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AUTOMOTIVE SUPPLY CHAIN DISRUPTIONS CAUSED BY CRISIS IN UKRAINE

Abstract

The aim of the work is to analyze the functioning of supply chains in the automotive industry in the conditions of the crisis caused by the war in Ukraine.

First of all, the theoretical foundations are set, through defining the concept and importance of supply chains, determining the goals of chain management and the difference between traditional and modern supply chains. Then, the economic impact of the crisis in Ukraine on the entire world economy is observed, by analyzing macroeconomic indicators, global consequences, but also the impact on the two main parties in the conflict - the Russian Federation and Ukraine. Finally, the analysis of supply chains in the automotive industry in the period of crisis is approached, through presenting the current situation, defining risks and predicting the future of supply chains in this industry.

Key words: *supply chains, crisis in Ukraine, automotive industry, global crisis, economy*

JEL classification: *H56, L62, R41*

ПРЕКИДИ ЛАНАЦА СНАБДЕВАЊА У АУТОМОБИЛСКОЈ ИНДУСТРИЈИ ИЗАЗВАНИ КРИЗОМ У УКРАЈИНИ

Апстракт

Циљ рада је да се анализира функционисање ланаца снабдевања у аутомобилској индустрији у условима кризе изазване ратом у Украјини.

Најпре се постављају теоријске основе, кроз дефинисање појма и значаја ланаца снабдевања, одређивање циљева начина управљања ланцима и разлици између традиционалних и савремених ланаца снабдевања. Затим се посматра економски утицај кризе у Украјини на целокупну светску економију, анализом макроекономских показатеља, глобалних последица али и утицаја на две главне стране у сукобу - Руску Федерацију и Украјину. Коначно, приступа се анализи ланаца снабдевања у аутомобилској индустрији у

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периоду кризе, кроз презентовање тренутне ситуације, дефинисање ризика и предвиђање будућност ланаца снабдевања у овој индустрији.

Кључне речи: ланци снабдевања, криза у Украјини, аутомобилска индустрија, глобална криза, економија

Introduction

Supply chains attract the attention of a large number of theorists and practitioners in the field of economics. There are different definitions of this term. Among all of them, they have certain common characteristics that are just formulated in a different way.

Technological developments have enabled national and global supply chains to contribute to economic development, job creation, poverty reduction, and increased cooperation and interdependence. Supply chains play a key role in delivering raw materials or materials to end consumers. (Retrieved December 12, 2022 from <https://www.ilo.org/global/topics/suppli-chains-previev/lang--en/indek.htm>). The escalation of the crisis in Ukraine, which started back in 2013, caused disruptions and interruptions in supply chains in all sectors of the economy. The Russian Federation and Ukraine are large producers of food, but also suppliers of energy, as well as certain raw materials such as palladium, aluminum, argon, neon and many others. The introduction of sanctions against the Russian Federation, the suspension of imports and exports, the closure of many ports and the restriction of air traffic, led to a shortage of the above-mentioned components and an increase in their prices, especially in Europe. This was followed by a double-digit increase in inflation, with a tendency for it to increase. (Retrieved December 19, 2022, from <https://www.economicsobservatory.com/what-would-be-the-economic-consequences-of-a-military-stalemate-in-ukraine>).

The crisis in Ukraine also affected the European automobile industry, which produces more than one fifth of the total cars produced in the world. As the Russian Federation and Ukraine are large and significant suppliers of auto parts, supply chain disruptions have slowed down or completely stopped their supply, making it difficult to manufacture cars in European countries. Also, sooner or later, all European car companies withdrew from the Russian market, as a sign of protest, and as a result suffered great losses. This made it easier for Chinese car manufacturers to enter the market of the Russian Federation. (Retrieved December 12, 2022, from <https://www.businesswire.com/news/home/20221202005447/en/Russo-Ukrainian-War-and-its-Effects-on-the-Global-Automotive-Industry-Worsening-Supply-of-Raw-Materials-Semiconductor-Chips-EV-Batteries-would-Lead-to-1-Million-Fewer-Vehicles-Produced-Worldwide---ResearchAndMarkets.com>).

After the introductory considerations, in the first part of the paper, entitled *Concept of Supply Chains*, terms related to supply chains are identified and the goals and methods of supply chain management are defined.

In the second part of the paper, entitled *Economic impact of the crisis in Ukraine on global business*, the impact of the crisis on macroeconomic indicators of countries is analyzed. Then the effects of the crisis on the warring parties and its global consequences are elaborated.

In the third part of the paper, entitled *Supply chains in the automotive industry during the crisis period in Ukraine*, the subject of analysis is the companies that left the market of the Russian Federation as well as the Chinese companies that took their place.

European companies from the field of the automotive industry suffered the most damage, due to the withdrawal from the market of the Russian Federation, which was taken advantage of primarily by Chinese companies. Finally, supply chain risks and perspectives are discussed.

The concept of supply chains

If viewed from a historical perspective, the term “logistics” comes from the Greek word “logistikos”, which means “art of calculation”. Over time, the term began to be associated with the military activities of supplying troops located at the front with ammunition and all means. In the 1960s, logistics became a quantitative science to which an engineering perspective was added. From the 1970s to the 1990s, efforts were made to shorten transit times in order to reduce overall costs. Since the 1990s, the focus has been on improving quality as a means of differentiating the offer. Also, in addition to the application of information technologies, we strive to establish good relations with suppliers and end consumers. At that time, there is a merger of organizations, in order to increase market share and achieve higher sales. Then the supply chain comes into play. (Milovanović, Barac & Anđelković, 2011).

Supply chains attract the attention of a large number of authors, which contributes to the creation of a large number of works on the same topic. There are different definitions and determinations of supply chains, where each of the authors, based on the most important characteristics, defines the term. Regardless of the differences, we can say that the supply chain is a network of organizations that performs the activities assigned to it in order to create value for the end consumer. (Mitrović & Mitrović, 2019).

In modern business, supply chains face numerous challenges. First, a potential lack of transparency can jeopardize the business of a party that does not have enough information that is being withheld from it. Second, an inadequately optimized production process increases the total amount of waste on a global level, as well as inventory. Third, the disappearance of goods causes consumer dissatisfaction. Fourth, the increase in customer demands increases the chances that the supply chain will not be able to keep up with all the demands and novelties that exist from day to day. Due to all the challenges, it is suggested that the supply chain strives to increase flexibility and minimize inventory losses, to devote its time to improving relations with customers and suppliers, to shorten the cycle from procurement to final delivery and to be familiar with the latest technology in order to be able to apply it. (Retrieved December 22, 2022, from <https://www.techtarget.com/whatis/definition/supply-chain>). Modern supply chains are also subject to an increasing degree of risk. Such vulnerability makes it difficult to manage and is a challenge for companies that should create awareness about this problem, to identify the source of risk as well as strategies to reduce it. (Barac, Milovanović & Anđelković, 2011). In order to improve business performance, it is necessary to effectively manage supply chain risk. (Milovanović, Milovanović & Popović, 2018).

Supply chains involve a large number of participants, usually three or more. Manufacturers, suppliers, wholesalers, retailers, buyers are just some of the participants in supply chains. When buying any product, the customer usually does not buy directly from its manufacturer, but through an intermediary. (Felea1 & Albăstroi, 2013). The mentioned entities join together, because it provides a large number of advantages for each of them individually. The association of subjects in supply chains enables reduction of total costs and increase of: efficiency, exchange of knowledge, rate of innovation and performance. (Arora & Brintrup, 2021).

By introducing the conveyor belt, Henry Ford aimed to produce as many products as possible and to reduce costs per unit of product. The purpose of the conveyor belt is to perform all activities on it, thus eliminating the need to provide a separate machine for each activity. This logic can also be applied to the supply chain. The main goal of the supply chain is the creation of greater value through mutual cooperation compared to the one that would be obtained if all entities functioned independently. The total value of the supply chain, which will be created, depends on all the individual values realized by each of its members. The greater the degree of integration between the members, the greater the value will be realized. (Aćimović, 2018).

In order to improve the efficiency of supply chain management, vertical integration can be used to reduce costs, increase business efficiency and improve competitive activity through cooperation and efficiency. Each member of the supply chain has the freedom to define its own supply system, except in cases where there is a clear intention to restrict other members or through a conscious enhancement of its own domestic product. (Končar, Marić & Vukmirović, 2018).

When managing the supply chain, the main focus is on the satisfaction of the end consumers, which means that the supply chain should be managed in such a way as to achieve consumer satisfaction. In order to create an insight into the fulfillment of the main objective of supply chain management, success measurement is carried out, which aims to show the level of success and, if necessary, to enable the performance of corrective actions if there are deviations. (Putri, Huda, Sinulingga, 2019). Good supply chain management is imperative today. Consumer demands are increasing and any, even minimal delays in product delivery can cost the entire supply chain dearly. It is necessary that all activities are coordinated, that there is good communication and coordination between members, so that unforeseen situations do not occur and that consumers are satisfied with the offered products or services. (Kleab, 2017).

Today, the Internet is used more and more for communication and business. Due to this fact, the need to protect supply chains from cyber attacks and hacking is growing. (Retrieved December 23, 2022, from <https://www.ibm.com/topics/supply-chain-management>).

The economic impact of the crisis in Ukraine on global business

The beginning of the crisis in Ukraine is not related to 2014 or 2022. This crisis officially manifested itself for the first time in 2014, but it was preceded by several years of tensions. First, in 1991, a new nation state was created. Second, over time, Ukraine has isolated itself from economic blocs and collective security organizations. Third, the

rivalry between Russian and European imperialism followed. Fourth, the strengthening of Russian influence was manifested while the weakening of European influence. The property of Ukraine was gradually transferred into the hands of a few people, who began to manage it for private and personal benefit. (Retrieved December 23, 2022, from <https://commons.com.ua/ru/prichini-ukrayinskoyi-krizi/>).

In November 2013, the President of Ukraine Viktor Yanukovich (Viktor Yanukovich) abruptly stopped the preparations to start the process of joining Ukraine to the European union. In December 2013, large protests broke out in Ukraine, during which, as well as in those in the first quarter of 2014, there were deaths. Pressure from Europe led to the overthrow of the president of Ukraine and his departure to the Russian Federation. After sending troops from the Russian Federation to Crimea, a referendum was held in Ukraine, in which it was voted that Crimea should join the Russian Federation. The holding of elections and the appointment of Vladimir Zelensky (Vladimir Zelenskij) as the head of state by Europe, the approach of NATO troops to the Russian Federation and the improvement of its security, as well as the poor life of people in Ukraine, led to the crisis we are witnessing today. (Retrieved December 23, 2022, from <https://roem.ru/03-03-2022/287520/mirshmaier-ukraine/>).

The crisis in Ukraine has affected not only the parties in conflict, the Russian Federation and Ukraine, but also the whole world. In the countries of Europe (primarily in the countries of the European union), there was a decrease in GDP and an increase in inflation above all planned limits. Unlike Europe, some Asian countries are experiencing high growth (they are expected to achieve almost three quarters of global GDP growth). Saudi Arabia recorded the most significant growth in Asia. For 2022, GDP growth of 9.8% compared to 2021 (base year) was predicted. In 2023, GDP growth of 5% and 3.5% in 2024 is expected. The expected growth in India is 5.7% in 2023 and 6.9% in 2024. Japan is projected to achieve positive growth rates in 2023 and 2024. In 2022, China achieved GDP growth of 3.3% compared to the previous year. For 2023, a growth of 4.6% compared to 2022 is predicted, as well as a growth of 4.1% in 2024 compared to the previous year. High growth rates were also predicted for Indonesia in 2022. growth of 5.3%, while for 2023. predicts growth of 4.7% and in 2024. growth of 5.1%. Unlike Asian countries, the situation in Europe is completely different. It was also predicted that in 2022 FR Germany would achieve growth of only 1.8%, while for 2023. predicts that GDP will fall by 0.3%. A slight recovery or continuation of bad results is also predicted for 2024, where growth of only 1.5% is predicted. Although the public is talking about the profiteering of the United States of America, the data show, at least those related to GDP, that in 2022. The United States of America will achieve a growth of only 1.8% of GDP, in 2023 a growth of 0.5% and in 2024 a growth of 1%. For the Russian Federation, it was predicted that in 2022. achieve a drop of 3.9%, while a drop of as much as 5.6% is expected in 2023 and a slight drop of 0.2% in 2024. When it comes to inflation, the inflation rate is high all over the world. It was also predicted that the highest values will be recorded in 2022, while over the next two years, the situation will gradually stabilize, which should lead to a drop in inflation. In FR Germany, the predicted inflation for 2022 was 8.48%, while forecasts for 2023 indicate that it will amount to 8% and in 2024 to 3.34%. The situation is similar in other European union countries. In the United States, inflation is at a lower level than in Europe. It is predicted that it will amount to 3.52% in 2023 and 2.57% in 2024. Again, as when talking about GDP, Asian countries record low

inflation rates. In Saudi Arabia, inflation of only 2.6% was predicted in 2022, 3.2% is the forecast inflation level for 2023 and 2.3% for 2024. The situation is the same with Japan: 2.3% in 2022, 1.97% in 2023 and 1.67% in 2024. (Retrieved December 24, 2023, from <https://www.oecd.org/economic-outlook/november-2022/>).

The great energy dependence of the European union on gas from the Russian Federation can be confirmed by the fact that in 2019 the import of oil and gas amounted to 200 billion euros. Due to the introduction of sanctions by the European union, it will have to increase imports from alternative suppliers by as much as 70%, which is a very expensive option in the short term. Before finding substitutes, they need to be at an acceptable price, which is not often the case in times of crisis. Before the crisis in Ukraine, the European union was affected by the consequences of the Covid-19 virus pandemic, as shown by the reports of the European Central Bank. The Russian Federation is also feeling the effects. Companies from this country have a lower value on the stock market, the value of the ruble has fallen, inflation has increased, the funds of Russian banks have been frozen and imports are limited. However, this segment, which refers to imports, was compensated by the support of Asian countries. (Khudaykulov & Obrenović, 2022).

The pandemic caused by the Covid-19 virus has led to the disruption of global economies and the instability of the global market. The pandemic has not yet ended, when a new crisis is emerging caused by the war in Ukraine. This pushed the unrecovered economies into a new crisis, where the consequences of the previous one were still present. Although the pandemic did not end with the start of the war, it gave the impression that it did. The war became the center of interest all over the world. Although the war concerns two countries - the Russian Federation and Ukraine, as two Orthodox countries, countries around the world got involved in the war and chose sides in the war, who to help and who to harm and stop the action. According to estimates by the International Monetary Fund (IMF), global growth is predicted for 2022. from 4.4% to 4.9% compared to 2021. However, the optimistic predictions that existed were erased by the crisis. If we look at Ukraine, since the period of more intense crisis in 2013. until 2017. there is a drop in GDP by as much as 15.1%. After the start of the war, many European countries imposed sanctions on the Russian Federation, which included blocking Russian banks from using the "SWIFT" system, suspending the certification of the Nord Stream 2 gas pipeline by Germany, New Zealand banning the source of goods to the Russian military, The United States of America banned the export of military technology, the European union introduced financial sanctions, the export of aircraft and equipment, then made it more difficult for banks to operate, canceled the visas of well-known Russian citizens, who are most often referred to as diplomats, who will not be able to travel to European countries under preferential conditions Union, Canada revoked export permits, Switzerland and Japan freeze Russian assets held in their banks, Australia imposed a travel ban. Finland, Belgium, Latvia, Ireland, Estonia, Lithuania, Poland, Bulgaria, Moldova, Romania, Slovenia and the Czech Republic have banned Russian planes from flying through their airspace, while Great Britain also introduced financial and other sanctions. On the one hand, there are sanctions aimed at the Russian Federation, while on the other hand there is aid directed to Ukraine - from humanitarian aid in the form of food, to the most modern combat equipment. The Russian Federation responded to the sanctions by: banning the export of over 200 products until the end of 2022, increasing interest rates to stop the fall of the Russian ruble, banning interest payments to foreign investors who own Russian

government bonds, and many others. This can harm the Russian Federation itself, which has warned of the possibility of introducing countersanctions if the situation does not change in favor of the Russian Federation regarding the sanctions introduced against it. From the beginning of the crisis until today, there has been no change, nor the end of the war. Long-term consequences for both countries and the whole world are predicted. (Ozili, 2022).

It is expected that the costs of sanctions against the Russian Federation will be compensated through higher energy prices, however inflation forecasts for 2022. they say that it is estimated at more than 20%. Also, there are negative predictions related to the movement of GDP and other macroeconomic indicators. (Retrieved December 25, 2022, from <https://www.niesr.ac.uk/publications/economic-costs-russia-ukraine-conflict?type=policy-papers>).

Although the share of the Russian Federation and Ukraine in the total global production and trade is relatively small, they are significant suppliers of basic foodstuffs and energy. In 2019, if we look at aggregate exports, they recorded 25% of wheat exports, 15% of barley exports and 45% of sunflower exports from the total exports of the aforementioned foods to the world. When it comes to energy sources, the Russian Federation meets 1/5 of the world's total demand for natural gas. The Russian Federation, in addition to supplying the aforementioned raw materials and energy, is a large and significant supplier of palladium and rhodium, which are key to automobile production. (- Retrieved December 26, 2022, from https://www.wto.org/english/news_e/news22_e/devl_08apr22_e.htm).

The Russian Federation and Ukraine are also major suppliers of internal gases, such as argon and neon, which are key to semiconductor production. Titanium sponge, which is produced in these two countries, is crucial for the production of airplanes. Uranium, in addition to those mentioned above, is important for world production, and the largest source is found in the two warring parties. With the beginning of the conflict, the price of all these cheeses rose significantly, which consequently led to an increase in the prices of the products in which they are found, along with their difficult procurement. Monetary policies around the world raise interest rates by slightly more than 1 percentage point in developed countries, while in developing countries the increase goes up to 1 and ½ percentage points, with constant control and application of timely measures. (Retrieved December 27, 2022, from <https://www.oecd-ilibrary.org/sites/4181d61b-en/index.html?itemId=/content/publication/4181d61b-en>).

The crisis in Ukraine has affected different parts of the world in different ways. By far the biggest negative effect is recorded in Europe, especially in the European union. According to forecasts of the European Commission (EC), the impact of Covid-19, the slowdown of supply chains and the rise in energy prices could have the effect of flattening the economic growth curve for all countries of the European union that use the euro as their currency to 4%. (Endam Mbah & Wasum, 2022).

If we look at Africa, Egypt is highly dependent on the import of wheat from the Russian Federation and Ukraine, because it imports 80% of wheat from the mentioned countries to meet its own needs. Also, the negative effects will be reflected in tourism. In Latin America, inflation above 8% is recorded, and the highest in: Brazil, Mexico, Chile, Costa Rica and Peru. Higher oil prices hurt importers from Central America and the Caribbean, while exporters of oil, copper, iron ore, corn, wheat and metals can

charge more for their products and thus cushion the impact on growth. However, unlike all the other parts of the world, where the crisis spread, the least damage is related to the countries of Asia, precisely because of the small trade cooperation between the countries in conflict and Asian countries. Possible pressures on food prices are mitigated by encouraging domestic production and greater reliance on rice compared to wheat. (Retrieved December 28, 2022, from <https://www.imf.org/en/Blogs/Articles/2022/03/15/blog-how-war-in-ukraine-is-reverberating-across-worlds-regions-031522>).

Supply chains in the automotive industry during the crisis period in Ukraine

The Covid-19 pandemic has disrupted supply chains in the automotive industry. A shortage of semiconductors and parts during that period was a reality facing the automotive industry. However, it was expected that this situation would be resolved with the end of the pandemic. However, hardly anyone could have guessed that the recovery of supply chains in this industry would be more difficult compared to the forecasts at the time. Ukraine is among the world's largest suppliers of cables used in the production of automobiles. With the emergence of the crisis in Ukraine, supplies from Ukraine to other parts of Europe became much more difficult. The German automobile industry was particularly affected, where before the crises the supply was relatively simple, especially from Western Ukraine. Today, the supply is difficult, which has a negative effect on the car product. In addition to cables, Ukraine and the Russian Federation are large sources of other rare elements such as neon and palladium. Neon gas is used to manufacture microchips. Palladium is used as a catalytic element for the production of microchips. Also, nickel and cobalt, as the two main raw materials used for the production of car batteries, will be in smaller quantities in other European countries. Due to the imposed sanctions on the Russian Federation, the price of these elements will inevitably increase. According to some estimates, that increase will be at least 20%, which will significantly increase the price of electric cars. With the introduction of sanctions against the Russian Federation and the departure of companies from this country, there was a decrease in income. Its market is the world's largest car market. Annual sales for years past exceeded 1.5 million sales. A large number of companies left this country (Volkswagen, Ford, Toyota, General Motors, Honda, Bentley, Nissan, Porsche, Jaguar, Ferrari), as well as a large number of component manufacturers (Continental, Magna, Aptiv, Leoni). However, Renault (Renault Group), as the largest car seller in this country, did not withdraw its production. Škoda joins the list of companies from Europe that have kept their production, with its two factories. The departure of most European companies, on the other hand, opened the market for the entry of Chinese original equipment manufacturers. In this way, China has seen its opportunities that it wants to use, which will achieve a large participation in a large market. Observed according to car brands, in 2021, as stated above, Renault had the largest share in the Russian Federation (32.1% share in total sales), followed by Hyundai with a share of 22.7%, Volkswagen (Volkswagen), 12.3%, Toyota (Toyota), 7%, Gaz (Gaz), 3.4%, BMW (BMW), 3% and others with a share of 19.6%. The situation changed dramatically with the exit of the aforementioned companies, except for Renault, and the entry of Chinese automobile companies. (Retrieved January 3, 2023, from <https://www.counterpointresearch.com/ukraine-crisis-reco-automotive-recovery>).

With the emergence of the crisis in Ukraine, due to the introduction of sanctions and the increased risk for doing business in the war-torn territory, some car companies either temporarily or completely and permanently stopped the production process in the Russian Federation and withdrew from the market. Toyota has closed its factory in St. Petersburg. The American giant Ford has stopped and suspended its “joint venture” with the Russian automobile company “Sollers OJSC”. Hyundai has also halted production at its plant in the Russian Federation. However, they were among those who hope that the closure will last as short as possible and that they will be able to resume business soon. Analyzes show that, according to current information, the damage to the entire sector of the automotive industry at the global level could be reduced sales by about 1.5 million cars annually. Toyota also shut down its production due to the inability to obtain parts. (Retrieved January 6, 2023, from <file:///C:/Users/korisnik/Downloads/Ukraine%20War%20Plunges%20Auto%20Makers%20Into%20New%20Supply-Chain%20Crisis%20-%20WSJ.pdf>).

When it comes to Renault, it is the biggest European giant in the market of the Russian Federation. According to the volume of sales, the Russian Federation is the second most important market after the native France, with more than 482,000 vehicles sold in 2021. Also, it owns a large number of subsidiaries in this country where over 200,000 people are employed. Renault is also the largest shareholder in Avtovaz (Avtovaz), with a 67% stake in the share capital, the main producer of Lada vehicles in the Russian Federation. Avtovaza’s production facilities are dependent on imported parts from Western Europe, which undoubtedly affects the slowdown in production and sales. The automotive group, which includes 14 brands, the largest of which are Peugeot (Peugeot), Citroen (Citroen) and Fiat (Fiat), has ended the import and export of vehicles from the Russian Federation, but with the retention of production in Kaluga (Kaluga) north of Moscow. Production has continued in this city and is intended only for the market of the Russian Federation. At the end of 2022 and this brand is leaving the Russian market. (Retrieved January 6, 2023, from <https://www.sneci.com/blog/situation-in-ukraine-consequences-for-the-automotive-industry/>).

Unlike most companies from Europe, on the other hand, there is an increase in the sales of Chinese companies, which currently make up 1/3 of the car sales market in the Russian Federation. Sales of the three main Chinese brands (Haval, Chery and Geely) increased by almost double to 16,138 units in November 2022, in contrast to January and the pre-crisis period when it amounted to 8,235 units sold. The market share also increased to 31.3% from 9.6% according to the analyzes of the Russian analytical agency Autostat (Autostat). The market share of Chinese automobile companies in 2022, observed by month. by month, it moved as follows: January (9.6%), February (9.4%), March (9.6%), April (12.6%), May (16.9%), June (21%), July (24.3%), August (25.9%), September (27%), October (29.5%), November (31.3%). For the first 10 months analyzed, the Russian Federation was China’s 6th export market when it comes to the automotive industry. (Retrieved January 7, 2023, from <https://www.reuters.com/business/autos-transportation/chinese-grab-russian-car-market-share-after-western-rivals-depart-2022-12-08/>).

The number of Chinese car showrooms in 2022. increased by almost 300 new stores, so their total number is 936. Only in the period July-November 2022. as many as 185 new salons were opened (leading among them with 48 stores opened is the Exeed

brand). Among the brands that did not enter the top ten, we should mention Voyah, Skywell and GAC, which opened a single-digit number of salons, but their potential for growth and expansion is noticeable. (Retrieved January 7, 2023, from <https://www.russia-briefing.com/news/chinese-auto-dealers-take-over-eu-exited-russian-market.html/>).

Statistically speaking, in 2021. for the first time, Chinese car exports exceeded 2 million units, accounting for 7.7% of total Chinese car sales according to the China Association of Automotive Manufacturers (CAAM). Of that number, sales in the Russian Federation amounted to 117,700 units, which is twice as much compared to 2020. The situation in 2022 was favorable for Chinese companies, as shown above, which had an even greater impact on increasing sales and gaining an ever-increasing market share. (Retrieved January 9, 2023, from <https://carnewschina.com/2022/03/04/russo-ukrainian-wars-impact-on-chinese-car-companies/>).

Of over 60 automotive brands that operated in the Russian Federation, due to sanctions and difficulties in obtaining raw materials, in 2022. there are only 14 brands left, 3 domestic and 11 Chinese. Three smokers (Lada, GAZ and UAZ) and Chinese brands (Chery, Geely, Haval, Jac, Faw, Dongfeng, Changan, Exeed, Gac, Foton, Omoda). (- Retrieved January 10, 2023, from <https://intellinews.com/only-11-foreign-car-brands-left-in-russia-out-of-60-before-the-war-265282/>).

Great Wall Motor's subsidiary, Haval (Haval), is unique in that it is the first Chinese car manufacturer to sign a special agreement with the Russian Ministry of Industry and Trade. According to him, it is predicted that the investment will amount to 42.4 billion Russian rubles (\$650 million), which is intended for the expansion of the car factory that was opened in Uzlovaya. (<https://www.automotivemanufacturingsolutions.com/assembly/chinese-carmaker-haval-signs-a-major-investment-contract-in-russia/41210.article> - Retrieved 11/01/2023). Its plan is to localize more than 80% of Russian car production in the next 6 years. Until August 2022. 2000 jobs were created. The plan is to open another 4,000 in the future. The production capacity of the factory in the first phase is 80,000 cars per year, while the planned production capacity for the future is 150,000 cars per year. (Retrieved January 12, 2023, from <https://interfax.com/newsroom/top-stories/82405/>).

As for production in the Russian Federation by German car companies, in 2021. 170,000 were produced for the Russian market. (<https://www.reuters.com/business/autos-transportation/german-carmakers-warn-fallout-ukraine-invasion-production-get-worse-2022-03-02/> - Retrieved 15/01/2023) . Immediately after the beginning of the crisis, it hit the factories of Volkswagen (Volkswagen) both in Germany and in Eastern Europe. He stopped his production facilities in the city of Zwickau (Zwickau) in eastern Germany where electric cars are produced primarily for the market of the United States of America. Also in the city of Wolfsburg (Wolfsburg) there are difficulties and interruptions in production. Furthermore, Porsche, which is owned by the Volkswagen company, stopped its production in Leipzig, where the famous Panamera and Macan models are produced. (Panamera and Macan). In this way, the delivery of the same to fans of these models around the world is slowed down. (Retrieved January 18, 2023, from <file:///C:/Users/korisnik/Downloads/Ukraine%20War%20Plunges%20Auto%20Makers%20Into%20New%20Supply-Chain%20Crisis%20-%20WSJ.pdf>).

This company locates an increasing number of production plants in the United States of America, but also in China, on whose market they particularly focus. In 2022,

the participation of this company was recorded at 16% in the total market share of China, which it intends to increase in the coming period. The management of Volkswagen believes that there is little chance of a possible conflict between China and Taiwan, which would negatively affect the position of their company. In Western Europe, the production of Volkswagen is in 2022. significantly reduced, primarily due to the lack of parts and the slowdown in their production. One of the major suppliers, Leoni, suspended the production of wire belts from the beginning of the crisis until the first half of 2022. in Ukraine, which was directly reflected in the reduction of car production during the period of production interruption. (<https://europe.autonews.com/automakers/vw-shifts-output-north-america-china-ukraine-war-dampens-outlook> - Retrieved 15/12/2023). In the second half of 2022, Leoni continued its production in Western Ukraine. Changes in the way of work followed, which adapted to the current situation. (Retrieved February 15, 2023, from <https://europe.autonews.com/suppliers/leoni-says-ukraine-output-wire-harnesses-nearly-prewar-levels>).

Due to the crisis in Ukraine, BMW produced 6,500 fewer vehicles in the city of Dingolfing. The number of cars produced also decreased in Munich. Bottlenecks in the production of microchips affected the reduction of production. However, despite this fact, the sale of BMW cars in the USA and in the period of crisis (specifically in the first quarter of 2022) increased by 3.2%. (Retrieved January 20, 2023, from <https://www.bmwblog.com/2022/04/02/bmw-march-production-loss-ukraine-war/>).

In order to reduce the consumption and use of natural gas, which is in short supply, Mercedes has started switching to electric and other energy sources in order to solve the problem and continue production at full capacity. The German government has launched a plan for crisis management and rational management of gas consumption. The construction of a wind farm is also planned, which would provide 85% of electricity needs. An agreement was also signed for the use of facilities on the Baltic Sea, as an additional source of supply. In addition to leaving the Russian Federation, not all German-made brands currently export cars to the mentioned country. (<https://europe.autonews.com/automakers/mercedes-forced-cut-shifts-european-plants> - Retrieved 22 /01/2023).

Mercedes left the Russian market relatively recently, if its production in the Russian Federation is observed (8 months after the beginning of the war). (Retrieved January 25, 2023, from <https://www.cbsnews.com/news/ford-mercedes-benz-russia-ukraine-exit/>).

Based on the above, the current situation in the world is very bad when it comes to supply chains. The Ukrainian sea is closed, which means the blockade of a large number of ships. The areas around the Black Sea and the Azores are congested and there is no possibility of easy transportation. Ports in the cities of Odessa and Mariupol (Odessa, Mariupol) are often closed. In addition to water transport, a similar situation exists in air transport. The problem of finding alternative suppliers outside Eastern Europe can be clearly seen in the example of neon gas, which in order to be used must be purified to 99.9% purity, a complex and time-consuming process that only a few companies in Europe can carry out, outside Odessa where its largest production is located. Russian and Ukrainian seafarers make up 14.5% of the world's total shipping workforce. As the Russian Federation is excluded from the "SWIFT" system, there is a problem of paying workers, in addition to the discouragement that exists in terms of business security. The Russian Federation can be said to be the "gas station" of the world. When it closes, Europe finds itself in a big problem, bearing in mind that it is supplied with about 40% of its natural gas and about 25% of its oil from the Russian Federation. (Nguyen H. et al, 2022).

The pressures and sanctions from the European union and the United States of America did not start in 2022. already much earlier, even before the 2014 crisis. The Russian Federation today, as a countermeasure, states the possibility of introducing the Russian ruble as a means of payment for all goods traded with the Russian Federation, which will strengthen it while rival currencies will be constantly and continuously devalued. Such a situation would only have a more unfavorable effect on the countries from which the sanctions were imposed. (Retrieved January 27, 2023, from <https://www.just-auto.com/features/ukraine-auto-market-impact/>).

The current situation requires the necessity of creating alternative sources of supply, the so-called “supplier B” and even “supplier C”. In this way, by increasing the number of possible suppliers and not relying on only one supply source, the likelihood of supply chain disruptions and delays that increase the price of transported goods will be reduced. In addition, a greater reliance on local rather than distant suppliers is recommended. (Retrieved January 29, 2023, from <https://www.cips.org/supply-management/opinion/2022/july/ukraine-war-battling-with-supply-chain-disruption/>).

Conclusion

Supply chains represent a topic that occupies the attention of a large number of scientists. They define them in different ways while maintaining the same meaning, so they can be understood as the process of delivering raw materials and materials to end consumers. In order for supply chains to function effectively, it is necessary to adequately manage the entire flow of goods, from procurement, through production to final delivery.

With the development of the crisis in Ukraine, there was a deterioration of macroeconomic indicators around the world, especially in Europe. There is a decrease in GDP as well as an increase in inflation. Living standards are decreasing, which is causing protests across European countries. The European union is suffering great damage, primarily due to the introduction of sanctions against the Russian Federation and the inability to supply gas from this country. Also, there is a withdrawal of European companies from these markets, which leads to them giving way primarily to Chinese companies.

After the exit of the European giants, they see a great void and opportunity. On the other hand, the European giants are experiencing negative consequences, due to the withdrawal from the Russian market, as well as the inability to obtain parts for the production of cars in Europe in their factories. Chinese companies not only occupy a large market, but also use all other benefits. In addition to three domestic companies, currently all others are companies from the Chinese market.

The future of supply chains will depend on the ability to find alternative suppliers (one or more). Also, finding new, alternative sources of supply as well as evaluating the possibility of supply from their own or neighboring countries is also an option that companies must consider. It is believed that in the future, Chinese companies will continue to expand their business to the war zones, which will have a positive impact on the income of these companies, if the current trend continues in the future. However, due to the uncertainty of the current situation, the future course of events in any industry, including the automotive industry, cannot be predicted with certainty.

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