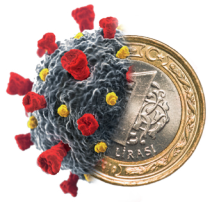

The Effects of COVID-19 Outbreak on Supply Chains and Logistics Activities

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Abstract
A virus called COVID-19, which emerged in Wuhan, China in December 2019, crossed the country's borders and was on the global agenda in a short period of time. In order to reduce the speed of the spread of the pandemic, the quarantine practices and curfews of countries caused significant breaks both in the countries' economies and in the global economy. The COVID-19 outbreak showed the vital importance of supply chains and logistics as well as the commercial deficiencies of the globalizing world and increased the need for reliable supply chains. During the pandemic process, it has been understood that all supply chains and logistics operations should function flawlessly from supply to production, warehouse operations to transportation, e-commerce to cargo and courier services in order to reach food, health, cleaning and all other basic consumer products easily and quickly.

The aim of this study is to evaluate what happened in the supply chains and logistics operations with the COVID-19 outbreak and to develop predictions about possible changes for these areas after the pandemic. The effects of pandemics on supply chain, logistic sector, and especially logistic activities in Turkey are examined. The measures taken for the logistics sector, the expectations of the sector, and the possible changes in supply chains and logistics activities for post-pandemic period are discussed. It is thought that the localization for the supply chains, easy access to suppliers and customers, flexibility, dynamism and digitization will be areas for improvement after the pandemic. The contactless transport models; multi-location, dynamic, low-cost storage approaches; improving communication in logistics services; digitalization; cargo services adapting quickly to demand fluctuations will come to the fore as the topics to be developed in the logistic sector. It is thought that supply chain in health, humanitarian logistics, reverse logistics, closed-loop supply chain issues and the sustainability of supply chains will be areas to be studied and focused by both practitioners and academicians in the post-pandemic period.

Keywords
COVID-19, supply chain, logistics

[1] This study is a translation and updated version of the paper previously published in the book titled "Küresel Salgının Anatomisi: İnsan ve Toplumun Geleceği" by TÜBA in June 2020.

Introduction

The COVID-19 outbreak that occurred in China in December 2019 and spread all over the world in a short time like 3 months affected all countries with sudden deaths. Implications concerning the absence of a vaccine for the virus as well as the resistance of the virus to treatment processes have forced countries to take measures to reduce the spread of the outbreak and its burden on the health system. The precautions that started with suggestions of not being present in crowded places where people socialize because the virus is transmitted by personal contact and airway have continued with measures such as the closure of these places and the prevention of crowds in closed environments. However, since recommended precautionary measures failed to be adequate and mortality intensified in some cities, regions and countries led authorities to opt for more radical measures.

The most important measures against the outbreak were quarantine and curfews. They were initially implemented in local areas such as neighborhoods and villages, but then expanded to region and nationwide as the epidemic increased in severity (Yu, Sun, Solvang and Zhao, 2020). Citizens all around the world have been forced to stay at home, and as a result, demand for goods and services have dropped suddenly. COVID-19 epidemic brought radical changes in economic and social life, and almost every sector excluding medical products, food and IT sectors, was negatively affected and disrupted by this outbreak. Especially transportation, tourism, automotive, energy, metal, electronics, and non-food retail sectors are the ones that suffered the most (Ivanov and Dolgui, 2020). Due to inter-sectoral interaction and goods/services exchange, setbacks, or standstills in one sector spread rapidly to other businesses and sectors. As a result, an unprecedented type of crisis in which supply and demand shocks occurred at the same time has been developed (Karakaya, 2020).

As the epidemic progressed, the fragility of supply chains has been manifest. The chains suffered from a two-sided damage both due to the decrease in demand in the end customer, where the pull effect is created, and the difficulties in the supply of raw materials and parts. The disruption of the activities of companies in the sectors producing goods/services has been reflected in their supply chains and led to their rupture.

While governments and health institutions are working hard to stop the spread of COVID-19 and treat infected people, manufacturers in many industries are struggling to manage the growing impact of the outbreak on their supply chains (Majid, 2020). In this context, in order to survive through the epidemic process and to recover quickly at the end, the presence or absence of risk-mitigating inventories, subcontractor capacities, alternative suppliers, backup transportation infrastructures, multi-channel distribution systems, flexible production systems, data-oriented and real-time monitoring and visibility systems in supply chains stand out as issues that need to be addressed (Ivanov and Dolgui, 2020).

Due to the epidemic, the disruption of supply chains and the closure of national borders have created a domino effect which in turn affected the logistics sector drastically. Logistics activities, ranging from customs transactions to transportation modes, from cargo and courier services to storage operations, have been affected by the outbreak, but have also become more open to alternative business models and practices.

This study aiming to investigate the effects of the COVID-19 epidemic on supply chains and the logistics sector intends to discuss the circumstances in these areas specific to Turkey, and evaluate the measures taken regarding the logistics sector during the epidemic process, the expectations of the industry, and possible changes for supply chains logistics activities after the end of the epidemic. However, it should be noted that the evaluations here will be limited to highlighting the issues deemed to be important, considering that the outbreak has not yet ended on the date this study was composed.

After this introduction, in the first part of the study, which consists of four main parts, the circumstances in supply chains due to the COVID-19 epidemic are evaluated and projections are made for the post-epidemic period. In the second part, the impact of the epidemic on the logistics sector and its operations, the expectations of the sector and possible changes for the post-epidemic period are discussed. The study is completed with the conclusion part in which areas of supply chains and logistics activities that may be improved and require particular focus are underlined.

Supply Chains in the COVID-19 Epidemic and Projections for the Post-Epidemic Period

Effects of the COVID-19 Epidemic on Supply Chains

Supply chains are structures that encompass the whole process starting from raw material supply up to the end of the delivery of a product/service to the customer, including the transformation into finished product and distribution to retailers or directly to end users. These chains are systems in which a number of business processes are synchronized and integrated between various business units such as suppliers, manufacturers, third party service providers and distribution channel participants (Min and Zhou, 2002). According to this definition, well-planned, synchronized and properly-functioning supply chains are necessary for companies in order to provide customers with goods/services free of problems. Management of supply chains is especially critical for companies operating globally.

In case of being dependent on imports in raw materials and parts supply, emergence of unexpected events that adversely affect these forecasts in terms of planning the supply chain based on sales forecasts, problems in which multiple participants (suppliers, manufacturers, retailers, customers etc.) of the chain are affected, interruptions and disruptions may occur in supply chains. While supply chains are often able to create sufficient inventory to function during these periods when production and supply are at a standstill, in a global and comprehensive outbreak like COVID-19 they have failed to function (Craighead, Ketchen and Darby, 2020). The heavy impact of the economic and social circumstances that emerged with the outbreak not only affected many sectors and businesses but also caught the supply chains off guard. This epidemic underlined the importance of supply chain management and made the shortcomings of supply chains more obvious.

The impact of the COVID-19 epidemic on supply chains is quite different from typical supply chain interruptions experienced in terms of scope, extent and disruptive aspects (Craighead, Ketchen and Darby, 2020). This epidemic did not occur in a particular geographic region or in a certain sector but affected all countries and sectors. Its impact has proceeded from regions to countries and from one sector to another with an effective spread like a domino effect. The disruptive power of the epidemic acting on supply chains is strong enough to force supply and demand to excessively high or low levels. For example, whereas there is excessive demand for medical supplies, hygiene products, foods and home delivery services and e-commerce rises incredibly, the demand in many other sectors (tourism, automotive, furniture, construction, etc.) is low enough to paralyze companies.

Global supply chains were disrupted as a result of decreased production capacity due to the decline in global consumption and the cessation of the operations of production companies in China, the Far East and European countries. Experts indicate that the global supply chain is bilaterally affected by

China's shutdown of intermediate and final goods production activities. First, due to the problems in the supply of final products and intermediate goods, companies whose final products come from China had to close their sales stores. Manufacturing companies that could not procure the necessary raw materials and parts for their production had to either stop their production or find alternative suppliers from different geographical regions. For example, the automaker Hyundai based in South Korea declared on February 5 2020 (within two months of the outbreak), that it was unable to supply intermediate goods from China and that it had to close all automobile factories in the country and remain closed until finding new suppliers (Dağlı, 2020). A similar situation has taken place in luxury products such as Swiss watches, as manufacturers faced problems in the supply of parts. Toy manufacturer Hasbro announced that it had difficulty in providing products to the market since it procures almost 70% of its products from China (Fernandes, 2020). LPP company, a fashion manufacturer in Poland, declared that in case of continued delays in Chinese productions, they would contact factories in Turkey, Bangladesh and Vietnam. It is possible to say that even a simple product like ketchup produced in Sacramento Valley in America is globally dependent on bottle caps from China (Sanders, 2020). In a study by Deloitte, it was reported that global automotive production decreased by 40% in 2020 compared to March 2019, and global maritime traffic by 10% compared to February 2019. In addition, it was indicated that more than 200 of Fortune 500 companies have suppliers in Wuhan which is the early epicenter of the epidemic, the world's largest 1000 supply chains had more than 12,000 plants (factories, warehouses, etc.) in the quarantine areas and about 94% of Fortune 1000 companies experienced disruptions in the supply chain due to the COVID-19 epidemic (Ivanov and Dolgui, 2020).

The second effect of the situation in China was on the consumption side. As China is the second largest market for goods and services in the world, the decrease in production and consumption as well as trade with and touristic trips to other countries became another reflection of the epidemic. The fact that trade was weakened by the closing of borders, and that countries such as China and India, both seen as large consumer markets, were not able to create demand for sectors other than food retail, and that touristic accommodations had to remain vacant due to lack of Chinese tourists are other reflections in that respect.

Projections Regarding Possible Changes in Supply Chains in the Post-Epidemic Period

It is generally assumed that changes will occur at the global scale in supply chains and logistics activities with the passing of the initial shocks created by the COVID-19 epidemic and the commencing of controlled normalization process. These changes for supply chains can be explained under the headings of localization of supply, easy access to suppliers and customers, flexible approaches to product diversity and stock management, dynamism, and digitalization.

In the post-epidemic period, companies will keep in mind that all stakeholders in the supply chain they are involved in are affected by the outbreak, and will try to identify alternative suppliers, logistics service providers and distribution channels. In many sectors ranging from food to textile and to electronics, companies are expected to diversify their resources in supply and engage in efforts to create local alternatives where appropriate. For example, even at the beginning of normalization, some American companies have shifted some of their production activities from China to Vietnam and started to increase local purchases (SAM, 2020). Although it is not possible to think that the dependence on China which achieves nearly 30% of the world production will disappear completely after the epidemic, every decrease in this rate will cause a significant mobility both in search of alternative regions for production and in the domestic production economy of Europe. The manufacturers and the logistics sector in Turkey is also expected to acquire a share from this mobility as well. Especially the companies in global supply chains are expected to spread their supply, production, warehouse and sales activities to different regions and even continents as much as possible, so as to be able to preserve their supply chain in unexpected risk situations such as disasters, epidemics, etc.. Even extreme models such as co-opetition will be among the strategies which companies can implement in these issues such as ensuring supplier diversity (Sanders, 2020).

On the other hand, disruptions in the supply chains experienced during the epidemic showed that shorter and more flexible supply chains are needed. Supply chains or manufacturing facilities worldwide will need both flexible designs and flexible supply chains to have cross-product manufacturing systems that can easily switch to different products (for instance, from cars to ventilators, from electronic products to respiratory devices, from apparels to surgical gloves, protective clothing or masks, etc.). For example, the chemical company DuPont accelerated the production of protective clothing at its Richmond Factory with the COVID-19 Epidemic (Sanders, 2020). Similarly, in the past, when the SARS Epidemic occurred in 2003, a Toronto-based lotion manufacturer quickly switched its production from lotions to hand sanitizers.

In order to create flexible supply chains in extraordinary situations, stocks, demand and supply conditions, production and purchasing schedules must be clearly known and visible throughout the supply chain (Sanders, 2020). In such situations, fast and accurate information flow is paramount (Tanyaş 2020). Supply chains which ensure open and continuous communication with customers about the emergency action plans provide advantages for businesses (Büyüközkan, 2020). Thus, it can be guaranteed that supply chains remain prepared and dynamic so as to reduce negative effects as much as possible in extraordinary setbacks such as epidemics or major disasters, or global economic crises.

Before the world faced the COVID-19 epidemic, especially in the last two decades, supply chains were planned with just-in-time production approaches, where stock levels were kept minimal, and stock costs were aimed to be

minimized throughout the supply chain. However, it has been understood that this approach excessively reduced the flexibility of companies in the epidemic. In the post-epidemic period, it will be almost impossible for companies to maintain managerial approaches requiring minimum stock, such as lean supply chain and just-in-time production system. It is considered that companies paying a heavy price for not being flexible during the epidemic will review their strategies after the epidemic and re-evaluate their stock levels in terms of quantity and warehouse location (Brakman, Garretsen and Witteloostuijn, 2020). Companies that keep their stock levels minimal by producing with just-in-time approach, especially in assembly products such as automotive and electronics, may switch to new stock-keeping models after the epidemic so as to be able to adapt to unexpected demand changes. In this regard, companies may be suggested to create diverse models related to stocks, to evaluate and classify their stock items in terms of criteria such as the limited alternative sources of supply and the length of lead times, and to formulate policies accordingly (Sanders, 2020).

Although the disruptions in supply chains are similar to the situation across the whole economy, there has been a two-way disruption in the supply chain. The disruption on the consumer side affects both the general economic situation and the supply chains as a whole. Intensified use of digital media by consumers who could not leave their homes due to the epidemic led to an increase in the volume of e-commerce and the retail sector to gain importance. On the other hand, the necessity of increased digitalization has led to consumer's increased information requirements regarding both purchasing (information/decision processes) and supply processes. This rapid digitalization process concerning consumers will also require the entire supply chain to adapt to it. In the post-epidemic period, it will be inevitable to increase automation and artificial intelligence investments in supply chains, to use information and communication technologies more intensively and to increase relevant technological capabilities. However, cyber security investments are likely to increase as cyber risks increase with digitalization.

Logistics in the COVID-19 Epidemic and Projections for the Post-Epidemic Period

Effects of COVID-19 Outbreak on Logistics Sector

Like all sectors operating at global level, the logistics sector is also under the influence of the COVID-19 epidemic. The setbacks in the commercial activities of all countries brought the logistics sector, which acts as a sort of bridge between manufacturers and consumers, face with uncertainties and risks. Although the effects of the epidemic on the logistics sector are multifaceted, they become manifest in the form of disruptions and blockages especially in freight transportation activities and in cargo services (the lack of capacity, inability to meet the demand and a decrease in service quality).

Like in all countries in the world, the negative impact of the epidemic on trade has emerged more evidently in March 2020 in Turkey. According to the Turkish Ministry of Commerce data presented in Table 1, there is a serious decline in exports in March. This is mainly due to the quarantine measures implemented in the customs of Turkey's neighbours (Iraq and Iran) and decreasing demand in Europe which is affected a lot by the epidemic. This decrease led to a negative growth of exports as of the 3-month period, which initially increased by 4.1% in the first 2 months of the year. Exports in March decreased by 17.81% compared to March 2019, while imports increased by 3.13%. In addition, foreign trade volume decreased by 6.76% compared to the previous year and reached 32 billion 247 million dollars.

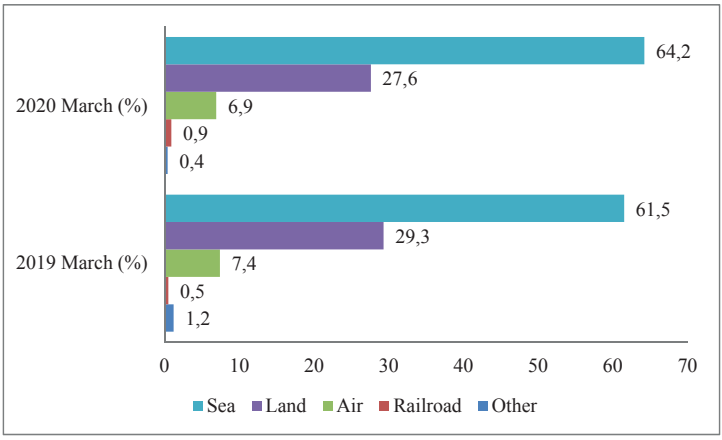
Table 1. Turkish Trade Ministry Foreign Trade Data (Million Dollars)

Foreign trade	March			January- March		
	2019	2020	Change (%)	2019	2020	Change (%)
Export	16.336	13.426	-17,81	44.534	42.783	-3,93
Imports	18.250	18.821	3,13	50.472	55.662	10,28
Foreign Trade Volume	34.586	32.247	-6,76	95.006	98.446	3,62
Foreign Trade Balance	-1.915	-5.395	181,79	-5.938	-12.879	116,89
Export/Import Coverage Ratio (%)	89,5	71,3		88,2	76,9	

Source: *T. C. Ministry of Commerce March 2020 Data Bulletin.*

Considering the export data presented in Chart 1 according to transportation modes, the most heavily used mode in Turkish foreign trade in March 2020 was sea transport. While most exports were made by sea (8 billion 620 million dollars), this mode is followed by land (3 billion 702 million dollars) and air (929 million dollars).

Chart 1. Exports by Transportation Modes (%)

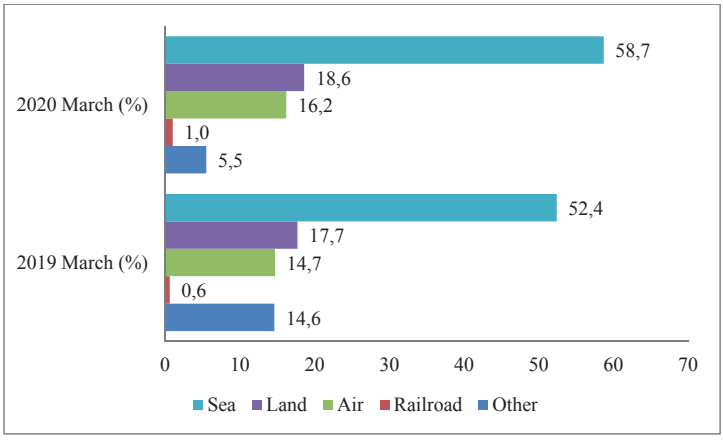


Source: *T. C. Ministry of Commerce March 2020 Data Bulletin.*

(Note: *"Other" includes self-propelled vehicles, pipeline and mailing.)*

Considering the import data presented in Chart 2 according to the transportation modes, exports were mostly made by sea (11 billion 44 million dollars), followed by land (3 billion 500 million dollars) and air (3 billion 50 million dollars).

Chart 2. Imports by Transportation Modes (%)



Source: *T. C. Ministry of Commerce March 2020 Data Bulletin.*

(Note: *"Other" includes self-propelled vehicles, pipeline and mailing.)*

In land transport, the freight costs increased by approximately 15% due to COVID-19 as a result of the delays in export loads due to closed border gates, and trailers and containers not returning due to truck queues at the border gates. The Association of International Freight Forwarding (UTIKAD), an association representing the logistics industry in Turkey, reported that problems emerged in Ro-Ro navigation as drivers in land transport could

not be transported by plane from Turkey to Europe, and vice versa. The fact that the drivers returning to Turkey are quarantined for 14 days and that the public institutions in the European countries applied for visa extension are being closed created a bottleneck in the availability of drivers, and these factors have caused serious shortcomings and blockages in land transportation (UTİKAD, 2020). On the other hand, due to the epidemic, a high demand for food products have occured in Turkey as elsewhere in the world. Especially, the use of trucks with prices above the market average by chain stores has brought an increase in land freight transportation costs.

Considering that approximately 80% of the world trade is carried by sea, all kinds of delays or interruptions in sea transportation negatively affect the flows of goods and therefore supply chains. Sea transportation has been disrupted as the COVID-19 epidemic has created restrictions on crew and ships in many ports around the world. Container transportation costs, which increased due to the cleaner fuel application in 2019, are estimated to have increased even more due to the epidemic (Tanyaş, 2020). In addition, the epidemic has caused consumers concerns against goods from China and the Far East countries, and due to the decrease in the number of cargo and containers from the Far East to Turkey, the problem of finding the empty containers for export has become a current issue. Due to the accumulated loads waiting on the ports, there is also a shortage of space in export ships. The fact that cargoes to China and Italy cannot cleared on time leads to the problem of not being able to deliver the goods to their final destinations.

Due to the restrictions and prohibitions imposed on airlines, commercial flights were canceled and global air passenger traffic decreased by 28.2% in the first three months of 2020 with a loss of 620 million passengers (Akca, 2020). When the cargo volume that can be transported by commercial aircrafts is withdrawn from market, the demand for cargo aircraft has increased the shipping costs significantly. Another reason for the increase in demand of air transport is the shifting of the orders, that cannot be delivered on time by sea due to the disruptions mentioned above, from sea to air transportation.

Since physical contact is less in rail transport compared to other modes, the negative impact of COVID-19 epidemic on rail has been relatively low, and the importance of rail transport has been better understood. Especially due to problems in the transition of land vehicles from Turkey to Iran, demand for railway has increased in the region. Wagons are not drawn to the buffer zone between Iran and Turkey by locomotive, but are pushed, so only the cars are passing to the Iranian side without driver and staff. Empty wagons that return are disinfected in the designated waiting area, and thereafter drawn to Turkey. These waits also increase the duration of these trips. In addition, the number of wagons is not sufficient due to high demand.

Because of these challenges during the COVID-19 epidemic, the logistics sector has various expectations from government. Within the scope of the Economic Stability Shield Package, the withholding tax and VAT return payments for the

logistics-transportation sector were postponed for 6 months (Tanyaş, 2020). Sector representatives state that they support incentives, but new economic measures should be implemented to prevent the logistics sector from having problems. In this regard, the foremost expectations of the sector can be listed as SCT-free fuel subsidies, freight subsidies related to the cargo carried, the regulation of measures to be implemented by the customs administrations against the epidemic so as not to prevent logistics flow, the resolution of demurrage and warehouse problems for cargoes waiting at the ports in a way not handicapping relevant parties, and introducing discounts on airport tariffs of fares.

The Measures Implemented Regarding the Logistics Sector in the COVID-19 Epidemic

The measures the government has taken to mitigate the impact of the epidemic concerning the logistics sector in Turkey can be summarized as follows (https:// www. covid19.ticaret.gov.tr):

- *Employees working in the warehouses are given masks and gloves, the health checks of the drivers are made, the offices and the interiors of the vehicles are disinfected.*
- *No-touch packaging, clean packaging materials, daily cleaned delivery tools and protective measures such as the use of masks and gloves help responding to the hygiene concerns of customers.*
- *Hygiene and health rules for the epidemic are applied at customs, and employees are provided with masks and protective clothing.*
- *Border gates are disinfected.*
- *In the trade with Iraq, the practice of driver exchange was implemented in the buffer zone. According to that, the driver returns by leaving his vehicle in the buffer zone, and another driver from the other side comes to take the truck. Thus, there is no human contact, and entry and exit is managed by disinfecting the front part of the vehicle.*
- *Preparations are in progress to develop the practice of delivering full containers in exchange for empty ones. For example, rail shipments at the Kapıköy Border Gate with Iran are pushed by locomotive from the Turkish side without human contact and drawn by towing locomotive from the Iranian side.*
- *Work has been going on to increase the expeditions via the Baku-Tbilisi-Kars railway from 2500 tons to 6000 tons per day.*
- *Vehicles traveling to Italy and France by Ro-Ro are shipped without human contact by tow trucks in these countries.*
- *Risk assessments are made regarding ships and marine vessels arriving at the ports.*

Projections Regarding Logistics Sector in the Post-Epidemic Period

In the normalization process of the COVID-19 epidemic, it is likely that some changes will take place in logistics activities both due to circumstances in supply chains and related to the sector itself. These can be discussed under the headings such as transportation models that will enable no-contact practices in foreign trade; multi-location, dynamic but low-cost approaches to meet the increasing demand on storage; logistics services providers that are better interwoven into supply chains and open to communication; digitalization; and development of models that will adapt quickly to demand fluctuations in cargo services.

It is anticipated that the changes envisaged and explained above for supply chains, especially the new approaches to the stock policies of manufacturers, will increase the demand for storage space and the overall demand for logistics services. It is probable that some sectors will increase their raw material or finished product stocks, while some others will start keeping safety stocks, and the increase in stocks hence will require capacity increase in storage areas and create the need for new storage areas. Also, in order to be close to the customers and to reduce the risks in extraordinary periods, the necessity to keep stock in different cities or countries may arise for companies. In this regard, multi-locational warehouse models, which enable dynamic planning but are low-cost at the same time will need to be developed. In addition, alongside with these changes in the stock policies of the producers on the supply side, there has also been shocks on the demand side during the epidemic. Since cities, states and/or regions were quarantined and mobility restrictions were applied, citizens had to stockpile the products they would need to manage their lives during the quarantine processes. For this reason, some products that are not supplied sufficiently have caused crises (Acar, 2020). Therefore, we can say that the stock approaches of retailers, which are contact points with the customer, will also change and this will lead to capacity increases on the transportation side of logistics.

As a result of the COVID-19 epidemic, physical trade has come to a halt due to reasons such as avoiding physical contact, unsafety of going outside, quarantines and prohibitions. However, continuing consumer needs and advanced internet technologies have ensured the continuity of trade online and the epidemic has even created a catalyst effect in e-commerce. It is known that the number of consumers in e-commerce has increased and new consumer masses have formed worldwide due to the epidemic. There is no physical interaction other than cargo acceptance in e-commerce. In the epidemic period, 37.4% of consumers have been first-time shoppers. It is estimated that millions of new consumers will have experienced online shopping by the end of the epidemic period (Javed, 2020). According to a study of the research company Nielsen, e-commerce growth has exceeded its growth in the first two months of 2020, reached to three-digit values as 171% in the first 5 weeks after the announcement of the first COVID-19 case in Turkey.

One of the most important stakeholders in e-commerce is cargo services. In this respect, it can be claimed that with the increase in the number of e-commerce orders, the need for logistic services will increase, and the necessity to increase the capacities of existing e-commerce operation centers and establish new e-commerce order preparation centers will emerge. New alternatives such as delivery on the same day, or online ordering in return for delivery of products from retailers like shopping malls, supermarkets or other locations will develop. Delivery on the same day will lead land vehicle fleets to grow and new e-commerce logistics service providers to enter the sector.

Conclusion

The COVID-19 outbreak has demonstrated the commercial shortcomings of the globalizing world on one hand, and the vital importance of supply chains and logistics as well as the need for reliable supply chains on the other hand. During the epidemic process, it has been understood that all supply chain and logistics operations should function flawlessly from supply to production, from warehouse operations to transportation, from e-commerce to cargo and courier services in order to ensure easy and swift access to food, health, cleaning and all other basic consumer products. This epidemic not only underlined the importance of supply chain management and logistics but also made the shortcomings and vulnerabilities more obvious.

The significant impact of the epidemic not only affected various sectors and businesses but also caught the supply chains off guard. Since the impact of the COVID-19 epidemic seems likely to be long-term and similar virus outbreaks are expected to be on the global agenda due to increasing population, urbanization, international travel, commercial integration in the coming years, a questioning and self-assessment process is inevitable in the post-epidemic period in supply chains and logistics activities. In the business world, as crises can also bring great opportunities with the awareness, planners and those in management levels in the supply chains and logistics fields should strive to turn the crisis into an opportunity and create management approaches that will keep extraordinary global risks at an optimum level.

The self-assessment process for supply chains in the post-epidemic period will take place under the headings of localization, easy access to suppliers and customers, flexibility, dynamism, and digitalization. In the logistics sector, issues such as no-contact transportation models, multi-location, dynamic and low-cost storage approaches, open-to-communication logistics services providers, digitalization, and development of cargo services that will adapt quickly to demand fluctuations will become paramount.

On the other hand, during the epidemic process, the whole world understood the negative effects of globalization on natural resources and environmental pollution better and that these effects pave the way for the occurrence of global epidemics and disasters such as COVID-19. In this regard, the expectations

of states and individuals from the business world will now be reducing environmental impacts and prioritizing human health. The same will apply to supply chains and logistics operations.

The estimation that the effect of the COVID-19 epidemic will be long-lasting and that similar outbreaks will always be on the global agenda makes issues such as disease control, epidemic prevention planning, humanitarian logistics, and reverse logistics concerning the recycling of medical supplies and plastics more prominent than ever. In the epidemic, the great difficulties have been experienced in the provision and delivery of medical supplies to the points of need such as test kits, masks, gloves, which are critical for human health and the prevention of the spread of the disease. This implies that there were setbacks and ruptures in the health supply chains. In addition, the intensive use of disposable plastic products and increased medical wastes to reduce contact and prevent infection during the epidemic have made reverse logistics and closed loop supply chain practices more important. In this context, it is envisaged that health supply chain, humanitarian logistics, reverse-logistics, closed-loop supply chain and sustainability of supply chains will be areas to be studied and focused by both practitioners and academicians.

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