IMPACTS OF COVID-19 PANDEMIC ON GLOBAL SUPPLY CHAINS

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Abstract: *The primary motive of this research is determining the impact of the Covid-19 pandemic on the highly complex structures such as global supply chains. The research draws conclusions about the current situation and challenges that global supply chains will face in the near future. Therefore, primary and secondary data sources, statistical indicators and researches about the effects of the pandemic on global organizational structures were consulted. The main fact is that Covid-19 pandemic is not only driver of change, but an essential accelerator of the need to restructure global supply chains. Global supply chains that want to maintain or expand their market shares in rapidly changing market conditions are forced to adapt extremely quickly their overall business concepts at all levels of these complex structures. The essential feature of this research is the definition of basic strategic guidelines for efficient adaptation to current and future needs of the global market.*

Keywords*: Supply Chain Managament, Covid-19, Global Supply Networks, Economic Integration*

The products we use are mainly the product of complex supply chains spread over many highly developed and specialized markets. The Global Supply Chain (GSC) is a cross-border network of manufacturers, corporations, information and other resources involved in the production and movement of semi-finished and finished products. For many years, supply chains have been created according to what comparative advantages can be achieved in countries with lower levels of costs (wages, wages, transport) or with which favorable trade agreements have been concluded. This has resulted in an increase in the relocation of certain activities to "cheaper" locations around the world. The effects of economies of scale in supply chains have been achieved through the allocation of low value-added production activities to cheaper labor markets (and as close as possible to end-customer markets), while high value-added activities (such as research and development) are located in home, highly developed holdings. In this way, home markets generated a higher share of profits with lower operating costs. The formation of global supply chains took off at the end of the 20th century, aided, among other things, by improvements in the management of global trade flows (establishment of the World Trade Organization - WTO, 1995), reduction of customs rates and minimization or even complete elimination of other non-trade barriers. and innovation in the field of information and communication technologies. All of the above contributed to the development of intercontinental transport routes for the supply of necessary materials, greater complexity of the final product, increased the importance of operational efficiency, but also contributed to China's establishment as the world's largest supplier of raw materials in global supply chains. It is the increasingly rapid development and implementation of advanced IT solutions that is transforming the supply chain from the concept of linear supplier integration into complex globally configured digital supply networks. In such digital supply networks, functional silos are broken down within organizations, allowing organizations to connect to the entire supply network to enable transparency from the beginning to the end of the chain, as well as better stakeholder cooperation, flexibility and optimization at all levels. Digital supply networks are designed to prevent possible interference. Kilpatrick and Barter (2020) state that, if interference occurs, they are designed so that they can be adequately reconfigured in order to minimize the impact of the resulting interference as soon as possible.

1.1. China's importance for global supply chains

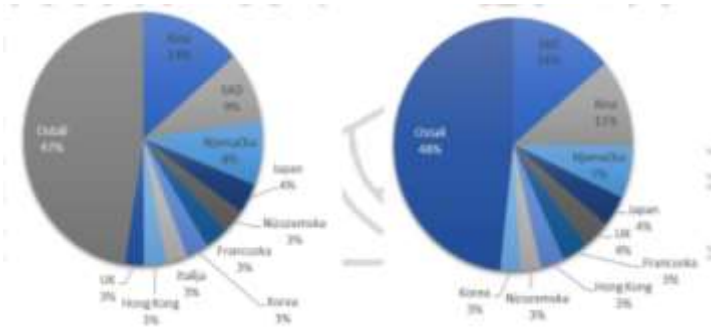
In 2019, China generated a nominal GDP of $ 14.34 trillion, ranking second behind the United States in the ranking of the world's most developed economic powers, generating $ 21.43 trillion (see Chart 1). China in 2019 realizes 13.71% of total world exports compared to the second-ranked US with a share of world exports of 9.02%. On the import side, the USA leads with a share of 13.95% in total world imports, in contrast to China, whose share is 11.24% (see Chart 2). While in the past China was considered a producer of low value-added products, today it acts in the supply chains of many top products. Over the years, China has established itself as the world's largest manufacturing hub for the production of raw materials and semi-finished products, or as the second strongest economy in the world, generating 60% of global exports of consumer goods and 41% of global exports of technology, media and communications. The literature cites large capital investments (financed by large domestic savings and foreign investment) and rapid productivity growth as key causes of China's rapid economic growth. Productivity growth is another key factor in China's rapid economic growth. Increased efficiency is the result of reallocating resources for more productive use, especially in sectors previously heavily controlled by the central government, such as agriculture, trade and services. Not to be overlooked is the fact that foreign direct investment in China has brought new technologies and processes that have contributed to efficiency gains.

Chart 1: 20 largest global economies in 2019 (nominal GDP in trillions of USD)

Source: Adapted to www.trendeconomy.com

It is possible to conclude that any slowdown in economic activity in China directly affects the global economy. Delays or disruptions in supply chains in China mean a reduction in production capacity and material output, which in turn affects exports and production opportunities in many other markets with which China cooperates. Given that China is the second largest global consumer. this fact represents an additional vulnerability for supply chains of which China is a stakeholder, as it is precisely China's reduced demand for certain goods that can result in complications and / or delays at many levels of the chain.

Graph 2: The most significant global exporters and importers in 2019 (share of global exports)



Source: Adapted to www.trendeconomy.com

Based on the above indicators and the fact that China and the USA are global economic rivals, a logical assumption arises that the relations between these two economic superpowers have been strained. Admittedly, we have witnessed growing tensions between the US and China in recent years. Tensions have been fueled by the introduction of punitive tariffs imposed by the United States in 2018. ordered the import of goods from China and Kineks countermeasures imposed on imports of goods from the United States. Huawei's listing on the U.S. List of Entities and issues in restricting trade practices with the U.S. further fueled the rift, while the outbreak of the Covid-19 virus pandemic in the Chinese city of Wuhan was an additional motive for the U.S. to criticize China. With June 2020. the Chinese security law for Hong Kong enters into force, which provides for penalties for separatist activities or interference by foreign forces. The United States immediately in July 2020. reacted by passing a law providing for the punishment of persons and institutions that extinguish the freedom of Hong Kong, and the property of these persons may be frozen in the United States and those persons may be barred from entering the United States. In addition, the United States has abolished Hong Kong's special trade status and treats it as part of China in terms of customs procedures and visa regime. China's reaction to this is reflected in the ban on entry to China for certain American politicians and through threats to tighten the visa regime for US citizens. How bilateral relations between the United States and China will develop remains to be seen in the coming period. It can be established with certainty that a trade war between these two global superpowers would have a great impact on the entire world economy, and especially on the possible formation of two world trade fronts and the reshuffling of the world economic order.

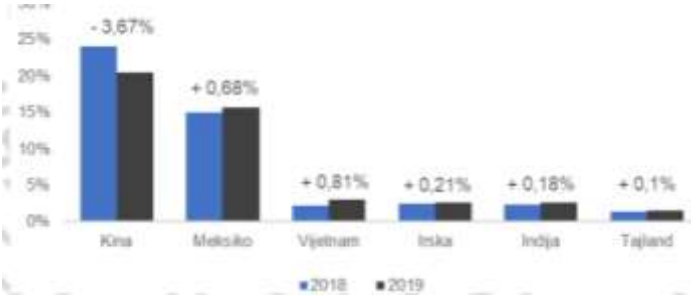
Drivers of change in global supply chains

Complex structures such as global supply chains respond dynamically to changes caused by economic and / or non-economic factors, to geopolitical tensions, and to changes in socio-economic values and norms. The global financial crisis in the period 2008-2009. it has mitigated the momentum of globalization. Globalization itself has encouraged economic inequalities in advanced economies, so many

governments have pursued protectionist policies in the form of the introduction of non-tariff barriers (quantitative restrictions, price restrictions, regulatory restrictions such as licensing, etc.). Increased levels of US-China tensions have heightened concerns among organizations and countries that are stakeholders in global supply chains. Declining production benefits in lower wage markets, increasing natural disasters (causing costly supply chain downtime), and the development of new disruptive technologies (which can simplify and shorten supply chains) have further encouraged global actors to reconsider their procurement strategies. . Reducing flexibility and calling into question the sustainability of supply chains, spurred by the Covid-19 crisis facing the world since early 2020, have certainly further accelerated the trend of declining globalization activities in supply chains. Fan, Holzheu, and Wong (2020) point out that it is very likely that global supply chains will undergo numerous transformations and restructurings of both the modus operandi and their very structure in the coming years.

Research conducted by experts from SwissRe, Fan, Holzheu and Wong (2020) provides five fundamental drivers for the accelerated restructuring of global supply chains: (1) reducing cost leadership, (2) increasing the level of political risks, (3) social values, 4) increase in costs caused by business disruptions and (5) development of new technologies. The development of new technologies such as Artificial Intelligence (AI), additive manufacturing, Machine Learning (ML) or advanced robotics are already transforming supply chains. A good overview of all levels of the supply chain is key to developing a resilient supply chain. When it comes to highly complex global supply networks, it is very difficult to determine all the data on suppliers in the depth of supply chains. Therefore, many organizations turn precisely to technology to support them in achieving chain transparency. The issue of China as a world economic power is closely related to the transformation of supply chains. One of the reasons why China has grown into the largest manufacturing hub over time is, among other things, its demographic dividend. When the level of working age population reached its peak and in 2011. began to decline, the Chinese government raised minimum wage levels to support income growth and boost consumption. At the same time, Southeast Asian countries with a better demographic dividend (Thailand, Malaysia, Vietnam, among others) profited in terms of labor costs. As a result, global supply chains began to expand into other ASEAN markets. The capacity of the above countries to attract foreign investment in the manufacturing sector has increased, in particular in terms of providing quality infrastructure for investors, raising logistics competencies and the availability of local suppliers. Increase in the level of political risks from 2018. further resulted in a decrease in China's market share in the US in 2019, while at the same time some other countries (e.g. Mexico, Vietnam, Thailand) increased their market shares there.

Graph 4. Imports to the USA 2018/2019 (share in total global imports)



Source: Adapted to www.trendeconomy.com

But while exports from China to the US declined, exports from China to other countries rose sharply, resulting in an increase in China's share of global exports by 0.8% in the 2017-2019 period. (see Charts 4 and 5). For example, China has lost market share in the U.S. semiconductor sector due to tariff barriers, but at the same time has established itself in the global semiconductor market to the detriment of traditional suppliers such as South Korea, Singapore and Taiwan, among others. Chinese exports,

therefore, are increasingly competing with products from more advanced industries such as South Korea, Germany, Japan, Singapore and Taiwan.

Graph 5. Exports from China 2018/2019 (share in total global exports)

Source: Adapted to www.trendeconomy.com

3. The impact of the Covid-19 pandemic on global supply chains

Supply chains have been created with the intention of making individual materials more easily accessible through channels of this type of integration. However, as the COVID-19 virus pandemic has shown, unexpected events can break this basic premise. Supply chains should therefore be flexible, dynamic, responsible and interconnected with the ecosystem and chain stakeholder processes. Lee and Wright (2020) point out that this requires transparency from the beginning to the end of the chain, accurate real-time information and decisive action — especially in escalating situations. As the COVID-19 pandemic erupted around the world, in early 2020. some states have declared closure measures to prevent the spread of the virus. This meant disruptions in global supply chains so that demand for many everyday products disappeared almost overnight, while demand for other (unexpected) products exploded, leading to supply constraints and shortages. Organizations face significant business and operational disruptions and challenges, from mitigating the effects of reduced / discontinued supply, through managing disruptions in relationships with suppliers to a number of barriers to meeting their own contractual obligations to customers. The realization of deliveries and the shock caused by the almost complete closure of the economy at the beginning of 2020 are becoming increasingly difficult. highlighted the many vulnerabilities of global supply chain management strategies. Although there were intentions to shorten supply chains even before the pandemic, the pandemic has forced many organizations to reconsider the ways in which their supply chains function extremely quickly. Thus, the pandemic is an accelerator of the already announced changes and an incentive to find innovative ways to achieve resilience to crisis situations and maximum efficiency at all levels of supply chains.

The BCI Institute from Great Britain spent 2020. a study of the impact of the Covid-19 pandemic on the functioning of supply chains in a sample of a total of 353 organizations from 77 countries and 19 different sectors. One of the conclusions made by Elliot (2020) is that 50.50% of the surveyed organizations were not ready for a pandemic outbreak. It also profiles the three most prominent streams of thinking of organizations operating within global supply chains: (1) those that fully want to revise and adjust their business strategies, (2) those that consider diversifying the supplier portfolio and reducing dependence on the Chinese market, and (3) those considering holding additional (safety) stocks in the future. The research also found that many organizations were faced with delays in the delivery of necessary raw materials or individual deliveries could not be realized at all, precisely because of the locations where individual suppliers produced certain products. Given that many countries are still facing some degree of restrictions due to the pandemic, this is also manifested through changes in demand. Elliot (2020) points out that almost half of organizations (48.9%) record a decrease in

customer demand, while a quarter of respondents (23.8%) recorded a significant drop in demand. However, it is significant that 18.2% of organizations point out that during the pandemic they recorded an increase in demand, while 14.7% of organizations recorded a significant increase in demand. Thus, for example, the organization Zoom (which offers a platform for video conferencing), in the period from February to April 2020. recorded revenue growth of 169% and a share price increase of 152% compared to 2019.

If the overall situation caused by the Covid-19 virus pandemic is generalized, the fact is that the majority of organizations directly exposed to the limitations of the pandemic have acted according to similar patterns of behavior. The transport of goods from the quarantined area to locations near trade hubs has been intensified, in order to facilitate the availability of goods for shipment. Demand for stocks of certain raw materials and intermediate goods increased significantly as these goods became more inaccessible. As a result, many organizations procured larger quantities of necessary raw materials in advance in order to ensure the smooth production of their products. Organizations have included additional suppliers in their supply chains where possible, especially in cases where key suppliers are located in areas where quarantine and closure measures have been imposed. In addition, stopping transit in many supply chains has manifested itself in disruptions and delays in various parts of the supply chain. According to Doerfler (2021), the average time of realization of transport of goods has increased many times over: 222% in China, 217% in Korea, 209% in Japan, 201% in Europe and 200% in the USA. In order to level oscillations of this type, it is necessary to set priorities and meet the urgent requirements of the market as much as possible within the "new normal". Thus, it is possible to profile the key challenges facing supply chains since the outbreak of the Covid-19 virus pandemic: closure and social distancing, restrictions on the movement of goods, changes in demand, and the increasing importance of e-commerce channels.

4. Strategic guidelines for supply chain competitiveness

In order to achieve a higher level of supply chain resilience, organizations should, following the above facts, focus on the following key areas in order to strengthen the competitive advantage of the supply chains in which they operate: defining structural risks, ensuring flexibility, achieving global transparency and rapid response and resolution. problems. Under these assumptions, it is possible to define key strategic guidelines for the successful creation of efficient global supply networks: (1) conducting reevaluation and diversification of supply strategies, (2) maintaining optimal inventory levels, and (3) using advanced technological solutions as tools for smart global supply modeling. network.

4.1. Reevaluation and diversification of supply strategies

Organizations should conduct a thorough assessment of their suppliers, partners and all supply chain stakeholders. Lee and Wright (2020) point out that special attention should be paid to determining the level of impact of potential risks that an individual organization can tolerate in relation to the level of operational flexibility it wants to achieve. Manufacturers in most industrial segments have created networks of their suppliers in recent years, starting primarily from the criteria of the level of specialization of suppliers. This meant ensuring a high level of flexibility in terms of the elements they incorporate into the final product, as well as the ability to integrate the latest technological solutions into these elements. However, the failure of such a supplier (which produces a key component or material for the final product somewhere deep within the supply chain structure) can cause many delays and disruptions in the final product manufacturing process, as well as the potential inability to deliver the final product to the customer. Willy and Shih

(2020) emphasize that the risk of not being able to deliver raw materials for the final product is even higher when a narrowly specialized supplier manufactures its product in only one plant or in only one country and / or region. In order to resort to the emergence of such risks, or to make organizations aware of them, they necessarily need to conduct a mapping of all their suppliers. Supplier mapping involves their identification, classification and categorization into low, medium or high risk suppliers. The supplier map of a global supply chain is extremely complex and, above all, opaque, given the various modalities of engagement of individual stakeholders. Therefore, the application of advanced information technologies is crucial for the targeted collection, processing and visualization of chain stakeholder data. High dependence on a single medium or high risk source can be reduced by adding multiple sources to sites that are not subject to the same types of risk. In recent years, more and more organizations are considering the "China + 1" strategy, ie avoiding investing exclusively in China and diversifying business into other markets. However, activating the "China + 1" strategy also carries certain difficulties, such as initiating business in new markets with new (unknown) legal frameworks and relocating business to multiple locations. Reducing the level of dependence on China will be easier with products such as clothing or furniture because this type of product is relatively easy to produce in some other locations as raw materials are generally readily available. It is more difficult to find adequate markets for the relocation of production facilities for sophisticated machinery, electronics and other goods containing high-tech components. To ensure the continuity of production of the latter products, it is necessary to find a location that, among other things, has adequate infrastructure, competent staff and a secured supply of necessary raw materials under competitive market conditions. The relocation of production capacities from China also calls into question the smooth functioning of logistics activities. The fact is that apart from China, the countries of Southeast Asia do not have enough competitive ports to perform maritime transport. Thus, relocating production capacity to other locations would certainly mean more transhipment through ports such as Singapore or Hong Kong and a longer transit time to the final market, which ultimately means an additional cost burden. On the other hand, the "China + 1" strategy for the Chinese economy has no negative connotations. On the contrary, the strategy does not mean reducing the number of plants or employees in the manufacturing sector in China, it only reduces their growth rate, and at the same time allows China to develop other economic sectors. China will thus be able to maintain the production of low value-added goods, but at the same time will be able to encourage sectors in which a high level of value added is generated. It is deep integrated supplier networks, an efficient and flexible workforce, highly efficient large trading ports and transport infrastructure that will give China a place among the leading global economies in the future, so in the long run it would be completely wrong to eliminate China from global supply chains.

4.2. Maintaining adequate levels of intermediate stocks or safety stocks

Organizations that do not have alternative suppliers in their portfolio as soon as the need arises, should define a plan of measures to ensure uninterrupted production until the engagement of alternative suppliers. This implies determining the required level of additional stocks, defining in what form it is necessary to keep these additional stocks and ultimately deciding where along the supply chain these stocks will be created. It should be borne in mind that the holding of safety stocks (especially for goods for which there is less demand or goods with shorter shelf life), carries a certain risk of obsolescence of stocks, but also the fact that stocks bind capital. This is certainly not in line with the principles of JIT and / or JIS delivery of goods and keeping stock levels low along the supply chain. But instructed by the latest developments caused by the Covid-19 pandemic, organizations should thoroughly examine the potential negative and positive

impacts on their business in order to maintain a successful business in the coming period of high risk. This specifically means that the savings that organizations would generate through holding minimum inventories need to be put in relation to all the costs that may result from the disruption. The costs that may result from disruptions must include lower revenues, higher prices that organizations should pay for materials that suddenly become unavailable, and certainly quantify the time and effort required to supply the necessary maintenance materials. continuity of goods.

4.4 Smart modeling of supply chains

The reevaluation and new configuration of the supplier portfolio requires an adequate review of the supply network, in order to be able to make concrete and informed decisions about changes in the constellation of supply chains. Therefore, organizations need to engage in smarter supply chain modeling, in order to be able to instantly but continuously assess the balance between lean business and mitigating potential risks. Technological progress and continuous innovation have enabled the availability of state-of-the-art technologies to wider economic structures, so that many organizations within global supply chains in recent years have been automating and computerizing large parts of their processes. The application of new technological advances allows organizations to minimize the level of production costs and guarantees a higher level of flexibility to produce more variants of the required product without affecting productivity. The outbreak of the Covid-19 pandemic has made the application of automation even more necessary, given that maintaining social distance is one of the fundamental measures in the fight against the spread of the pandemic. Precisely this kind of thinking encourages economic nationalization, ie the return of productive activities to their home countries, which are in turn highly developed economies with a higher level of costs. However, lower labor costs at remote locations are compensated precisely by the application of automated robotic solutions in the home countries, ie less required labor force with a higher level of process efficiency.

The application of artificial intelligence in supply chains enables numerous optimizations in terms of capacity planning, improving productivity, achieving top product quality, reducing costs and increasing production volumes. McSweeney (2020) points out that artificial intelligence is useful for processing supply chain information and allows people to better focus on control, management, and decision-making tasks. In addition, Chan et al. (2018) further point out that the application of 3D printing allows for rapid prototyping, easier product differentiation and the production of small series of orders without negative impacts on product quality. The application of 3D printing can simplify production processes and drastically reduce the number of suppliers required. Less mass production reduces the need for offshoring, while production can be realized very close to end customers. The application of 3D printing also allows for less workforce, which consequently means lower costs, bearing in mind the fact that human capital makes up a significant share of production costs. In addition to the above, the application of artificial intelligence contributes to the rapid planning of possible scenarios and provides inputs that increase the ability of supply chain creators to identify potential hazards and opportunities, and take appropriate measures to eliminate threats and make positive business decisions. Organizations can use artificial intelligence tools to transform unstructured data in real time into knowledge that helps predict interference and vulnerabilities For success in today's global, rapidly changing environment, it is the timely availability of information that is crucial for making adequate business decisions. Thus, organizations should implement data exchange platforms with stakeholders of their supply chains so that strategic partners are able to cooperate and understand the impact of potential risks and disruptions along the supply chain. Tools such as integrated control towers (CTs) can

provide complete transparency of different flows within the supply chain. Control towers are not physical objects, but centralized hubs that contain all the technology, organizational tools, and processes needed to collect data from all levels and stages of the supply chain from supplier to end customer. The benefit of the control tower is that it can be used to collect and analyze data in real time and make informed decisions about stocks, production needs and storage centers to alleviate uncertainties, all with a high level of accuracy and efficiency. Combining the potential of a control tower with connected IoT tools, artificial intelligence and blockchain technology, allows organizations to see where their products are around the world, in real time. This helps not only to anticipate possible vulnerabilities and disorders, but also to understand their impacts, thus enabling a faster response if needed. Lee and Wright (2020) point out that data exchange platforms, such as control towers, help strategic partners quickly come together to detect, understand, and address the impacts of disruptions in their shared supply chains.

CONCLUSION

Radically changing the existing supply chain is not as easy as it may sound, as creating a solid and secure chain will still need to balance the demands for economy. The primary challenge posed by the pandemic to logistics operations is certainly the question of how to maintain the level of service to end customers, taking into account the new safety and health requirements of social distancing. The impact of the pandemic and the impact of urgently defined measures to ensure business continuity, trade and economic flows will only be visible over time, but today it is necessary to take measures to build a smarter global supply chain, extremely flexible and resistant to risks and contingencies. In any case, future-oriented organizations will recognize and take advantage of the available advanced technological advances in order to be able to resort to a general shift from unforeseen to possible business scenarios.

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