

Forum:	The Group of Twenty (G20)
Issue:	Improving Food and Energy Security by Promoting Resilient Supply Chains
Student Officer:	Panagiotis Bouloutas
Position:	Deputy President

PERSONAL INTRODUCTION

Dear delegates of the G20,

My name is Panagiotis Bouloutas, I am 16 years old and an 11th grade student at the American College of Greece. This year, I have the utmost honor to serve as one of the Deputy Presidents in this year's PSMUN session of the Group of 20.

After having attended a total of 10 MUN conferences and having obtained every position an MUN participant can obtain, from a delegate to a Secretariat member, I can comfortably say that MUN is more than an educational experience; it is an extracurricular where you can improve some useful social skills, such as public speaking, where you can meet new people with similar interests to you, but mainly where you can have fun and spend your weekend joyfully and creatively.

The G20 is an organization consisting of the 19 most economically powerful nations of the world, along with the European Union. In this year's PSMUN conference, the G20 will discuss, amongst others, the issue of Improving Food and Energy Security by Promoting Resilient Supply Chains. In this study guide, you will have the chance to take a look at what food and energy security are, why they are important and their impact on the global economy; but mainly how resilience in supply chains can be achieved in order to ensure these two.

While this guide provides a thorough analysis on the issue, it should not be the only source that you will use in your preparation research, but just a source to give you a good general idea of the topic. You should conduct further research on your own, to understand the topic even better according to your needs. Furthermore, I urge you to be aware of your country's policy on the issue, as it will be vital both during lobbying and debating, as well as during voting.

That is everything from me. I am looking forward to meeting you all at the conference in March. Should you have any questions on the contents of the guide or generally regarding the committee or the conference, do not hesitate to contact me.

Yours truly,

Panagiotis Bouloutas p.bouloutas@acg.edu

INTRODUCTION

Last January, Russian President Vladimir Putin gave the Russian military an order to invade Ukraine through the eastern border. Governments around the world were not prepared for such a move and, subsequently, for the financial consequences of the war in the rest of the world, regarding food and energy security.

The first immediate consequence of the Russian invasion in the global economy was a food crisis in Europe. This crisis happened because Ukraine and Russia were the main suppliers of crops and similar products to Europe, and, thus, European countries did not have enough supplies of these goods (as trading was not the main priority of these countries at the beginning of the war), which are vital for human survival. The result was importing these products with largely increased prices due to limited trading with the two countries, leading to a food security infringement.

Later on, however, as European countries were mostly in support of Ukraine, Russia imposed sanctions on them, limiting the amount of natural gas supplied to Europe. The result was an unprecedented energy crisis that still holds to this day, as Russia was the main supplier of energy in Europe. As a result, countries either have to sustain the financial burden and import energy from Russia, or purchase energy from farther distant countries at a higher cost, meaning a breach of energy security.

The conflict between Russia and Ukraine is just an example of how food and energy security could be harmed and just how important resilient supply chains are on food and energy security. Resilience in supply chains would ensure food and energy security both on a domestic and a global scale.

Supply chains play a vital role in the trading of the 21st century, where global transactions are part of our everyday life. Making supply chains resilient would not only ensure food and energy security, but would also reduce any chances for further economic crises.

DEFINITION OF KEY TERMS

Food security

A nation is considered having food security when its people have the physical and economic ability to access nutritious and quality food at all times, which meets their needs and preferences for a healthy, stable and productive life, as it was decided by the World Food Summit in 1996.¹

¹ *Policy Brief Food Security - Food and Agriculture Organization.*

www.fao.org/fileadmin/templates/faoitally/documents/pdf/pdf_Food_Security_Cocept_Note.pdf.

Energy security

According to the International Energy Agency (IEA), a nation is considered having energy security when it has uninterrupted access to any kind of energy sources. Long-term energy security is achieved when energy investments are in line with the economic and environmental developments and needs, while short-term energy security is achieved when the energy systems react quickly to supply-and-demand needs changes.²

Energy transition

Energy transition is a plan which aims to transform the global energy sector from fossil-based to zero-carbon by 2050. It is considered vital for energy security as, by reducing the carbon dioxide emissions, much more energy resources will be available.³

Supply chains

A supply chain is a network between the producers and the distributors of a good, until that reaches the final buyer/consumer. It is composed of various activities, people, data, information, entities, capital and resources.⁴

Resilience

A person or an entity is considered resilient when it has the ability to successfully adapt to difficult conditions, adjust to internal and external needs, as well as to come back from pushbacks⁵. Supply chain resilience refers to supply chains being visible, flexible and properly controlled, while the factors of a chain are aware of its vulnerabilities, in order to avoid such or to continue functioning through them⁶. Resilient supply chains are characterized by risk anticipation, open markets, minimal exposure to threats and trust.⁷

Bottlenecks

Bottlenecks in supply chains are the points within the chain where activity is delayed, costing the corporation time and money, as the whole procedure lasts for a longer period of time⁸.

² Iea. "Energy Security – Topics." *IEA*, www.iea.org/topics/energy-security.

³ Energy Transition, www.irena.org/energytransition.

⁴ Hayes, Adam. "The Supply Chain: From Raw Materials to Order Fulfillment." *Investopedia*, Investopedia, 8 Oct. 2022, www.investopedia.com/terms/s/supplychain.asp.

⁵ "Resilience." *American Psychological Association*, American Psychological Association, www.apa.org/topics/resilience/.

⁶ "Supply Chain Resilience: Deloitte Panamá." *Deloitte Panama*, 3 Feb. 2015, www2.deloitte.com/pa/es/pages/operations/articles/supply-chain-resilience.html.

⁷ "Resilient Supply Chains - the OECD's 4 Keys to #Resilient Supply Chains Present Analysis and Evidence in Response to Unprecedented Disruptions to International Trade, in Pursuit of #Sustainable and #Inclusive Recovery." *OECD*, www.oecd.org/trade/resilient-supply-chains/.

⁸ "How to Navigate Supply Chain Bottlenecks." *Rebound Electronics*, reboudeu.com/insights/blog/how-to-navigate-supply-chain-bottlenecks/.

Inflation

Inflation is the increase rate of the price level for a period of time, usually a year. It's generally caused either due to increased demand, which cannot be met by the supplied quantity, or due to the increase of the production cost, while many times the two causes are codependent. Inflation is generally considered anti-productive, as purchasing power is decreased, due to the fact that salaries stay the same, while prices increase. However, during periods of deflation (a decrease of the price level for a period of time), buyers expect even lower prices, so there is lower economic activity, resulting in lower economic growth for a country, which means that an increase of the price levels during such times is necessary⁹.

Currency appreciation/depreciation

A currency is appreciated when its value is increased compared to another currency¹⁰. On the other hand, a currency is depreciated when its value is decreased compared to another currency¹¹. These changes in the value of currencies can occur due to various governmental policies, interest rates being increased or decreased, etc.

Law of supply

The law of supply says that as the price of a good increases, the supplied quantity will be increased for profit maximization and vice versa, while all other factors remain untouched¹².

Law of demand

The law of demand says that, as the price of a good increases, the demanded quantity by the consumers will be decreased and vice versa, while all other factors remain untouched¹³.

BACKGROUND INFORMATION

Food Security

Food security is targeted by the United Nations through the 2030 Sustainable Development Agenda, specifically through Sustainable Development Goal 2 “Zero

⁹ Ceyda Oner is a deputy division chief in the IMF's Finance Department. “Inflation: Prices on the Rise.” *IMF*, www.imf.org/en/Publications/fandd/issues/Series/Back-to-Basics/Inflation.

¹⁰ Chen, James. “Currency Appreciation: What It Is, How It Works, Examples.” *Investopedia*, Investopedia, www.investopedia.com/terms/c/currency-appreciation.asp.

¹¹ Smith, Tim. “What Is Currency Depreciation?” *Investopedia*, Investopedia, www.investopedia.com/terms/c/currency-depreciation.asp.

¹² Team, The Investopedia. “The Law of Supply Explained, with the Curve, Types, and Examples.” *Investopedia*, Investopedia, 10 Nov. 2022, www.investopedia.com/terms/l/lawofsupply.asp.

¹³ Hayes, Adam. “What Is the Law of Demand in Economics, and How Does It Work?” *Investopedia*, Investopedia, 30 Sept. 2022, www.investopedia.com/terms/l/lawofdemand.asp.

Hunger”. The goal aims, through specific targets, at ensuring that all nations globally have ensured all four pillars of food security, namely food availability, food access, food utilization and food stability.

Pillars of food security

Availability

Food availability is “the availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports (including food aid)”¹⁴. It is affected by food supply after production and distribution. The amount of food produced is determined by land availability and management, as well as careful animal breeding and crop harvesting. Sufficient natural resources, like water and sunlight, can also increase the production of food if used properly. However, there is a limited number of producers of the specific good; on the other hand, there are many consumers of that good worldwide. As a result of these, that good needs to be distributed all around the world. Food distribution includes its storage, how it is processed, as well as its delivery. Low quality warehouses, processing chains and delivery methods may harm the amount of food available.

Access

Food access is “access by individuals to adequate resources (entitlements) for acquiring appropriate foods for a nutritious diet”¹⁵. Food access can be examined in two sub-categories: direct access and economic access. Direct access refers to when an entity, such as a household, produces food for consumption by its members, whereas economic access refers to when an entity has the necessary money to purchase food. An entity’s gender distribution, educational levels and economic resources can influence the type, as well as the quality and quantity of food produced (direct access) or purchased (economic access).

Utilization

Food utilization is achieved “through adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met, while bringing out the importance of non-food inputs in food security”¹⁶. For food to be properly utilized and meet the aforementioned categories of needs, it must be safely maintained, prepared and cooked to stay quality. High poverty rates resulting in households not owning the necessary tools and devices can decrease food

¹⁴ *Policy Brief Food Security - Food and Agriculture Organization.*

www.fao.org/fileadmin/templates/faoitally/documents/pdf/pdf_Food_Security_Cocept_Note.pdf.

¹⁵ Ibid

¹⁶ *Policy Brief Food Security - Food and Agriculture Organization.*

www.fao.org/fileadmin/templates/faoitally/documents/pdf/pdf_Food_Security_Cocept_Note.pdf.

utilization. On the other hand, education on nutritious foods and dietary choices can increase it.

Stability

Food stability refers to the ability of an entity to maintain access to food at any time, meaning it has access to food through both regular events (e.g., decreased food available due to the season) and irregular events (e.g., an avalanche destroying a field), mainly of environmental nature, but not limited to it. Economic crises may hurt food stability, in cases where food prices are increased and food supply is decreased.

Importance and economic effects of food security

Food security is crucial to a country's economic and social development. It has been observed that countries which achieve food security have managed to decrease poverty rates drastically. As a country achieves food security, it means that they have covered the basic necessities to survive; hence, they have the "comfort" to focus on other projects which could increase their income. For example, after having achieved food security, a nation is able to construct a national railroad network, which could help in the faster transportation of goods, resulting in further economic activity, both in the public and private sectors, which boosts the nation's economic prosperity.

Food security is very important for both national and global economies. It allows for further development, which subsequently can increase the overall economic prosperity, but it can also have a direct impact on the economy of a country or the world.

Firstly, food security allows for access to food by all (as it is one of its pillars). This means that the people of a country, instead of working extreme hours to receive an income which will be spent on providing food for their family and themselves in order to survive, they can work so they can focus on gaining a further financial income and allow for development on a macroeconomic scale. For example, if a person has a regular income, as they have ensured food security, they can apply for an investment loan, which would decrease the central bank's reserve and subsequently increase inflation in recession periods.

Furthermore, food security allows for changes in the supply of food products. After food security has been achieved, the supply by the companies of food goods is increased, as their availability has increased and been ensured. That means that, as long as the demand for the same product stays the same, the price for the same product decreases, as shown in the graph below (see Figure 1).

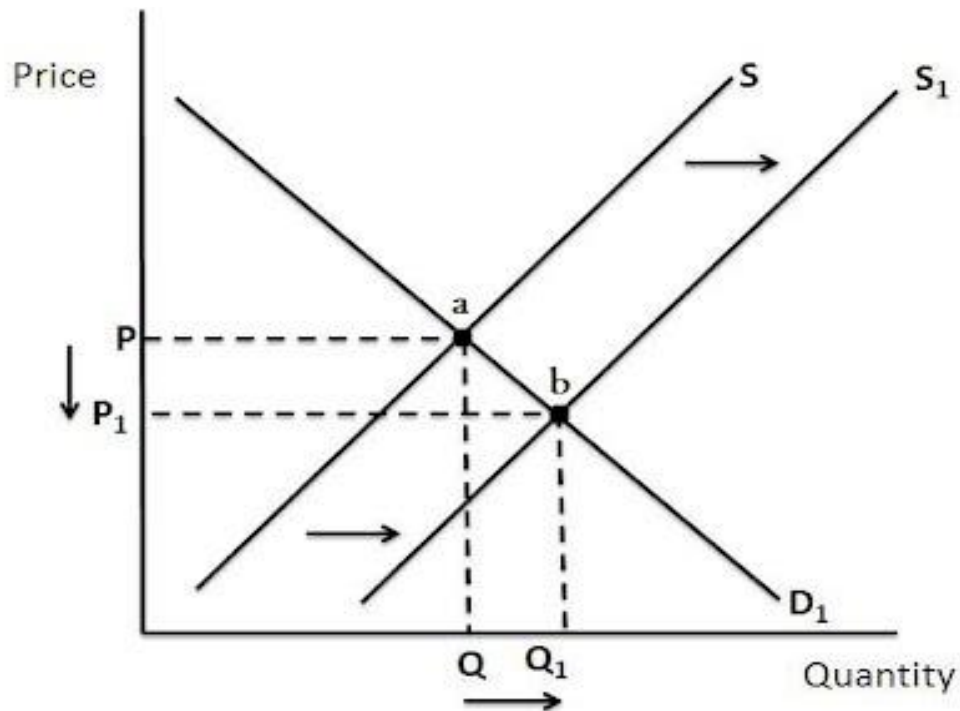


Figure 1: Graph showing how a change in the supply of a product results in a reduced price (S: Supply, D: Demand, Q: Quantity, P: Price)¹⁷. It can be noticed that the demand curve has a negative incline, as consumers ask for less quantity when the prices are high (law of demand). On the other hand, it can be noticed that the supply curve has a positive incline, as suppliers want to sell larger quantities when the prices are high (law of supply). As the supply chain shifts to the right, the two lines meet at a lower point, which means a lower price.

Threats

Factors of many kinds can harm food security. These kinds could be of social, environmental, economic, or political nature. Regarding the social aspect, overpopulation could be harmful for global food security. This is due to the fact that, as the global population grows, more food will be needed in order to sustain that large number of people. However, the land available to grow the necessary crops is limited. This means that food availability would be infringed, either because there will not be enough food for everyone or because the quality of the food produced will not be sufficient to sustain quality lives.

Regarding the environmental aspect, climate change is already threatening to food security and will be even more in the following years. The change of the climate all around the globe deems many parts of it uncultivable and unable to sustain animal breeding. This has an even larger effect on food products which are produced in certain areas, as the conditions there are slowly changing towards not being the proper ones for these goods. Furthermore, global warming dries up lots of water

¹⁷ "Concepts & Diagrams - Econzaitech." *Google Sites: Sign-In*, sites.google.com/site/econzaitech/concepts.

bodies, which are vital for the cultivation of many crops in agricultural cities, deeming their production near impossible.

Food security could also be infringed from actions in the economic and in the political scene. Many countries, which produce the overwhelming majority of a certain good, form alliances and set the prices according to their needs and benefits. This creates a kind of “monopoly” and food access is infringed. Moreover, inflation can easily infringe food security. As the price for food products rise, the purchasing power over them is decreased, creating a problem to economic food access. Inflation, however, can impact direct food access as well, when inflation hits the necessary agricultural equipment to produce food.

Energy Security

Similar to food security, energy security is targeted by the United Nations through the 2030 Sustainable Development Agenda, specifically through Sustainable Development Goal 7 “Affordable and Clean Energy”. Under specific targets, the goal aims at ensuring that everyone across the world is energy secure and that every country has ensured the four pillars of energy security, which are energy availability, energy affordability, energy accessibility and energy acceptability (commonly known as “the 4 A’s”).

Pillars of energy security

Availability

Energy availability refers to the availability of energy resources in the world. These energy resources could include oil, natural gas, or renewable resources, such as biomass, running water etc. The term availability can also refer to the reserves of energy countries have. Furthermore, energy availability can include the diversification of energy resources, as well as the independence from other countries for energy. Availability can be maintained by following general energy consumption guidelines, which foresee minimal energy waste (e.g., lights should be turned off when lighting is not needed).

Affordability

Energy affordability mainly refers to the economic cost of being supplied with energy. Energy is considered affordable only when supplying energy does not have an impact on the country’s economic performance and activity, and not when a country is simply able to purchase a quantity of energy. Energy affordability also refers to a country being able to provide energy performance boost services to its citizens, while not hurting their financial situation.

Accessibility

Energy accessibility refers to all social actors having access to energy at any time. Many times, energy accessibility may also refer to governments supporting their citizens in order to enable them access to energy, by providing allowances for energy to the

lower social classes, for example. Furthermore, it can refer to implementing prices to energy which are affordable for current generations and will be affordable for future generations, taking into account inflation as well.

Acceptability

Energy acceptability refers to the ability of the available energy to function in the already existing energy systems. In modern energy systems, energy acceptability may refer to the environmental impact of different energy resources (i.e. if they are sustainable), while also being adaptable to technological evolution.

Importance of energy security

A nation achieving energy security can have an important impact on its economy. Being energy secure results in more state projects to improve the overall economic prosperity of the nation, but it also allows for fluidity in the country's energy market.

First of all, when a nation is energy secure, it means that the state can conduct projects to ensure further national development, as it allows for energy being sustainably used without hurting the other social classes. These projects could aim at improving, for example, the public transportation sector, which means that an extra layer of backup security is created in case of need or a possible crisis. Macroeconomically, as expansionary fiscal policies would be used to conduct these projects, inflation would be combatted.

Furthermore, there would be changes in the supply and demand of energy within the country. When the nation achieves energy security, the supply of energy will be increased. This means that, as the demand remains the same, there would be a surplus of supply in the market. As a result, there would be deflation, as the suppliers would try to sell the whole quantity of their product, and the value of the currency would be appreciated.

Threats

Energy security is extremely vulnerable in today's market structure, facing many threats. Internal problems (e.g., system failures), environmental factors (e.g., extreme weather conditions or other natural disasters and climate change), international relations and trading, economic factors (including changes in the supply or the demand of energy and workforce instability), are all threats which could infringe energy security.

First of all, energy supply could be shut down temporarily due to malfunctions of the energy systems. These could be caused by a component which might be broken and cause a leak of energy (e.g., a converter of kinetic energy to electricity might have broken, losing some of that energy, converting it into heat). Furthermore, energy security is sensitive towards environmental events, if measures to protect it from such have not been taken, disturbing energy availability. For example, an earthquake could

lead to a broken energy tube, if no protective structures have been constructed for such cases.

The global economic scene, on the other hand, might have an impact on energy security as well. To begin with, international trading relations are crucial for global energy security. When a country does not have good trading relations with countries that own large portions of the world's energy resources, importing energy from them will drastically increase its price (due to possible sanctions imposed), resulting in an infringed energy affordability. Moreover, changes in the supply or the demand of a specific energy resource could change its purchasing price. If the supplied quantity of a resource decreases (as it possibly may be ending in nature), its price will probably increase, as its reserves are limited. On the other hand, if the demanded quantity for another resource decreases, according to the law of demand, the price will increase. The result of both scenarios is energy not being affordable, as well as accessible.

Supply Chains

Supply chains in today's society, in the time of globalization, are important in the daily life of people. From conducting a purchase of a product online to supplying a country with natural gas, supply chains are the key component to this. Nevertheless, resilience in supply chains is needed to maximize their production. Once their resilience is achieved, they will be able to improve lots of problems that the world is currently facing, in which food and energy security are included.

Historical background

Supply chains have existed in the world for a long time now. In much simpler forms, humans use supply chains from ancient times. The first kind of supply chains were first seen in Ancient Greece, during the Geometrical Period (~1100-800 BC). The Greeks were mainly producing agricultural and animal products within small units called "houses". Within the house, the products were processed in order to be consumed safely. Afterwards, there was trading between the different houses in an area, creating the first supply chain (production, processing, purchase, consumption).¹⁸

In later years, during the Archaic Period (~800-480 BC), city-states were formed. Within the city-states, people, along with crops and animal products, produced tools and devices, such as vases, to help them in their everyday life. They went on to sell their products in many areas of the Mediterranean coast with ships, being the first ones to do international trading.¹⁹

Years later, during the Roman Period, the Romans designed and built one of the most famous road networks in human history. Many roads throughout the whole Roman

¹⁸ History.com Editors. "Ancient Greece." *History.com*, A&E Television Networks, www.history.com/topics/ancient-history/ancient-greece.

¹⁹ Ibid

Empire were constructed, in order to deliver goods in the different regions of the large roman territory. The main pathways were made out of rock for easier movement. For heavy goods, a kind of rail was built, in order to put the goods in a wagon and deliver them to any part of the empire. During the empire’s peak, the roman road network consisted of around 400,000 kilometers, with 20% of them being made out of rock. This gave a new perspective on supply chains at the time and how important it is to provide goods in many different areas. The road network continued being used even after the division of the empire, during the Byzantine years.²⁰



Figure 2: The main roads of the Roman Road Network during the Roman Period²¹

During the Middle Age, Europeans were being supplied products from Asian countries, mostly silk for their clothing, which was largely produced in Eastern Asia. The “Silk Routes” or “Silk Roads” were something extreme for that period of time, as only a handful of people from Europe had been to the Far East. It was a big development in the supply chains of the time, as it allowed for an even bigger trading picture. Local communities, though, that were based across the path of the silk routes, posed dangers for the merchants. Thus, the major supply chain of the time faced challenges and was considerably vulnerable.²²

²⁰ Cartwright, Mark. “Roman Roads.” *World History Encyclopedia*, <https://www.worldhistory.org#Organization>, www.worldhistory.org/article/758/roman-roads/.

²¹ 3, December. “An Ancient Network: The Roads of Rome.” *Brewminate*, brewminate.com/an-ancient-network-the-roads-of-rome/.

²² The Strong Traveller, and Shairik Sengupta. “Silk Route and Its History.” *The Strong Traveller*, 22 Mar. 2019, thestrongtraveller.com/2019/03/10/silk-route-and-its-history/.

Figure 3: The Silk Roads/Routes²³

Resilience in supply chains

Risk anticipation

A main characteristic of resilient supply chains is anticipating risks. This means that supply chain managers are able to overcome possible crises, as they are aware of the potential dangers. To perfect risk anticipation, thorough research is conducted by the companies related to the supply chain and other consulting companies to exactly identify the possible dangers the flow of the supply chain may face. Usually, this is done by conducting stress and reverse stress testings. Stress testing simulates a specific problem the supply chain might face, so the result of the simulation can be analyzed and there are measures taken to tackle the problem if it actually occurs. Reverse stress testing poses a specific outcome, which is examined, resulting in finding the problems that lead to that outcome, so as to be prepared to overcome them if they occur. Governments play an important role in risk anticipation, as they can provide a specific image on the current state of the national economy, as well as other factors (e.g., military operations), which can be taken into account by companies, in order to anticipate further problems and draw strategies to defend against them.

Minimal exposure

So as to promote resilience within the supply chains, exposure to shocks and possible dangers is minimalized. Investments on the infrastructure of the supply chain are done, in order to minimize the physical threats that may pose a problem to supply chains. For example, investments on warehousing ensure that the products will be safely maintained, stored and organized until delivery. Furthermore, digital trading is a characteristic of resilient supply chains, as the products are not physically available for anyone to see, touch, etc., resulting in possible damage; also, products are not

²³ The Strong Traveller, and Shairik Sengupta. "Silk Route and Its History." *The Strong Traveller*, 22 Mar. 2019, thestrongtraveller.com/2019/03/10/silk-route-and-its-history/.

outside the appropriate warehouses, whereas, otherwise, they would be vulnerable to environmental factors too, such as humidity, harming the quality of the goods. Lastly, flexibility can minimize exposure to threats and, as a result, build resilient supply chains, as the chain is able to adapt to possible environmental, social, economic, etc. crises and can continue functioning without being exposed to dangers.

Trust

Resilient supply chains are largely characterized by trust and constant attempts on building trust between the public and the private sector. In resilient supply chains, private companies trust the public sector and the attempts made by the government to boost trading and business activity within the country and by IGOs and NGOs to boost trading and business activity internationally. Similarly, the public sector respects the facilitation of businesses and works with them, not against them. This results in cooperation between the two sectors; hence, the private sector can provide goods in the right quality and quantity to the public sector, and vice versa, which means that product shortages are constantly covered.

Open markets

Mainly, resilient supply chains exist as long as open markets exist and function properly. Open markets are characterized by transparency, predictability, international agreement and cooperation and trade facilitation. Transparency and predictability in supply chains allows governments to easily identify and foresee crises and help the companies overcome them, resulting in building trust between the private and the public sector. In open markets, no international barriers exist; thus, international trade is conducted, resulting in a supply chain maximizing its suppliers and being more flexible, meaning more resilient. Agreements between nations boosts trade facilitation, as they strengthen their diplomatic relations and allow for more often trading and economic activity. As a result, supply chains are able to be more secure as well, as they have a safety barrier (international agreement), under which they can facilitate more openly and functionally.

Supply chains structure

Planning

The first department of supply chains is planning. Good planning is necessary before any actions begin to match the supplier with the buyer, in order to achieve the best possible results. The people/bodies responsible for the planning of a supply chain (i.e. consulting companies or NGOs) need to study what will be needed in further stages of production and perform the necessary activities. The data which are studied during planning may derive from customer surveys, the amount of returned products, efficiency in manufacturing factories etc.

Sourcing

The second part of every supply chain is sourcing. The sourcing department mainly focuses on building good relationships with the suppliers of raw materials for manufacturing. The companies must ensure that the materials they will be provided with will meet the specifications for manufacturing. Furthermore, they will need to make sure that, in emergency cases, they will be provided with supplies, and that delivery would be made promptly. Also, it is vital that they choose the most quality material in an affordable and profitable price range.

Manufacturing

Following sourcing, the next operation within a supply chain is manufacturing. Manufacturing is the processing of the raw materials to the final product. Within manufacturing, there are subdivisions, to maximize the production efficiency. These subdivisions could vary from collecting the raw material and testing it to packaging and storing. While manufacturing, companies must take into account methods to use as less energy as possible, while maximizing the production under these circumstances. Usually, manufacturing is the most vulnerable aspect of supply chains, as a slightly different approach from the planning could have a large impact on the rest of the production (e.g., a different amount of raw material used in product processing could result in non-sufficient material for protective packaging).

Delivering

After the product has been made, examined, packaged and stored, the next thing needed to be done is to be delivered for the final purchase. The delivery stage includes distributing the products to the buyers, finding alternative ways to get the product to the customer in case the initial method of transferring the good is inaccessible, but also the final transaction. Distributing the products could be done through the ground or the sea, depending on where the final destination of the good is. Usually, air distribution is not preferred, due to the high cost. However, if a way of transportation is unavailable for some time, alternative ways should exist. In the case of supplying products through sea, if that method is unusable due to extreme sea phenomena in an area, for example, then air transportation would be used for an immediate response.

Returning

The final stage of a supply chain is returning. This stage starts from the moment the customer returns back his product. Then, a series of actions takes place. Firstly, the refunding policy of the company should be implemented and the customer should be given back an amount the policy foresees, if it foresees. Then, the product has to be brought back to the warehouses and, then, to manufacturing labs, following the order of the supply chain backwards, to examine the issues for which the customer returned the product, in order to improve the product itself and increase sales in the future, as well as reduce the number of returns.

Problems with supply chains

Supply chains, although they have developed a lot and have helped the growth of the global economy and global trading, have problems which need to be resolved by becoming resilient, as the internal problems of supply chains have an impact on the rest of the world's activities. These problems are usually caused by the threats they face, which could be about sourcing, distribution, working conditions etc.

Supply chains many times are vulnerable due to them relying on one supplier for their sourcing. Thus, they are directly dependent on the wants of the supplier, as, if the supplier decides to stop, for example, his business, the whole production would collapse for a certain amount of time, until a new supplier is found. Nevertheless, even if supply chains rely on multiple suppliers, they could face again production issues. In cases where there is a small supplied quantity of the raw materials mainly used during manufacturing, as on one hand, there may not be enough quantity to cover the chain's needs, while on the other hand, due to the law of supply, the purchasing price of the material is increased.

A supply chain could also be found vulnerable regarding distribution issues. Many times, a patch needs to be delivered in a remote area, and in many cases, the delivery of the patch is either extremely delayed or never delivered. This shows the inability of current supply chains to deliver a product at any place, as warehouses and delivery stations are usually constructed near urban areas. Furthermore, the distribution could be infringed due to extreme weather conditions, such as hurricanes or snowstorms. In such cases, products are delivered with a delay, as most companies do not have the equipment to deliver products under such circumstances.

At last, supply chains could be disturbed due to low-quality working conditions. First of all, many times, low hygiene levels prevail in supply chain facilities, like factories, storages, etc. This can influence the quality of the product, which, then, may cause the returning stage of supply chains to begin, meaning additional costs for the company/companies. Also, working conditions can be influenced by the quality of education and expertise the employees have received. This means that insufficient work would be done, due to the lack of expertise and knowledge, which would lead to unreliable production activity.

Supply chains impact on food security

Food security is sensitive to the condition of a supply chain. Supply chains could infringe on food security if they are not resilient at every stage. Beginning with planning, it is crucial for suppliers to bear in mind that the products they will manufacture, distribute and sell are important to human survival; thus, they must consider while planning the strategy of the supply chain many outside factors, such as a heatwave, which can harm the quality of the food. This would result in insufficient food availability, as a large portion of the product could be damaged, or insufficient

food utilization, as the nutritional needs of the consumers could possibly not be met. Moving on with sourcing, resilient supply chains means a diverse network of suppliers. In the case of food products, that results in a larger food reserve and a larger variety of food products, further increasing food security globally. Manufacturing is probably the most sensitive stage of the supply chain that can cause food insecurity. First, food in resilient supply chains is thoroughly tested, examining its quality and nutritional value for the consumers, while at the same time, it does not sustain any damage quality and quantity wise. Next, while being processed, the nutritional value of food is not lost or tampered with, preventing insufficient food utilization, if the supply chain remains resilient. In the last stage of manufacturing, that being packaging and storing; food products are sealed in packaging, which does not allow for any outside effect to impact the product, and are later stored in warehouses, which have the ideal temperature and overall environmental conditions to preserve the product in perfect condition. Lastly, in delivery, the products are preserved in a space where there are the necessary conditions to keep the quality of the product intact. Distribution of the products is made through delivery routes, where the risk of harming the food is minimal to none (e.g., a national highway is preferred over a local road if both alternatives are available).

Supply chains impact on energy security

Similarly, energy security is also dependent on supply chains being well maintained and functioning. It is imperative that supply chains remain resilient throughout their entirety. Firstly, supply chain planning regarding energy supply is significant for the rest of the procedure. Resilient supply chains begin with good planning; thus, many variables are taken into consideration when planning the supply of energy. These variables may include natural disasters, such as earthquakes or hurricanes, where measures to prevent any damage in the chain are taken (e.g., wind turbines are usually not built at places where earthquakes usually occur). Next, sourcing of energy is crucial. Countries need to have good relations with other countries, which are the main producers of energy supplies (e.g., oil, natural gas), in order to be provided with energy at a reasonable price at any time. In resilient supply chains, countries usually form alliances to allow for further trading of energy resources between them, allowing for back up plans in the case of an emergency.

Moving on to manufacturing, the first thing that is done is some testing to check the capabilities of the different energy resources. Next, in resilient supply chains, the loss of energy extracted from these resources is minimized, resulting in exploiting the most out of a resource for maximum energy supply. In the last part of manufacturing, which is storing, it is vital that energy stores can store large quantities of energy, while they are not damaged by outside factors (e.g., low temperature) and do not allow them to harm the energy stored. Finishing with the delivery of energy, the tubes which distribute energy across whole continents are strong and durable to environmental

conditions. Power systems which are used to distribute energy to buildings, streets, etc., when resilient, are able to recover energy quickly when malfunctioning happens within them.

COVID-19 effects on supply chains

During the pandemic, the functioning of supply chains changed drastically. Most companies (98%)²⁴ were not prepared for the pandemic, even after the announcement of a possible lockdown by the World Health Organisation (WHO) and, as a result, they faced many issues financially, technologically and across their trading. As social contact was limited due to the virus, sectors of supply chains (e.g., final purchase) were disabled in their physical form. The economic and purchasing activity largely decreased for a period of time, resulting in an unexpected recession period. Central banks decreased the interest rates and increased the money supply to counter the economic effects of such inactivity, but the restrictions needed to be taken against COVID-19 continued to pose challenges for supply chains. Thus, companies moved on digitizing their supply chains, meaning they transformed the majority of their trading and commerce to digital form.

Digitization of supply chains was a pre-existing target for most companies, as it would allow for supplying their products all across the world. However, the pandemic sped up this process, as it was necessary for companies to sell their products without coming to physical contact with their customers. Digital business models were developed, resulting in online shopping seeing a drastic increase in its usage, which was found vital during the quarantine.

The pandemic, though, brought other vulnerabilities of supply chains to the surface. Firstly, during the period of few transactions being made, companies realized that the whole function of the chain was too costly and not as efficient as it could have been (meaning that there were many malfunctions in the entirety of the supplying procedure) for possible times of decreased economic activity. This resulted in them steering towards more environmentally-friendly resources, which were eventually proven to be more efficient and cheaper than the previous resources. Additionally, more problems regarding the function of storing the goods produced and pending for delivery occurred under no supervision by workers. Hence, resilience and transparency in the warehousing section was promoted, mainly by using further Internet of Things (IoT) devices, in order to monitor the condition of the products remotely and be able to combat possible issues from distance.

²⁴ Harapko, Sean. "How Covid-19 Impacted Supply Chains and What Comes Next." *EY*, EY, 18 Feb. 2021, www.ey.com/en_gl/supply-chain/how-covid-19-impacted-supply-chains-and-what-comes-next.

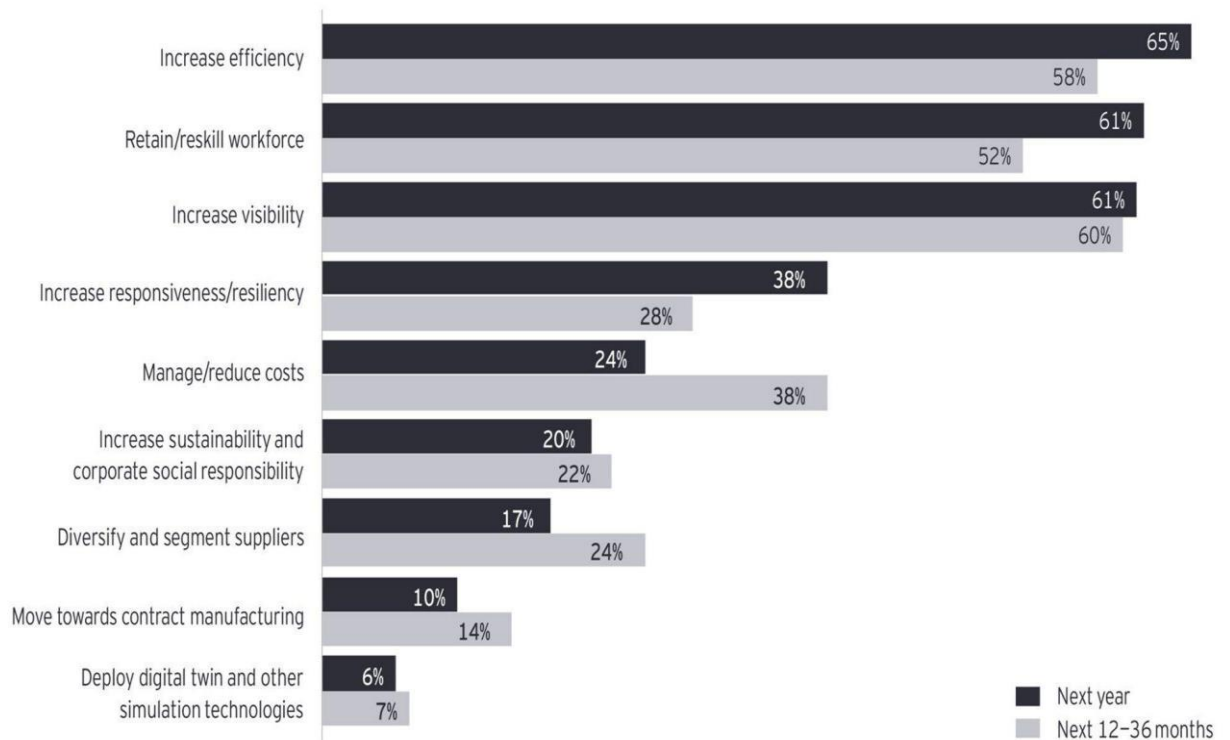


Figure 4: Plan of actions to strengthen supply chains in relation to the current levels; black is the plan for the next year, grey is the plan for the next 2-3 years (graph posted in 2021)²⁵

The “Ever-Given” supply chain crisis in 2021

On March 23rd 2021, the cargo ship “Ever Given” was set to make a routine crossing through the Suez Canal of approximately 17 hours. However, there was an unexpected turn of events, as a sandstorm and a southern wind accelerated the ship, setting it uncontrollable for the captain, which resulted in the ship “sliding” on the water till it got stuck in between the edges of the canal, blocking the way for other ships.

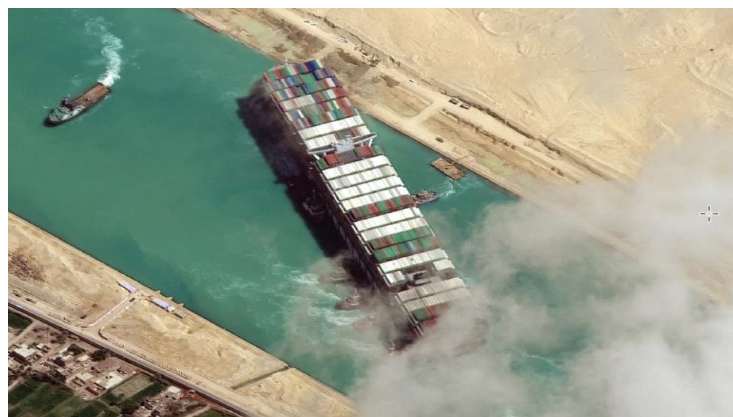


Figure 5: The “Ever-Given” stuck in the Suez Canal²⁶

²⁵ Harapko, Sean. “How Covid-19 Impacted Supply Chains and What Comes Next.” *EY*, EY, 18 Feb. 2021, www.ey.com/en_gl/supply-chain/how-covid-19-impacted-supply-chains-and-what-comes-next.

²⁶ “Lessons from the Ever Given.” *SCOR*, www.scor.com/en/expert-views/lessons-ever-given.

The canal remained blocked for six days; the ship got unstuck after rescue teams from all over the world were sent. Until the blockade was cleared, though, economic consequences, mainly regarding supply chains, of the event impacted the whole world. The “Ever Given” being stuck affected roughly 400 cargo ships which were set to pass through the Suez Canal awaited on spot or at nearby stations at the eastern coast of Egypt. The delay in the delivery of the products on the awaiting ships cost the companies large financial amounts: firstly, to help resolve the blocking, secondly to assist in the maintenance of ships and thirdly to remunerate their customers for the delay of the products.

The situation in Suez had huge economic effects worldwide, but mostly in Europe, where the majority of the blocked ships were heading to deliver their cargo. As products were missing, purchasing activity decreased in an unexpectedly large amount, resulting in governments taking measures, like increasing taxation, to avoid a recession period. Additionally, the euro, due to low economic activity in Europe, was depreciated in relation to the US dollar, for example. This had as a result the decrease of the European countries’ purchasing power for products outside Europe, like oil (which reached a high price for that six-day span in European countries).

The whole event showed further vulnerabilities of supply chains, as well as in the global economy. Attempts to improve resilience in supply chains have since been made by many companies, mainly by examining different routes in the transportation of their goods before their departure.



Figure 6: Euro-to-US Dollar rate from late December 2020 to June 2021; a drop in the ratio is seen during March 2021, during the blockage of the Suez Canal²⁷

²⁷ Best, Raynor de. “Euro to Dollar History Jan 1999 - Jan 04, 2023.” *Statista*, 5 Jan. 2023, www.statista.com/statistics/412794/euro-to-u-s-dollar-annual-average-exchange-rate/.

MAJOR COUNTRIES AND ORGANISATIONS INVOLVED

USA

The United States of America plays a crucial role in global food and energy security. Regarding food security, 89.8% of American households were food secure through 2022, according to the US Department of Agriculture Economic Research Service (USDA ERS)²⁸. The “Economist” ranks the USA as one of the most food secure nations globally for 2022²⁹. The USDA ERS also says that the projected US exported food goods for 2022 would be of a record-setting value of approximately \$196 billion³⁰.

Regarding energy security, the USA is amongst the top 10 most energy secure nations globally, based on the global energy security index, which takes into account carbon dioxide emissions, fuel imports and exports, energy resources reserve, as well as affordability of energy within the nation.

China

China is almost unanimously considered the most dominant nation globally regarding supply chain strength. Thanks to its location, surrounded by mountains and ocean, it is difficult to reconstruct the global supply system, as other nations are unable to interfere via means like highways. Other ways to reduce its power, such as diplomacy, are not considered, because the global economy is largely dependent on the Chinese economy. Regarding supply chains and as far as manufacturing goes, China manufactured around 20%³¹ of the products manufactured worldwide in 2021. Regarding trading and the distribution of products worldwide, 7 of the 10 most active ports in the world are located in China, including the most active one (in Shanghai)³².

Australia

Australia’s economic growth is largely dependent on international trade and endurable supply chains. It exports large quantities of minerals and oil to neighboring countries, mainly in the southeastern region of Asia. International trade is crucial for Australia, as it is far from other close allies of the Commonwealth, hence, it needs to develop trading relations with countries nearby. Adding to that, Australia along with India and Japan started conducting a multinational project called “The Supply Chain

²⁸ “Key Statistics & Graphics.” *USDA ERS - Key Statistics & Graphics*, www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-u-s/key-statistics-graphics/.

²⁹ The Economist, The Economist Newspaper, [impact.economist.com/sustainability/project/food-security-index/](https://www.economist.com/sustainability/project/food-security-index/).

³⁰ “Key Statistics & Graphics.” *USDA ERS - Key Statistics & Graphics*, www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-u-s/key-statistics-graphics/.

³¹ “China's Dominance in Global Supply Chains Won't Change Anytime Soon - Maritime Gateway.” *Maritime Gateway - South Asia's Premier Shipping and Logistics News Portal*, 29 Aug. 2022, www.maritimegateway.com/chinas-dominance-in-global-supply-chains-wont-change-anytime-soon/.

³² “Top 50 Seaports 2022.” *ShipHub*, 9 Sept. 2022, www.shiphub.co/top-50-seaports-2022/.

Resilience Initiative”, which aims at ensuring resilience by promoting supply chain policies in the Indo-Pacific region.

International Energy Agency (IEA)

The International Energy Agency (IEA) is an intergovernmental organization formed in 1974. Today, it is constituted by 31 member countries, with its latest addition being Lithuania this year. One of the IEA’s main goals is energy efficiency, thus, it analyzes data, statistics and different policies in order to promote renewable energy and achieve energy transition and energy security, so energy becomes efficient, clean and affordable for countries, businesses and households. The IEA has already launched some projects in order to meet its goal, with the main one being the “NetZero by 2050” program, which is constantly updated to meet the newly created standards. It is set out to be achieved in three decades’ time.

Food and Agriculture Organisation (FAO)

The United Nations Food and Agriculture Organization is a UN specialized agency, which is the frontrunner on efforts to eradicate hunger worldwide. One method of achieving that is by ensuring food security in all UN member states. Through FAOSTAT, it allows nations to look freely through reports and past conventions which may help them impose their policy to achieve food security. Data from FAOSTAT show track down the impact of the SDGs, mainly of SDG 1 “No Poverty” and SDG 2 “Zero Hunger” and allow for adaptation to the most recent conditions, which has been effective, resulting in accelerated action of the goals.

Organization for Economic Cooperation and Development (OECD)

The Organization for Economic Cooperation and Development is an organization established in 1961, consisting of 38 countries and aims at proliferating economic development and world trade. One of its commitments since its establishment is to promote resilience and strength in global supply chains, to sustain a continuously flowing global trading system. For that, it has published the 4 main keys of supply chain resilience, those being risk anticipation, open markets, trust and minimal exposure. Furthermore, it published in 2011 the “OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affiliated and High-Risk Areas” to provide general guidelines (recommendations and practices) to governments on building resilience in supply chains of minerals, where areas which may cause bottlenecks are involved.

European Union

The European Union is in the center of attention regarding the current energy crisis, as sanctions have been imposed by Russia on importing goods. Bodies of the European Union, like the European Commission and the Central European Bank, conduct projects and studies to understand the problem in-depth and find solutions for the prosperity of European people both short and long-term.

United Nations Center for Trade Facilitation and Electronic Business (UN/CEFACT)

The United Nation Center for Trade Facilitation and Electronic Business is a sub-commission of the UN Economic Commission for Europe (UNECE) and its purpose is to provide the Economic and Social Council (ECOSOC) with recommendations on digital business regulations and electronic trading frameworks. It has published certain guidelines for trade facilitation and electronic business, which are applied by many governments worldwide.

World Food Program (WFP)

The United Nations World Food Program (WFP) is a UN humanitarian organization whose goal is to achieve food security, end hunger and improve nutrition by 2030³³. It is currently trying to achieve these goals by delivering food in areas of need, as well as cooperating with local communities to build resilience in food supply chains, so as to maximize the chances of all pillars of food security being achieved and maintained.

Supply Chain Council (SCC)

The Supply Chain Council (SCC) is a global non-profitable organization which provides companies with tested and verified regulations, guidelines, frameworks, methodologies etc. to apply to their supply chains. These applications could result in promoting sustainability within the corporations. The SCC has released the Supply Chain Operations Reference (SCOR), which is the “world standard for supply chain management”³⁴. It provides a framework with the best metrics, practices and regulations that can be implemented for a supply chain to achieve the best results.

TIMELINE OF EVENTS

DATE	DESCRIPTION OF EVENT
17 November 1869	The Suez Canal opens.
15 August 1914	The Panama Canal opens.
1996	The SCC is established.
1996	The SCOR 1.0 model is published by the SCC.

³³ “Mission: World Food Programme.” *UN World Food Programme*, www.wfp.org/overview.

³⁴ *Supply Chain Council - Supply Chain 24/7 Company*.
www.supplychain247.com/company/supply_chain_council.

1 January 2016	The 2030 SD Agenda is put into action.
1 December 2019	First COVID-19 case is found in Wuhan, China.
11 March 2020	COVID-19 is declared a pandemic by the World Health Organization (WHO).
23 March 2021	The “Ever-Given” gets stuck in the Suez Canal.
24 February 2022	Russia invades Ukraine through the eastern border.
March 2022	Russia imposes energy sanctions on Europe.
6-19 November 2022	COP27 takes place.

PREVIOUS ATTEMPTS TO SOLVE THE ISSUE

2030 Sustainable Development Agenda

The 2030 Sustainable Development Agenda is an agenda adopted by the United Nations in 2015, which aims at offering all people the same opportunities to enjoy a quality life by 2030. It consists of 17 goals, also known as the Sustainable Development Goals (SDGs), which aim at social, economic, political, educational, gender and environmental sustainability and balance. SDG 2 “Zero Hunger” aims, amongst others, at improving food security, while SDG 7 “Affordable and Clean Energy” targets at providing sustainable and affordable energy to anyone at all times, improving energy security. Additionally, SDG 12 “Responsible Consumption and Production” aims at developing efficient and sustainable consumption and production patterns, largely within supply chains. The UN, since the adoption of the agenda, has started a campaign aiming at spreading awareness regarding sustainable development and the SDGs. Furthermore, the Secretariat has ratified roadmaps, which aim at accelerated action for a specific goal, as it is the one for SDG 7, which suggests an immediate transition to non-carbon energy. According to the 2019 SDG Report by the UN, significant improvement towards sustainable development was made, as people became aware of the issues the world faces. However, the 2022 SDG Report claims that 4 years of sustainable development were erased in the past 2 years due to the pandemic, setting back the 2030 Agenda plan.

EU’s response to energy crises

The European Union has created, through the European Commission, some expert groups to tackle the issues created by the current energy crisis and past crises as well.

The groups collect, study, and analyze data from their field of expertise, come up with possible solutions, and then, present them before the Commission. Some of these expert groups are the oil coordination group, the nuclear safety regulations group, as well as the electricity group. The groups shared information found through thorough studies with member states and the European Commission, for the proper policies to be applied. In regards to short-term impact, the energy crisis during the pandemic was tackled; in the long-term, however, another energy crisis occurred, as the shared data were only useful to overcome the specific crisis, not crises generally.

UN/CEFACT promoting digital business models to boost global trading

The UN/CEFACT, in an attempt to promote resilient supply chains through digitization, has developed some provisional digital business models, which could be used to promote digital global trading and make it even more possible and accessible. Along with the business models, it has created a set of regulations with which they will be functioning. The ultimate goal of UN/CEFACT is to allow for an easier flow of international transactions and trade information. The guidelines provided have been used to protect supply chains from being destroyed completely due to crises, one being the various food supply chains from and towards Ukraine during the war.

27th Conference of the Parties (COP27)

The COP27 took place on 6-18/11/2022 at Egypt. In the summit, issues such as climate change and paving a way for future generations to improve living conditions were discussed. Amongst these topics, building resilience within supply chains was also discussed. Specifically, the parties addressed their views on the ways to improve the current model of the supply chains, as well as to improve relations between suppliers, manufacturers, consumers and other relevant actors.

POSSIBLE SOLUTIONS

Building resilience in supply chains

Optimization

Firstly, production should be optimized. This means that supply chain planning, while outlining the production strategy, should consider some extreme scenarios which may occur in the procedure, like a sudden crash in the stock exchange market, which would limit the ability of products to be supplied due to the financial damage caused, or a natural disaster, such as a tornado, which could destroy the product warehouses or alter the path used to transfer goods. These scenarios could be studied with the assistance of prediction models, which would accurately give back data after simulating the respective scenario. In this way, supply chains would suffer less lost product, meaning increased available quantities of food and energy worldwide.

Understanding the data

Understanding the data given by the tests aforementioned is vital in making supply chains resilient. This data should be analyzed in depth, in order to understand the flaws and the vulnerabilities of supply chain systems and find alternative pathways in case something extreme happens. The implementation of artificial intelligence (AI) in the analysis tools could be found helpful and important, as it would be able to efficiently find the flaws of the chain and, in response, suggest possible solutions to restore them. As a result, goods will be produced quicker and be delivered faster to the consumers across the world.

Artificial Intelligence (AI) - enhanced tools

AI can find more applications in the function of the supply chains, in order to increase their resilience. Firstly, AI - enhanced tools and programmes can be used to find the most efficient route to deliver the products to other facilities or to the buyer, taking into account weather conditions, traffic, distribution of products to other buyers as well, etc. In the case of international delivery, these tools could be used to find the most optimal choice of delivery vehicle, while considering the cost of use, the time, the quantity of products that can be delivered at the same time, etc. Furthermore, all of the machines and the technological devices used during the whole supply chain can be enhanced with AI, so as to recommend the correct time for maintenance, as well as the most efficient maintenance methods, but also predict a possible failure, taking into consideration past data (e.g., the precedent events of a failure) and real-time events (e.g., analyze the conditions and compare them to past data), and recommend methods to prevent one.

Diversity of suppliers

A diverse group of suppliers would also drastically increase resilience. Companies should be supplied with their raw material from many suppliers and this material should be of different kinds as well. Having many suppliers would decrease the risk of production faults, in the case of a supplier not having the material demanded, as they would be able to be supplied with it from another partner, or, in the case of a general decreased supply of that material, the chances to be provided with it would be increased with a diverse suppliers' network. On the issue of improving food and energy security, countries should promote to have good trading relations with one another, helping their respective import industries in food and energy resources. If this is applied by most, if not all, of the countries in the world, a large global food and energy reserve would be created, resulting in a significantly decreased impact of possible crises on the economy.

Fighting anti-competitive practices

In order to combat the “monopolies” created among the main producers of a good, which is a form of anti-competitive practices within a market, there needs to be a mechanism that would monitor proceedings. Firstly, entities, such as companies or

countries, need to keep their developmental strategies and plans confidential, as competitors may take advantage of this information and adopt policies to weaken the former's plans. This could be ensured if companies train their staff properly, so as to be aware of how to interact with competitors. Adding to that, the companies should have the appropriate monitoring tools, so they can keep track of the practices of their employees, and "whistleblowing" platforms and opportunities, so the employees themselves can report any anti-competitive practice used by a colleague of theirs, which may have fallen under their radar. However, companies should make sure that their own strategies, plans, intel, etc. reflect the values of a healthy, open and competitive market and to update them consistently in order to avoid any anti-competitive practice happening by mistake. Furthermore, people that play a crucial role in the management of the supply chain should be aware of the anti-competitive legislation each nation has, in order to understand when an anti-competitive practice is imposed on them, so they can move on defending their supply chain and let it flow regularly and resiliently. This would result in unsuccessful anti-competitive practices, which subsequently means decreased to no interventions by outside factors on supply chains.

Promote trust between nations and organizations

A proven sufficient way to resolve any issue could also be implemented in the specific problem, that being rebuilding international trust and trust in and from intergovernmental and non-governmental organizations. This could be achieved if the data that are found through tests, which have been aforementioned, are shared between the responsible parties, with the objective to conduct studies and reports based on data retrieved from such occasions. They would, thus, be able to cooperate when facing an issue and try to find solutions beneficial for all sides. IGOs and NGOs could specify in aspects of food security, energy security, or strengthening supply chain resilience, providing countries involved with further data needed to resolve the issues that may arise. Promoting trust between the parties can also help in tackling anti-competitive practices, which have been aforementioned. Nevertheless, it is not the only method to do so.

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