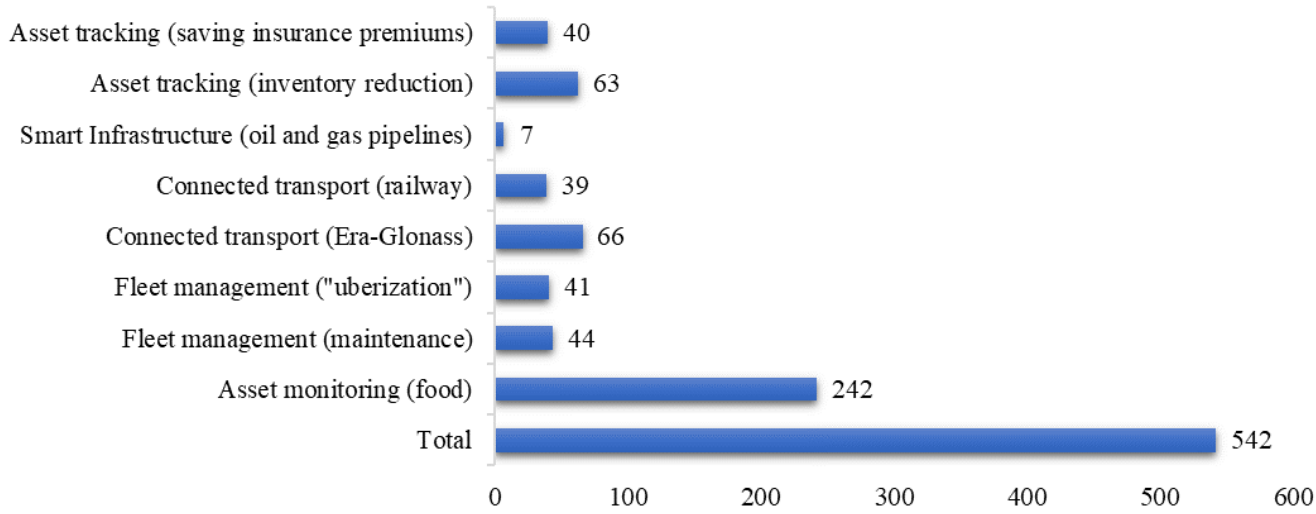

Fig. 1. Assessment of the economic effect due to the introduction of IoT in the transportation and storage of goods until 2025, billion rubles

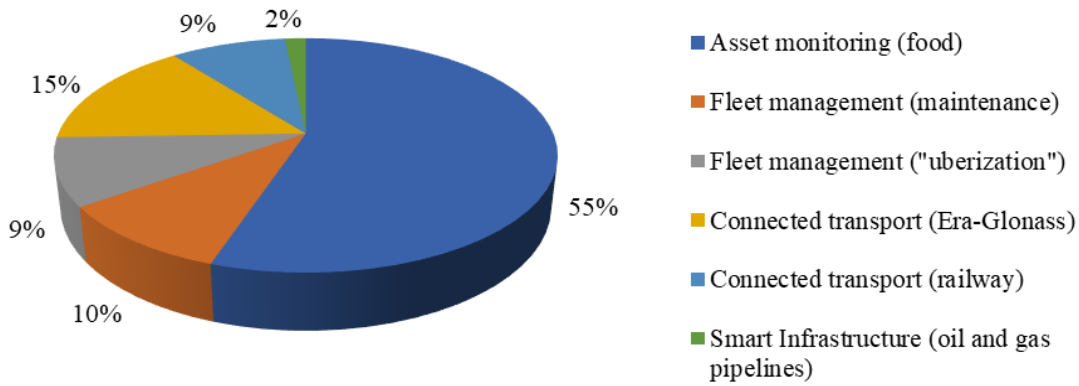

Fig. 2. Distribution of WMS systems by the number of implementations in the period from 2005 to 2020

transport (fuel level, traffic regime, load on units and assemblies), track the movement of material values and loading equipment in warehouses, carry out instant inventory, monitor transport infrastructure and much more.

Advances in technologies such as Wi-Fi, Bluetooth, RFID, 4G and 5G will drive the adoption of the Internet of Things for many logistics providers. Thanks to the IoT, they will be able to obtain such benefits as:

- increasing the controllability and transparency of the supply chain, the ability to detect bottlenecks and causes of losses and delays in goods;
- receiving discounts on insurance premiums that are offered when insuring tracked cargo;
- minimization of losses that occur due to violation of the conditions of transportation and storage of grocery goods;
- increasing the quality of service due to more accurate forecasting of delivery times and reducing the time of delivery of goods [33].

Figure 1 shows the economic effect of the introduction of IoT in the transportation and storage of goods.

Another area of PL-providers digitalization is the use of software products that automate various processes. To manage warehouse operations, systems such as WMS are used. WMS (Warehouse management system) is a special software package designed to automate various types of warehouses [34]. With its help, you can simplify the process of accounting for goods, optimize warehouse movements and the storage process, use the available space more efficiently, control the receipt, packaging and shipment of products. Thanks to automation, a high turnover rate of the warehouse is achieved, quick assembly of consignments of goods, and their shipment to consumers are carried out.

The most popular WMS systems and their distribution on the market are shown in Figure 2.

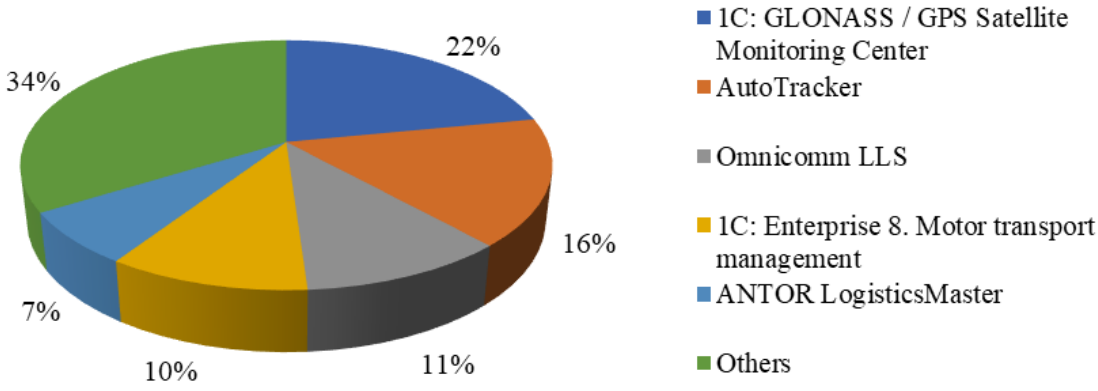

Fig. 3. Distribution of TMS systems by the number of implementations in the period from 2005 to 2020

Another solution that allows you to automate logistics processes are TMS class programs. TMS (Transportation Management System) is a transport management complex that allows you to control and manage transportation, track transport, plan a route and simplify the work with related documents. The introduction of these systems allows to reduce fuel costs, reduce the number of flights and idle vehicle runs.

Distribution statistics for such systems are shown in Figure 3.

An equally important area of digitalization of logistics providers is working with Big Data. According to a survey of 3PL providers, 98% of them believe that decision-making based on data analysis is the future of supply chain management, while 86% believe that this will become one of the key competencies of market players [25].

The collection of big data from logistics providers can be divided into several areas:

- optimization of supply chains and cargo tracking. By using large amounts of data, a PL-provider can provide a reduction in idle mileage for their vehicles. In addition, he has the opportunity to use RFID tags to track the movement of goods throughout the supply chain. This allows you to reduce losses due to improper transportation of goods with transportation characteristics (perishable, fragile, valuable goods);
- warehouse work. Using data on the location of goods, peak loading / unloading hours, movement of vehicles inside the warehouse, a logistics provider can build a rhythmic and continuous operation of its warehouse, reduce the downtime of workers and equipment and evenly distribute the load throughout the day;
- routing. Obtaining data on various routes of transport, the time spent on the delivery of goods and the road situation along the route of the material flow, it becomes possible to choose the most optimal direction of movement of the cargo in terms of fuel consumption and time;
- tracking the state of the vehicle fleet. By collecting information on the technical condition, fuel consumption, wear of components and assemblies of the vehicles used, the logistics company can manage the cost of fuel, maintenance and repair.

Another trend in the digitalization of logistics providers is robotization. Self-driving cars, flying drones and automated warehouses are already being used by industry leaders. For example, Amazon has successfully used aerial robots to deliver packages over short distances. In the medium term, such solutions will be able to replace drivers delivering ordered goods to end customers.

Automated warehouses are increasingly being used by logistics and trading companies. The introduction of such solutions allows increasing the productivity of warehouse complexes and the accuracy of processing the incoming material flow. For example, the Russian marketplace Lamoda has been introducing and applying automation of its warehouses for about 6 years, where more than 8 million items are stored and serviced. Acceptance of goods, moving to the shipping area, sorting, packaging and preparation for shipment are carried out without direct human intervention.

Self-driving cars could be the future of transportation. The implementation of the Era-Glonass system, the development of unmanned transport management systems by Yandex, Kamaz, Volgobas, the development of V2V (vehicle-to-vehicle; car-to-car) and V2I (vehicle-to-infrastructure, car-infrastructure) technologies will facilitate the early introduction of autonomous vehicles on the roads of our country.

TraPac cargo terminals automate most of the processes in seaports. Thanks to the use of autonomous loaders-robots and cranes, unmanned tractors, it becomes possible to reduce costs and increase the speed of movement of goods.

IV. Discussion

The main key factors in the transformation of logistics activities even before the pandemic were digitalization,

changes in the main processes caused by the introduction of new software, and changes in the main processes caused by the introduction of new technologies. However, the COVID-19 crisis has severely impacted the logistics and supply chains of many companies and countries. In order to quickly overcome these negative consequences, Russian companies need to quickly adapt to the changed conditions and take into account the further influence of the trends that have arisen in the global logistics market during the pandemic:

1. Dumping in the logistics market (the struggle for the consumer in the freight market will cause dumping wars, which not all companies will withstand).

2. Leaving of weak players from the market. In the near future, the small and some medium-sized players will be forced to leave the market of logistics services, only the strongest will survive. A series of bankruptcies, mergers and acquisitions will take place.

3. Development of collaborations, organizing communities among logistics and service companies, combining services to strengthen market positions.

4. Refusal to renew the vehicle fleet (due to the growth of the exchange rate), decrease in demand for new trucks, growth in demand for repairs and maintenance.

5. Increase in demand for "groupage cargo", which will eventually force logistics providers not only to group shipments on mutually beneficial terms, but to fill completely vehicles.

6. Implementation of the latest IT technologies.

7. Ordering transportation from mobile devices on a digital platform in a mobile application and the emergence of mobile carriers.

8. Development of domestic cargo transportation and logistics chains. The closure of borders with Asian countries and China, as well as the threat of subsequent waves of a pandemic, lead to the fact that some of the goods that were previously supplied from China (professional sports equipment, chemical fertilizers, clothing, shoes, etc.) can be produced inside Russia, which will lead to the growth of production and the development of internal logistics.

9. Development of logistics outsourcing companies, which, due to the most advanced digital solutions and information technologies, will be able to provide significantly higher employee productivity than non-core companies with their own logistics departments in the organizational structure.

10. The emergence of demand for the delivery of goods to the separate regions of Russia.

11. Development of delivery of parcels by drones and autopilot delivery services.

12. Development of "last mile" delivery.

13. Compliance with sanitary standards, the development of contactless courier delivery.

14. Transfer of some employees to remote work. Conducting most of the events in the logistics sector (meetings, negotiations, webinars, conferences) online.

15. Development of anti-crisis plans.

In these conditions, digitalization is becoming one of the drivers of rapid recovery and growth of the competitiveness of the logistics sector. However, 40% of the surveyed heads of transport and logistics companies said they did not plan to implement projects in the field of artificial intelligence. The main reason for this behavior is the limited supply of specialists in the field of new technologies in the labor market (55% of respondents) [25], but, in our opinion, the reluctance of managers to invest heavily in digital innovations and retraining of their employees should be considered a deeper reason. Nevertheless, the information and communication technologies (ICT) market continues to develop rapidly and has a serious impact on manufacturing and the service sector. The volume of the Russian IT market in 2018 amounted to 22.6 billion US dollars (to 3.69 trillion US dollars for the global market), which is 4% more than in 2017, the revenue of the 10 largest domestic IaaS in Russia increased by 56 % (up to 16.1 billion rubles) [29]. Moreover, such high growth rates (over 50%) have been maintained over the past five years.

In contrast to Russian businessmen, 97% of foreign business leaders believe COVID-19 has accelerated their company's digital transformation efforts. According to a Twilio survey of more than 2,500 business leaders, 79% of respondents said COVID-19 contributed to an increase in their digital transformation budget. More than half (54%) noted that COVID-19 forced them to focus on multi-channel communications, and 53% of respondents added new channels in the pandemic. One in three companies first started using online chat and IVR channels as a result of COVID-19 [35].

Undoubtedly, the nature of the restructuring of the logistics sector, engendered by digitalization, will affect the intensity of competition between participants in this market and the model of price behavior. Therefore, weak incentives for the growth of digitalization of the market of Russian logistics providers require government intervention to ensure compliance between private and public interests.

V. Conclusions

In conclusion, it should be noted that the logistics services market is undergoing significant changes caused by the factor of digitalization and global epidemiological threats. Technologies for managing streaming processes that involve the use of physical labor, which do not allow interactive monitoring of operations and quality control of their performance, the use of paper workflow, are becoming ineffective and outdated. The emergence of COVID-19 highlighted the limited human resources and unpredictability of the market. Therefore, companies looking for ways to increase labor productivity and reduce costs will seek to outsource more services. The transfer of logistics to outsourcing will lead to the inevitable consolidation of the market, the formation of new and strengthening of existing providers offering more complex services. ICT increasingly determine the level of competitiveness of logistics companies.

Investments in technology, including artificial intelligence, the Internet of Things and robotics, can dramatically improve the transparency and efficiency of supply chains. Leveraging data, artificial intelligence and broader supply chain management (SCM) technologies enables real-time analytics to improve operational and transactional processes. In addition, the integration of robotics, sensors and IoT provides more accurate prediction, faster response times, increased ability to recognize delivery patterns for risk planning, and savings in transaction costs. In times of crisis, the availability of robust and reliable tools ensures that companies can additionally build solutions to meet immediate needs while effectively meeting the business needs of existing customers. Those companies that fail to adapt to digital realities in time run the risk of significantly reducing their positions in the logistics services market or even ceasing their activities, significantly losing in the quality of service to industry leaders.

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