Impacts and Solutions of COVID-19 Pandemic on Logistics Industry

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ABSTRACT
The sudden COVID-19 epidemic has brought great impact to the global economy, and the transportation and delivery of medical resources and the basic living needs of the whole people all over the world are becoming urgent and centralized. This epidemic shows that there are still shortcomings in international logistics, emergency logistics, and green logistics. This research collected and collated data on the financial reports of major logistics companies, public social indicators, news reports, and national policies before and after the epidemic, and conducted a comparative analysis to derive the specific impact of the epidemic on the logistics industry. For example, the operating costs of logistics enterprises rose, the prices of international shipping soared, and so on. It also proposes corresponding measures for logistics companies such as building smart logistics and expanding their business scope. Finally, the future direction of the logistics industry is proposed - to accelerate the introduction of digital technology, optimize resource deployment and build a green and smart logistics system. By paying close attention to the development of the international logistics industry, this research hopes to provide the development direction for Chinese logistics enterprises and strive to create a logistics system adapted to the development of China's manufacturing industry, help the industrial supply chain and play a greater role in the global logistics and supply chain network.

Keywords: *The COVID-19 epidemic, Logistics industry, Countermeasure, Intelligent logistics*

1. INTRODUCTION

1.1. Background

Logistics is an important link between production and sales and is an important aspect of ensuring efficient business operations. In recent years, the flow of goods in China has been frequent and the Chinese logistics industry has been gaining momentum.

Moreover, the continuous development of economic globalization has benefited China as well, and today many industries and enterprises in China are in the process of internationalization. In this process, the supporting role of the international logistics system is essential.

With the sudden outbreak of the COVID-19 Pandemic in 2020, all countries are facing a serious challenge. The epidemic is characterized by widespread infection, long duration, and difficulty in prevention and control, and has a huge impact on the world economy. The epidemic has had a considerable impact on the world's logistics industry. This research will discuss the responses of China's logistics enterprises and the future development trend of the logistics industry.

1.2. Related research

The logistics industry has played an important role in the distribution of materials, and many academics and stakeholders have analyzed the impact of the COVID-19 pandemic on the logistics industry and given the solutions. Hobbs discusses the impact on the food supply chain, which includes labor shortage, transportation network interruption, and freight flow problems [1]. Price Waterhouse Coopers Consulting (PwC) analyses the impact of the epidemic on the logistics industry in terms of national policies on epidemic prevention,

revenue and costs, cash flow shortage and proposes four major contingency measures to address the risks [2]. Kumar et al. put forward some solutions to cope with the epidemic. First, how the supply chain and production systems cope with epidemic diseases. Second, it is related to how business organizations should deal with a safe and reliable labor force. The third is to focus on how to manage inventory and how to deal with the impact of COVID-19 on workers around the world [3]. Ren studies the difficulties faced by China's logistics industry, including warehousing, distribution, transportation management, and supply chain. Then, Ren came up with solutions to strengthen technological innovation, improve logistics intelligence, and enhance the contactless distribution mode to help the Chinese logistics industry thrive in the post-epidemic era [4].

1.3. Objective

This paper will analyze the impact of the epidemic on the domestic logistics industry as a whole, on its financial situation, and cross-border logistics. It then gives concrete solutions for the logistics industry to cope with the emergency outbreak and to develop intelligently. This is followed by a description of the future development prospects of Chinese logistics in the post-epidemic period.

2. CONCRETE INFLUENCE

2.1. Impact on China's Logistics Prosperity Index (LPI)

Logistics activity has been hampered since the outbreak of the COVID-19 pandemic in January 2020. LPI plummeted to 26.2% in February 2020, a drop of 23.7% from the previous month, as shown in figure 1. In 2020 in the first three quarters, the national total logistics amounted to 202.5 trillion yuan, up 2% from the previous year. The national total logistics decline 7.3% in the first quarter and 0.5% in the first half of the year, with the growth rate of total social logistics accelerating back up since the third quarter. In a word, LPI plunged and then rebounded rapidly. Despite the impact of the new crown epidemic, the logistics industry still maintained a relatively fast growth rate, which reflects the industry's strong vitality and flexibility.

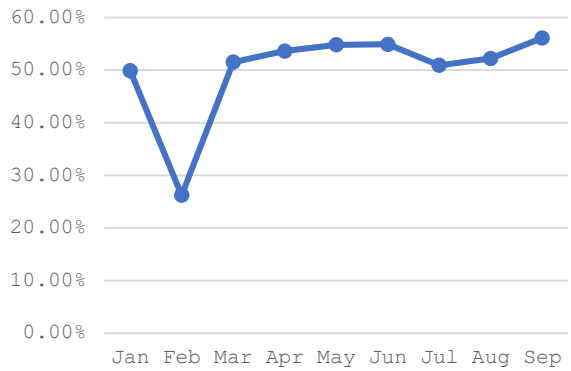

Figure 1 China's Logistic Prosperity Index of 2020

2.2. Influence of COVID-19 epidemic situation on operating cost and revenue of logistics industry

2.2.1. Internal salary system of personnel and resumption of production are affected

Affected by the COVID-19 epidemic, the overall operating cost of the logistics industry has increased. Large quantities of prevention and control materials need to be purchased for internal prevention and control of enterprises and front-line personnel. For example, S.F. Express during the epidemic, although the government introduced relevant tax reduction and fee reduction policies, the company's cost pressure was still relatively high. The Q1 cost of the company increased by 43% year-on-year to 28.1 billion yuan, exceeding the growth rate of income, and the management expenses increased by 2.57 to 2.83 billion yuan.

It is difficult for personnel to return to work. Express delivery covers all parts of the country and needs to be isolated after passing through high-risk areas. People can't return to work normally, the demand in the labor market is far greater than the supply, and some employees are worried about the infection and actively delay the time to return to work, and the labor cost still needs to be normally spent during the isolation period, so the labor cost pressure is huge, and the labor cost of express delivery enterprises has increased to some extent during the epidemic.

2.2.2. Internal competitive factors

Industry competition is fierce, and service prices remain low. In 2020, the logistics service price index will drop by 5 percentage points compared with the previous year. In the first three quarters, every month was in a downward channel. Although it picked up in the fourth quarter, the annual index was still below 50% on average. The capital of logistics enterprises is tightening, and the pressure of cash flow is increasing. At the beginning of 2020, it was generally difficult for logistics enterprises to operate, and the cash flow caused by the general increase

of operating costs continued to flow out, which caused the liquidity of enterprises to become tight. From January to November, the turnover times of liquidity of logistics enterprises decreased by 0.1 times year-on-year, and the payback period of accounts receivable was 12% longer than that of the previous year.

2.2.3. The pandemic monitoring and disinfection cost

The heightened precautions were released by the State Council's Joint Prevention and Control Mechanism. There are clear regulations for disinfection and disinfestation of personnel, goods, and transportation in the logistics process. These require the logistic firm to strictly check customs clearance documents for imported cold-chain foods and disinfect vehicles, ships, and other transportation equipment. Workers who have direct contact with the foods should take protective measures [5]. Costs related to epidemic prevention in the logistics industry, especially in cross-border logistics and cold chain logistics, have increased significantly. According to incomplete estimates, the costs related to preventive disinfection and cargo monitoring in logistics exceed 70 billion yuan in 2020 [6].

2.3. The impact of the epidemic on the Chinese international logistics industry

2.3.1. Impact on the air logistics industry

The sudden outbreak of the epidemic has highlighted the shortcomings of the Chinese international air logistics sector, especially in terms of capacity for long-haul aviation. S.F. Express, the company with the largest number of freighters in China, has only 59 freighters and 2 long-haul freighters. Judging from the number of freighters, there is still a gap between Chinese logistics companies and the international logistics giants (as shown in table 1).

Table 1. Comparison of freighters between Chinese and foreign enterprises

Item	Company name	Number of self-owned freighters
Chinese logistics companies	S.F. Express	61
	China Postal Airlines	33
	Air China Cargo	15
	China Southern Cargo	14
	YTO Express	12
	China Cargo Airlines	9
	ZTO Express	1
International logistics giants	FedEx	679
	DHL Express	420

In addition, the cancellation of a large number of international passenger flights has led to a significant reduction in the transport capacity of passenger aircraft bellies. As a result of the above, Chinese exporters are faced with the problem of unavailability of goods or wildly soaring transportation costs.

2.3.2. Impact on the maritime industry

According to figure 2, the China Container Freight Index (CCFI): composite index soared from 897.53 points at the beginning of 2020 to 1,658.58 points at the end of the year. The index rose to around 3,200 points by October 2021. This indicates an exponential increase in international shipping rates under the influence of the epidemic, which has a huge negative impact on export trade.

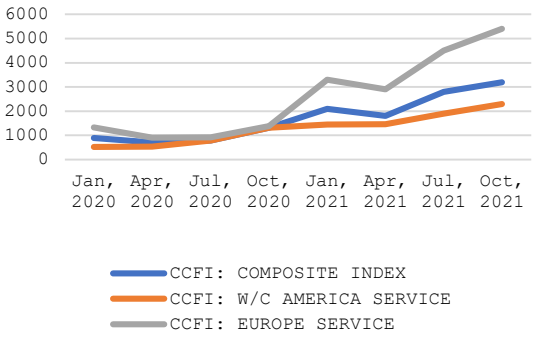

Figure 2 The China Container Freight Index

In addition, the large number of overseas dock workers infected with the COVID-19 Pandemic has caused a serious drop in inefficiency and a large number of ships stranded in ports. The flow of empty containers has slowed down, resulting in the actual weight of the

cargo in the hold exceeding the predetermined limit and a shortage of containers.

3. SOLUTION

3.1. Application of Intelligent Logistics

To better improve the resumption of production and reduce the situation of over-reliance on labor, each express delivery enterprise should improve personnel utilization efficiency, increase storage capacity, improve the automation degree of the whole supply chain by using big data from the aspect of personnel management, and complete work links with relatively fixed and repetitive, low added value and low technical requirements with the help of automated equipment (such as AGV, automatic sorting line, AI identification, etc.). It can focus on sorting and warehouse operation to reduce expenses in an all-around way. For example, JD.COM built an independent park to independently develop an unmanned delivery robot, which mainly applied the delivery service of the last mile of the city, improved service efficiency, and gave full play to the advantages of intelligence and multi-ecology, and carried out "contactless express service" through more than ten ways, such as self-lifting cabinets, convenience service points and community distribution Mini stations. JD Logistics whole process unmanned warehouse technology can improve the automation and intelligence of logistics operation, and reduce the manual input and personnel gathering production in the front line of operation; Open the warehousing, transportation, and property management system of the park, realize the digital and visual management of the whole process of material inventory, production, and transportation in the park, and intelligently dispatch and efficiently coordinate the vehicles, personnel and operation production in the park, greatly improving the peak throughput of the park.

In terms of reducing costs and increasing income, the express delivery industry should consider starting from the source. Because of long-term traffic constraints, the logistics cost of high-quality agricultural and sideline products entering the city is high, and it is difficult for farmers to increase their income. After the network of SF Express was built, the logistics cost of agricultural and sideline products decreased by 30%-40%. The implementation of the green concept, the application of green express delivery, the use of recyclable packaging, green procurement, and packaging recycling have also reduced internal costs. By the end of 2020, the electronic insurance policy has achieved full coverage. The third figure, shows from 2015 to 2020, the ratio of total social logistics cost to GDP in China dropped from 16.0% to 14.7%, a decrease of 1.3 percentage points, and the logistics industry achieved remarkable results in reducing costs and increasing efficiency.

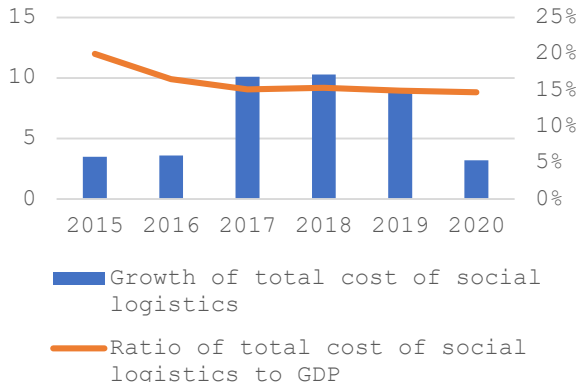

Figure 3 The ratio of the total cost of social logistics to GDP

3.2. National policies helped the logistics industry revive rapidly

In January 2021, the State Post Office and the Ministry of Industry and Information Technology jointly issued the paper proposed to support the express enterprise service manufacturing projects, including the relevant special funds in the field of industry and information technology to support the scope; support manufacturing enterprises jointly with express enterprises, declare national key laboratories, enterprise technology center recognition, and national science and technology awards; encourage higher education institutions Set up professional courses to train professional talents in the direction of the express supply chain. In this way, the logistics industry will be helped to build core competitiveness and develop innovatively.

Total logistics in the first three quarters of 2021 were all above the 2020 level for the same period, as shown in the graph, as shown in figure 4. The LPI has largely stabilized above 50% after the second quarter of 2020, reflecting the overall expansionary trend in the industry. The data above indicates a promising recovery in the logistics industry.

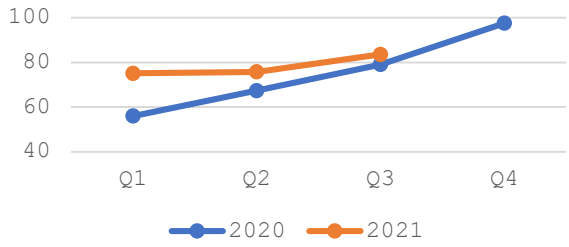

Figure 4 Total national logistics by quarter (in millions)

3.3. Broadening the scope of business

3.3.1. The cold chain logistic

China's cold chain logistics market size exceeds RMB 160 billion in 2019, with the market growing at a

compound annual growth rate of over 20%. Cold chain market demand will rise from RMB 80 billion in 2019 to around RMB 200 billion in 2022, a three-year boost of RMB 100 billion [7].

3.3.2. Pharmaceutical logistics

In the context of the COVID-19 pandemic, the demand for home delivery of medicines has surged, accompanied by the Internet medical and DTP pharmacy markets that have been promoted as never before. The development of pharmaceutical logistics can eventually realize full coverage of multiple areas of the healthcare industry and provide customers with professional and end-to-end pharmaceutical logistics supply chain solutions and services.

3.3.3. Intra-city delivery

Consumers' demand for immediacy is more personalized, and intra-city delivery and express shipping are consumer-focused to address the life needs of urban customers. The rush delivery market still has huge room for development. Taking SF to express as an example, the intra-city business achieved operating income excluding tax of 3.146 billion yuan, up 61.17% year-on-year, which is much higher than the industry growth rate. At the same time, businesses can optimize the B2B mode in the logistics industry and expand the new market.

3.3.4. Broadening the rural market

China have over 300 million express parcels per day by 2021, one-third of which is in rural areas [8]. According to the 7th national population census, rural citizens account for 36.11% of the total population.

As of June 2021, the number of rural internet users in China was 297 million, and the internet penetration rate in rural areas was 59.2%. This shows that rural areas have a great potential for consumption.

3.4. Enhancing international logistics capacity

3.4.1. Airline logistics company

Pay attention to freighter operation, and layout of suitable cargo airports according to the main base of enterprise operation. On the one hand, it is necessary to increase the capacity of self-owned freighters; on the other hand, it is also possible to flexibly deploy freighter capacity by leasing and credit. Under the background of increasingly frequent international logistics, aviation logistics enterprises should lay out cargo airports as soon as possible to meet the needs of the continuous expansion and frequent take-off and landing of freighter fleet. For example, China's SF Airlines adopted the mode of "aviation logistics hub + leading aviation logistics enterprise" to build China's first professional international logistics hub airport-Ezhou Airport, which can meet the transit demand and improve the timeliness [9].

Due to the reduction of passenger flights, airlines can take temporary measure-changing passenger planes into freighters. Goods can be loaded in the belly cabin or fixed in the passenger cabin. This can meet urgent freight tasks, bring in revenue and ease the cost pressure of airlines.

3.4.2. Shipping company

Facing the general shortage of containers, major shipping companies need to share information and work out solutions together. For example, Maersk will cooperate with Canadian Pacific to build a transshipment and distribution facility to further ensure that containers can get in and out of the dock quickly.

In addition, the alternative scheme of clipper transportation can also be adopted on ocean routes. Although the load is lower than that of ordinary sea transportation, it is 2-3 weeks faster than that of ordinary sea transportation. This will also greatly alleviate the problems of tight routes and rising freight rates [10].

4. PROSPECTS

4.1. Logistics network planning

4.1.1. Macro logistics network

The impact of the COVID-19 Pandemic has greatly accelerated the pace of the logistics industry in building a digital logistics system. The first is the application of intelligent technology to the planning of logistics networks. The logistics network contains a huge number of nodes (operating points, transit yards, and warehouses, etc.) and a large number of paths (vehicle routes, air routes, etc.) which are extremely difficult to arrange. At the macro-level (such as global or national networks), using methods such as big data and artificial intelligence, it is possible to simulate various business scenarios and deduce the best architectural solutions in terms of time efficiency and cost, such as where to build dry ports, airports, and harbors, and how to plan optimal freighter routes. Optimize the allocation of logistics resources and build an efficient logistics network [11].

4.1.2. Micro logistics network

At the micro-level (such as city or regional level), according to the degree of business distribution and logistics development potential of a city or regional economic circle, intelligent maps are introduced. Reasonable arrangement of goods receiving and dispatching stations, planning of urban vehicle allocation, and design of resource allocation scheme will

enable goods to reach the destination in the fastest and most economical way.

For example, UPS optimizes the on-road integrated optimization and navigation through big data and operational research in North America. After the implementation of the project, remarkable results have been achieved: the annual driving distance for UPS is reduced by about 160 million kilometers, and the cost is saved by 300-400 million dollars, which also makes the delivery time forecast of UPS more accurate and the delivery strategy more agile than that of competitors [11].

4.2. Information Technology Building a Shared Logistics Platform

In August 2020, China's total logistics cost/GDP was 14.2%, and the average empty highway transport rate was 24%, which means that logistics costs are still at a high level compared to developed countries and the logistics industry is operating at a low level of efficiency relatively. Traditional logistics data is distributed in different systems, which are highly centralized and suffered from the risk of manipulation. The popularity of cloud computing could further lower the threshold of data availability, while big data and the development of 5G will further accelerate the speed and accuracy of information transfer. The use of blockchain can decentralize data in the logistics industry, making information more transparent and improving the operational efficiency of the logistics industry. A shared database connects the supply side, the purchasing side, the distribution, storage, and so on, reducing the hidden costs caused by the transport process and idle resources. With information technology, the government departments will be able to provide better emergency response strategies for emergencies.

These information technologies serve as the basis for a shared logistics industry, offering the possibility of participation in logistics for all. Crowdsourcing, which outsources the logistics industry to non-formulated mass volunteers on a free and voluntary basis, taps into the potential of cross-discipline and exploits unused resources to the maximum.

The full utilization of resources will reduce energy consumption. As of October 2020, CO2 emissions from commercial vehicles in the goods-carrying category account for 56% of all vehicle CO2 emissions. When the problem of empty loads and unused resources in the logistics industry are solved, the number of freight miles can be reduced which leads to reducing carbon emissions. Ultimately, the goal of green logistics will be achieved.

4.3. Establishment of Intelligent Warehouse System

With the rise of land price, labor cost, and logistics business, the efficiency problem of traditional "plane" venues is becoming more and more prominent, which severely squeezes the profit margin. The traditional warehouse management model can no longer meet the new warehouse management needs. The logistics industry should break away from the traditional warehouse management mode, actively explore the new warehouse management information system platform, build a new intelligent warehouse management information system platform, rationally allocate warehouse resources, reduce operating costs, and thus enhance the market competitiveness of enterprises.

The current situation of China's intelligent warehousing industry is shown in the table below. In November 2020, China's warehousing index was 56.9%, up 4.1 percentage points from the previous month, and remained above the threshold for nine consecutive months. It shows that the warehousing business is affected by e-commerce activities, and the demand has increased significantly.

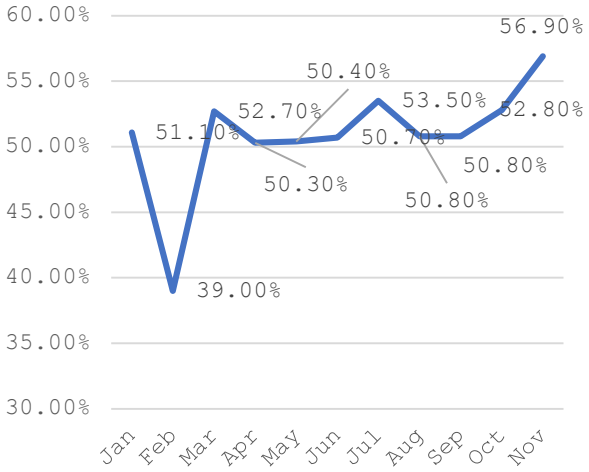

Figure 5 China's warehousing trend from January to November 2020

The intelligent warehouse has the following four advantages: 1. Saving labor and land occupation. 2. Shortening operation time quickly, accurately, and effectively when leaving warehousing operation. 3. Intelligent warehouse is beneficial to the storage of commodities. In the automated warehouse, there are many commodities, large quantities, and various varieties that can be stored. Through bar code technology, etc., the flow direction of goods can be accurately tracked and the traceability of goods can be realized. 4. After the intelligent warehouse management system is connected with the ERP system, the whole process automation can be realized from the formulation of the production plan to the issuing of the goods warehousing instructions, which can ensure accurate and timely information and effectively improve the management level of the warehouse.

At present, the layout of intelligent warehousing in most logistics enterprises is still in the early stage. Based on the promotion of domestic intelligent warehousing industry policies and the further expansion of market demand, the market space of domestic intelligent warehousing needs to be further explored. The sustained and healthy development of China's economy and the rise of China's logistics industry has provided huge market demand for the development of the warehousing industry. In addition, with the release of outsourcing demand of manufacturing, commerce, and circulation industry and the strengthening of the strategic position of the warehousing industry, there will be huge market demand for intelligent warehousing in the future.

5. CONCLUSION

The whole world is being affected by the COVID-19 epidemic on a large scale, especially in the logistics industry. Therefore, the researchers analyzed the impact of the new epidemic on the logistics industry, how to transform the logistics industry from domestic industry to foreign industry, and will seize the opportunity brought by the COVID-19 epidemic to transform the new industrial model.

In the reasonable investigation and data analysis, the research thinks that the widespread rise of intelligent logistics is one of the important directions of enterprise transformation and upgrading during the COVID-19 epidemic, followed by the help of national policies and the expansion of its business scope, and in the international logistics industry, enterprises strengthen their advantages, rationally layout their operating bases and actively cooperate with the same industry.

The future of the development of the logistics industry is bright. In the era of the rise of intelligence and 5G technology, the logistics industry should start from the first end of the industry, and carry out the technological transformation, from management, transportation to warehousing and distribution for intelligent management, reduce costs, improve the quality and level of industrial services, understand the market trend, and seize the opportunity to transform and upgrade.

REFERENCES

[1] Hobbs, J. E. (2020). Food Supply Chains during the COVID-19 Pandemic. *Canadian Journal of Agricultural Economics/Revue Canadienne d'agroeconomie, 68*(02), 171–176. https://doi.org/https://doi.org/10.1111/cjag.12237

[2] PwC. (2020, March 04). *Analysis of the impact of the epidemic on the transport and logistics sector and recommendations for response.* PwC. https://mp.weixin.qq.com/s/knk1TCtncHJ4URaRhDiI6g

[3] Kumara, A., Sunilluthrab, S., Manglac, S. K., & Kazançoğlud, Y. (2020). COVID-19 Impact on Sustainable Production and Operations Management. *Sustainable Operations and Computers, 01*, 1-7. https://doi.org/https://doi.org/10.1016/j.susoc.2020.06.001

[4] Ren, Qian. (2021). Opportunities and Challenges for the Development of the Logistics Industry under the COVID-19. *China Storage and Transportation* (06), 174-175. DOI: 10.16301/j.cnki.cn12-1204/f.2021.06.077.

[5] Xinhua. (2020, November 10). *China to Strengthen Supervision of Imported Cold-Chain Foods*. The State Council of China. http://english.www.gov.cn/news/topnews/202011/10/content_WS5fa9ce21c6d0f7257693f5d5.html

[6] China's Logistic Information Center. (2021, February 3). *Analysis of Logistics Operations in 2020*. China's Logistic Information Center. http://www.clic.org.cn/zxdt/306525.jhtml

[7] Securities daily network. (2020, June 8). *Cold Chain Not Cold! Cold Chain Freight Volumes up 12% Year-on-Year from January to June 2020*. China Federation of Logistic & Purchase http://www.chinawuliu.com.cn/zixun/202007/08/513518.shtml

[8] People's daily overseas edition. (2021, September 10). *National Township Express Network Coverage Reaches 98%, Rural Logistics More Efficient and Smoother*. People's Government of the People's Republic of China. http://www.gov.cn/xinwen/2021-09/10/content_5636538.htm

[9] Xie, Sixin, He, Mingjuan. (2021). Promotion path and strategy design of aviation logistics development resilience——Based on the dual circulation pattern in the post-epidemic era. *Prices Monthly* (08),77-89. DOI: 10.14076/j.issn.1006-2025.2021.08.11.

[10] Xi, Chongbin. (2020). Challenges and countermeasures of international logistics under epidemic. *Logistics & Material Handling, 25*(05), 58-62. DOI: CNKI: SUN: WLJY.0.2020-05-002.

[11] Rong Juesheng, Xu Chongyan. (2018, August 29). *Strategic Construction of Smart Logistics Operation System by Science and Technology: Building Three Core Competence*. MCK. https://mp.weixin.qq.com/s/jGA43VHFhFeDWAvaHF2iYA?forceh5=1