

THE IMPACT OF THE PANDEMIC ON GLOBAL LOGISTICS PROCESSES

GÁBOR NAGY¹-ÁGOTA BÁNYAI²-BÉLA ILLÉS³

Abstract: The COVID-19 pandemic reminded society that, in addition to natural disasters, epidemics are also part of our past, present and future. Even if we cannot prevent the emergence of dangerous viruses, we must be prepared to mitigate their impact on society. It is clear that the COVID-19 epidemic, in addition to its severe physiological effects, has caused significant economic damage worldwide. Global supply chains in different industries face significant challenges. Not only the economy is affected by the virus; society as a whole is affected, leading to dramatic changes in the behaviour of businesses and consumers. The global supply chains that have shown a high level of stability and resilience in recent decades now face a number of disruptive factors. The pandemic adversely affected the entire chain in terms of both manufacturing and logistics processes, as well as a significant shift in demand. The pandemic highlighted the need to focus on three key areas to increase the resilience of supply chains: risk and flexibility, global transparency, and rapid response and decision-making. It can be concluded that the changes caused by the epidemic will make global supply chains shorter and more transparent through renewed strategies of digitization, with tools of which are the building blocks of the DSN.

Keywords: Covid-19, global supply chain, digitisation, DSN-digital supply network

1. INTRODUCTION

According to the World Health Organization (WHO), the COVID-19 epidemic has been present in more than 220 countries since its outbreak in December 2019, with more than 82 million confirmed cases of COVID-19 registered by the end of 2020, of which 1.8 million were fatal [1]. The year 2020 was about prevention for the whole world, which is why all the countries involved have introduced restrictions to curb the spread of the virus. Countries around the world have agreed that the primary goal of the epidemic situation is to try to reduce the growing number of patients with the spread of the virus, thereby protecting society from adverse physiological effects. Another consequence of the epidemic, however, is that the restrictions imposed have had a severe economic impact in all countries of the world. The World Trade Organization (WTO) forecasts that global trade will fall from 32% to 13% [2]. The data in the WTO database are illustrated in Table I, which shows the estimated global trade volume of the major economic regions, which in the light of the figures may indeed give cause for concern from an economic aspect.

To curb the pandemic, governments have introduced a number of precautionary measures, such as travel restrictions, temporary shutdowns or closures of factories and shops, and mandatory isolation of citizens. As a result, many businesses have been forced to close, leading to unprecedented disruptions to trade in most industrial sectors. The situation was further exacerbated by the tightening of controls on logistics systems. As a

¹ research assistant, University of Miskolc
altnagy@uni-miskolc.hu

² associated professor, University of Miskolc
altagota@uni-miskolc.hu

³ university professor, University of Miskolc
altilles@uni-miskolc.hu

result, the planned lead times changed, and there were delays in the processes. Demand for certain products has exploded, so in many cases there has been a shortage of stock. It is not yet possible to accurately estimate the end of the epidemic, so it is important that companies prepare for rapid recovery and mitigation of unexpected disruptions in the future.

Table I.
Volume of trade in goods and real GDP in the period 2015–2021 [3]

	2015	2016	2017	2018	2019	2020	2021
World trade volume (average of exports and imports)	2.3	1.4	4.7	2.9	-0.1	-9.2	7.2
Export							
North America	2.6	0.7	3.4	3.8	1	-14.7	10.7
South and Central America	0.6	1.3	2.9	0.1	-2.2	-7.7	5.4
Europe	2.9	1.1	3.7	2	0.1	-11.7	8.2
Asia	1.3	2.3	6.7	3.7	0.9	-4.5	5.7
Other regions in Africa, the Middle East and the Commonwealth of Independent States (CIS)	1.8	3.5	0.7	0.7	-2.9	-9.5	6.1
Import							
North America	5.2	0.3	4.4	5.2	-0.4	-8.7	6.7
South and Central America	-7.6	-9	4.3	5.3	-2.1	-13.5	6.5
Europe	3.6	3	3	1.5	0.5	-10.3	8.7
Asia	2.1	2.2	8.4	4.9	-0.6	-4.4	6.2
Other regions in Africa, the Middle East and the Commonwealth of Independent States (CIS)	-3.9	-4.5	3.4	0.3	1.5	-16	5.6
Real GDP at market rate	2.8	2.4	3.1	2.8	2.2	-4.8	4.9
North America	2.8	1.7	2.4	2.8	2.1	-4.4	3.9
South and Central America	-0.8	-2	0.8	0.6	-0.2	-7.5	3.8
Europe	2.4	2.1	2.8	2.1	1.5	-7.3	5.2
Asia	4.3	4.2	4.8	4.1	3.9	-2.4	5.9
Other regions in Africa, the Middle East and the Commonwealth of Independent States (CIS)	1.5	2.4	1.9	2.1	1.4	-5.5	3.5

2. THE IMPACT OF THE EPIDEMIC ON LOGISTICS PROCESSES

COVID-19 isn't the first epidemic in history to have affected the civilization and the economy in such a sudden and severe manner. Outbreaks of global epidemics are projected to occur between every 10 and 50 years in the future. In recent decades, however, there has been no epidemic of such magnitude that it has caused such economic "devastation". The time scale of devastating viruses and natural disasters in recent years and decades has not been as long-lasting as that of the Covid-19 epidemic. In Figure 1, parameters and characteristics have been collected, which explain the contrast of the current pandemic with the previous ones.

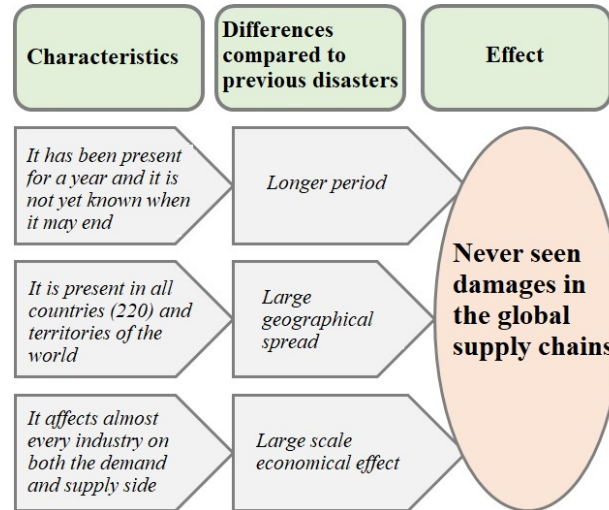


Figure 1. Characteristics of the Covid-19 epidemic (based on [7])

Logistics companies involved in the movement, storage and flow of goods were directly affected by the COVID-19 epidemic. As an integral part of value chains, both within and beyond international borders, logistics companies facilitate trade and help businesses deliver their products to customers. Disruptions in supply chains in sectors due to the epidemic can therefore have an impact on the competitiveness of companies, economic growth and job creation. The epidemic has also highlighted the interdependence of partners in the chain, as actors at the upper levels of the supply chain are severely affected by fluctuations in demand from actors further down the chain hierarchy [4]. This known whiplash effect has a devastating effect on higher-level players, especially small and medium-sized enterprises. The whiplash effect is caused by forecast inaccuracies at the end-user demand point and results in significant supply chain disruption [5]. In this case, companies face their weaknesses, such as a lack of visibility throughout the chain.

3. DISRUPTIONS IN SUPPLY CHAIN PROCESSES

In a globalized market, logistics service companies connect companies to markets by providing various services such as multimodal transport, freight forwarding, warehousing and inventory management [6]. Leading companies in key economic sectors use parts from suppliers in countless parts of the world. It can be said that today's global supply chains require greater flexibility and efficiency in the flow of goods between and within countries. The irrationality of consumer demand has reshaped market trends so far, distorting both the demand and supply sides. Figure 2 shows how the major economic sectors are affected by the pandemic, with disruptions occurring in both sectors on both the supply and demand sides. In a general sense, products fall into two categories: functional products and innovative products. Functional products show a stable supply and demand in a period free from hardships. Some products, such as the mask, have evolved from a functional product to an innovative product due to uncertain demand and supply. In times of pandemic, the

most important feature of supply chains is to respond quickly to consumers and realize high profits.

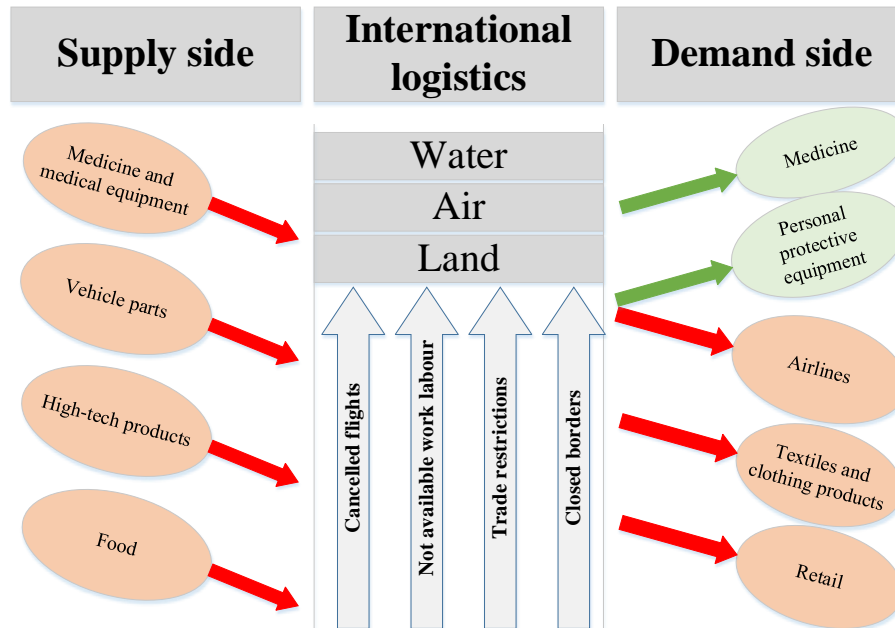


Figure 2. Effects of Covid-19 on global supply chains (based on [7])

Disruptions in the countries affected by the virus and lack of human resources have led to limited availability of raw materials and consumables in almost all sectors. However, there has been an increase in consumer demand for COVID-19 prevention tools. There was a high demand for masks, but demand for electronic products declined, leading to a market imbalance. International logistics for water, air and land routes have experienced delays, postpones, cancellations and obstacles due to large-scale travel restrictions and border closures [8]. The burden on international logistics during the epidemic has increased, thus serving global markets in a timely manner has become quite difficult. Significant crises in the global logistics sector are due to labour shortages and the suspension of commercial air traffic, as well as strict export and import restrictions. There is a shortage of manpower at all stages of the global supply chain, resulting from quarantine restrictions and infections. The situation is further exacerbated by the inability of supply chains to perform their vital tasks due to quarantine, travel restrictions and temporary shutdowns of some plants. The suspension of commercial aviation around the world severely limited air cargo capacity, making it difficult to move vital supplies such as medical equipment. It is estimated that more than \$ 6.2 trillion worth of goods are shipped by air each year, a mode of transportation that accounts for more than 35% of the value of world trade [9, 10]. Shipping companies and governments turn to air carriers to transport goods for prevention and treatment during a pandemic, which has led to an increase in air freight rates, and some carriers are experiencing delays due to increased airport congestion. Global logistics processes are further plagued by strict export and import restrictions in individual countries

and the closure of borders. There have been significant disruptions in cross-border logistics. The lack of truck drivers as a labour shortage is also significant here. Demand for rail services has increased due to higher air freight rates, empty shipping and longer transit times for trucks.

4. MITIGATION PLANS UNDER TIGHT TIME CONSTRAINTS

The global supply chain is a multi-level system with a number of invisible, lower-level suppliers who are very important to the supply system as a whole. During the epidemic, it was proved that only a very small number of integrator companies managed to track their suppliers in the 2nd or higher level. Networks of this size reduce the transparency of global supply chains, leading to a slow response to unexpected problems [11]. Supply chain transparency can be defined as the need for integrator companies to be aware of what is happening in the supply chain upstream and to communicate this information not only within the supply chain but also to the consumers for whom this information has become increasingly important nowadays [12]. Disruptions in a key company in the supply chain have harmful consequences for the global supply chain as a whole. During the epidemic, this parameter increased in value because information not only about the companies involved in the chain is important for the operation of their partners, but also for the consumer due to the time availability of the products. Millions of foreign companies have one or more 2nd level supplier from the Wuhan region, the focal point of the epidemic. In many cases, these are exclusive suppliers who find it almost impossible to find an alternative. The situation is further complicated by the fact that manufacturing companies nowadays have sought to increase efficiency with a lean philosophy, primarily using techniques such as just-in-time. The bottom line is that they do not accumulate high levels of security stocks, making them vulnerable to market demands in such a crisis situation. The most urgent goal for companies is to quickly restore their own capacity as well as the capacity of their supply chain partners. During the COVID-19 epidemic, the most important task of a central supply chain company is to support its business partners. The integrating actor must manufacture or purchase personal protective equipment and assist supply chain partners in implementing protective measures, thus ensuring the continuity of production of their suppliers. This strategy is followed by some companies to protect their employees, suppliers and customers from the consequences of a lack of protective equipment. By allocating their own resources, some leading companies choose to manufacture their own protective equipment, which they will maintain until prevention is properly designed.

5. CREATING VISIBILITY AND REACTIVITY IN VALUE CHAINS

Visibility and rapid and efficient response to disruptions are among the most disputed indicators of supply chain resilience [13, 14]. To mitigate the effects of COVID-19, the primary goal is to provide visibility and provide the necessary conditions for the reaction (Figure 3).

5.1. Increasing visibility in case of disturbances

Even in times free of viruses and other natural disasters, the concept of visibility in the functioning of supply chains is an extremely important factor. The construction of a global

value chain networks the whole world, connecting numerous economic actors, so the flow of information related to a reliable material flow is also important. Visibility as a concept can be interpreted as providing an opportunity to track the raw material from semi-finished to finished product throughout the process. Despite a simple definition, this is not something that is readily available. A “visible” supply chain is characterized by the ability to determine the overall status of all elements of the supply chain in an instant, as well as the ability to search to get more details about the current status. Supply chain complexity is a major issue for supply chain visibility. The virus has supported the fact that visibility as such today is not yet fully mature and has been introduced into the functioning of supply chains. Very few percent of today’s global supply chains have full visibility. However, achieving increased visibility is essential to achieving efficiency and agility.

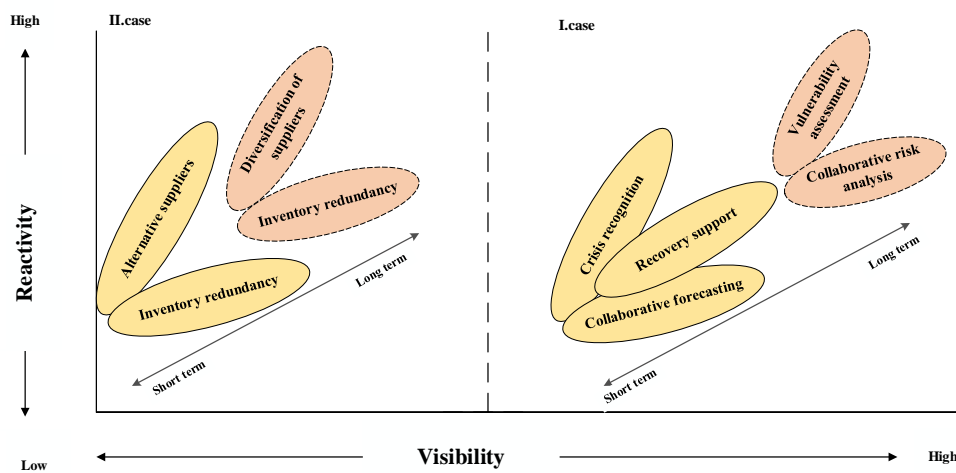


Figure 3. Suggestions for increasing visibility and reactivity to alleviate disturbances (based on [7])

The short-term proposals for mitigating losses are illustrated in Case I. of Figure 3. Redemption recognition means that the central company must examine all lower-level suppliers in the areas affected by the closures. Knowledge of the suppliers most affected by the current situation can significantly reduce the response time required to implement mitigation measures. Collaborative forecasting means joint demand forecasting with customers. It helps to avoid the whiplash effect, making production and resource planning more predictable. From the product portfolio supplying a given market, those who are given higher priority by the consumer needs during the virus should be identified. The third and final short-term solution is to support recovery. Central companies need to communicate with all stakeholders, including customers and suppliers, and provide the necessary support, from legal assistance to financial assistance, to restore their operations [15].

The other two proposals are in favor of long-term competitiveness. The first requirement is to uncover global supply chain bottlenecks and be able to monitor risk disruptions in real time. Supply chain vulnerabilities often occur in five segments: design and supplier network, transportation and logistics, financial flexibility, product complexity, and organizational maturity [16]. Today’s advanced information technologies make it

possible to monitor disruptions in real time. This allows to intervene and eliminate both quickly and in the early stages when errors occur. The other proposal is to establish cooperation with key strategic partners and long-term risk management action plans to alleviate material and production capacity shortages in order to create long-term competitiveness.

5.2. Enhancing reactivity in the event of disturbances

At unpredictable times, as is the case around us today, reactivity is a key driver in the lives of companies, enabling them to provide quick and cost-effective responses to deal with disruptions. Figure 3 case II. suggests an increase in reactivity in the short and long term. In the short run, we can apply two methods of alternative sourcing and inventory redundancy. Finding alternatives to replace suppliers located in virus-affected areas can be a solution, and inventory redundancy can be provided by quickly allocating security resources reserved for such cases. In the long run, diversifying suppliers to increase responsiveness in addition to inventory redundancy can reduce the risk of disruptions when supply chains experience limited activity due to a catastrophic event. Working with suppliers in different geographical locations can be a beneficial strategy. However, companies should be cautious about the implementation of the described action plans because both increasing visibility and increasing responsiveness come at a cost, which can lead to higher prices for their products, thus weakening their competitiveness in the global market.

6. DIGITAL SUPPLY CHAINS

The spread of COVID-19 has caused extreme delays in the delivery of essentials, while non-critical stocks are piled up as supply is not in line with current demand. To improve the functioning of the supply chain, supply chain managers need to know what is happening and where, including current and future threats, weather and traffic conditions posed by COVID-19. Supply chain optimization has been a high priority for decades. It has removed physical buffers to minimize costs, reduce inventory, and increase resource utilization, creating flexibility to absorb disruptions. COVID-19 shows that many companies are not fully aware of the vulnerability of supply chain relationships to global crises. Fortunately, new supply chain technologies are emerging that dramatically improve visibility in the end-to-end supply chain and support companies in preparing for such shocks. The traditional linear supply chain model (Figure 4) is transformed into digital supply networks (DSNs) (Figure 5), where functional storage is broken down and organizations are connected to their entire supply network through for end-to-end visibility, collaboration, agility, and optimization [17].

Industry 4.0 enables the digital transformation of supply chains utilizing advanced technologies such as the Internet of Things, artificial intelligence, robotics, and 5G, as digital supply networks are designed to anticipate and respond to future challenges. Whether it's a "black swan" event like COVID-19, a trade war, a war or terrorist act, a regulatory change, a labour dispute, a sudden surge in demand, or a bankruptcy of a supplier, organizations using DSN will be prepared to deal with unexpected events [19].

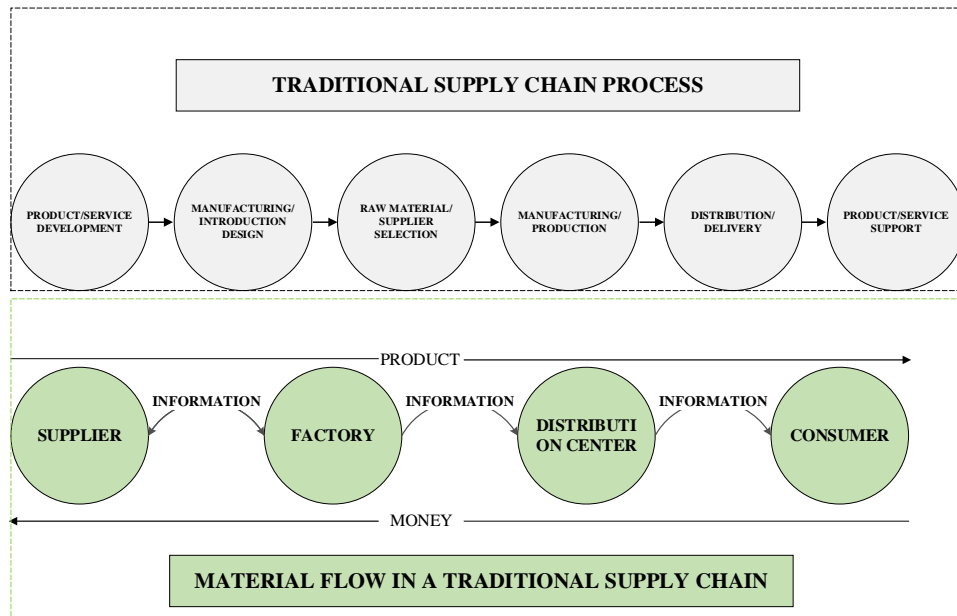


Figure 4. Traditional supply chain model [18]

Characteristics of DSN network capabilities (Figure 5) [19; 18]:

- **Digital Development:** This capability uses technology to conceptualize, design, and integrate products into production, ensuring multifunctional collaboration throughout the product lifecycle and improving design efficiency to develop high-quality products that meet unique customer needs.
- **Synchronized Design:** This capability aligns strategic business goals with financial goals and operational plans for various business functions. This layout helps to efficiently calculate customer needs and optimize inventory across the entire DSN.
- **Intelligent Supply:** This capability helps companies work more effectively with their strategic partners and improve customer and supplier satisfaction by using advanced electronic platforms for ordering and invoicing.
- **Smart Factory:** This capability uses a calculated balance of human and machine intelligence to improve business performance and employee safety based on production and demand data.
- **Dynamic Fulfilment:** This combined, multi-company capability delivers the right product to the right customer at the right time, enhancing the overall customer experience. It uses technologies such as IoT and robotics to provide real-time visibility and flexibility throughout the supply chain, facilitating multifunctional collaboration and improving responsiveness.
- **Connected Customer and Aftermarket:** This capability allows companies to move from a traditional transaction-based relationship to seamless customer engagement throughout the customer lifecycle.

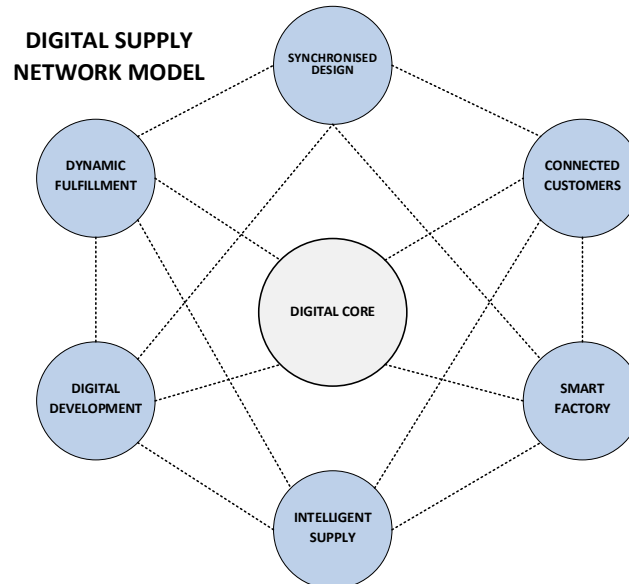


Figure 5. Digital supply network model [19]

7. SUMMARY

It is impossible to predict the occurrence of crises affecting the world globally, such as the outbreak of COVID-19. However, companies can mitigate their losses by developing robust and flexible supply chain processes and contingency plans. Emergency preparedness and response effectiveness depend to a large extent on a deep and comprehensive understanding of the impact of COVID-19 on global supply chains. It can be stated that COVID-19 differs from previous epidemics in three unique features: longer duration, global extent, and high economic impact. The study summarized the presentation of the problems facing logistics processes. The action plans presented offer an opportunity to effectively address disruptions in the global supply chain in both the short and long term. This epidemic is forcing companies to re-evaluate their global supply chain and act efficiently and agilely in the event of a disruption. The opportunities offered by advanced technology solutions provide a guarantee for global supply chains to greatly improve the efficiency of their responsiveness and transparency.

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