Universidad del Rosario

Rennes School of Business

What is the impact of the shipping container shortage due to the COVID-19 pandemic on maritime freight transportation and international trade?

Classic Graduating Project

Angie Paola MEDINA DOMINGUEZ

Rennes

October 31st, 2022

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International Business Administration

MSc Supply Chain Management

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Submitted in fulfillment of requirements for completion of MSc Supply Chain Management

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OATH OF PERSONAL WORK

I undersigned Angie Paola MEDINA DOMINGUEZ, declare that the following graduating project is my own work. No part of this research has been submitted in the past for publication or for degree purposes.

I am fully responsible for the truthfulness of this declaration.

Date: 31st October 2022

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Table of contents

Table of Figures

Resumen

La pandemia de Covid-19 impactó significativamente la economía global y las decisiones estratégicas de las empresas a lo largo de la cadena de suministro. Por esta razón, en el presente trabajo de investigación se estudia el impacto de la escasez de contenedores marítimos debido a la pandemia del Covid-19, en el transporte marítimo y el comercio internacional; así como la importancia de las estrategias de gestión de riesgos, la preparación y la resiliencia en las empresas para estar mejor preparadas para futuras escaseces e interrupciones.

Para llevar a cabo el estudio, la metodología de investigación engloba cuatro fases con el objetivo de recolectar datos cualitativos y cuantitativos y dar al trabajo de investigación una visión integral del tema. Como resultado, se analiza, comprende y se explica el impacto de la escasez de contenedores debido a la pandemia de Covid-19 en el transporte marítimo y el comercio internacional a través de una narración cronológica y una mirada a las perspectivas de expertos sobre los efectos del COVID-19 en la gestión estratégica, la resiliencia y la preparación de su empresa.

Finalmente, todos los actores interesados en el comercio internacional, el transporte marítimo de carga y la gestión de riesgos se beneficiarán de un conocimiento de valor agregado y de un artículo de alta calidad que contribuirá a la revisión de la literatura actual

en el área de estudio.

Palabras Clave: Comercio Internacional, Transporte de Carga, Industria Marítima, Transporte de Contenedores, Gestión de Riesgos, Pandemia Covid-19

Abstract

The Covid-19 pandemic significantly impacted the global economy and the strategic decisions of companies along the supply chain. That is why throughout this research paper, the impact of the shipping container shortage due to the Covid-19 pandemic on maritime transportation and international trade is studied along with the importance of risk management strategies, preparedness, and resilience in companies to be better prepared for future shortages and disruptions,

To conduct the study, the research methodology englobes four phases aiming to collect qualitative and quantitative data and give the research paper an integral view of the topic. As a result, the impact of the shipping container shortage due to the Covid-19 pandemic on maritime transportation and international trade is analyzed, understood, and put into words through a chronological explanation and a look into expert's perspectives about the COVID-19 effects on their company's strategic management, resilience, and preparedness.

Finally, all actors interested in international trade, maritime freight transportation, and risk management will benefit from added-value knowledge and a high-quality paper that will contribute to the current literature review in the study area.

Keywords: International trade, Freight Transportation, Maritime Industry,

Container Shipping, Risk Management, Covid-19 Pandemic

1. Introduction & research background

From the beginning of international trade, freight transportation has always been inseparable and complementary to exchanging goods and services across international boundaries to potentialize the world economy. Considering that no country has all the internal resources needed to satisfy people's needs and domestic markets, international trade empowers each country to obtain those high-cost resources locally to produce by acquiring them at a lower price through importations that mainly arrive in the country through containerized cargo in ships. Then, thinking about global business without mentioning freight transportation and the maritime and container shipping industry is technically impossible.

Until now, freight transportation has been a primary pillar of supply chain and logistics systems, as long as it encloses all the processes and stages involved when transporting goods, willing to achieve economic efficiency along the movement. The major modes of freight transportation in the world are ground, rail, air, and ocean transport. Broadly speaking, the type of transportation depends on the product characteristics, the location where is leaving and arriving the shipment, and the cost, urgency, or specific considerations of the agreement; Ground transportation is used for all kinds of goods around the world and is highly used across borders, for small shipments, and final-mile delivery; Rail transportation is known as the less costly and

easily accessible type of transportation and is primarily used in areas where the rail networks are strong; Air transportation is vital due to its speedy delivery and its accessibility all around the world, and finally, ocean transportation manages the vast majority of the world's trade economy, since it can transports heavy, bulk, and cumbersome products from country to country, being the most integral part of the supply chain for global industries.

Data and studies over the past years show how the exponential growth of maritime freight transportation derived from the increasing demand in global trade has caused countries, companies, and professionals to expand their interest in studying the process of planning, implementing, managing, and improving the exchange of goods and information along the ocean carriage; This valuable interest in studying such a complex and dynamic industry can be seen in the deployment of reactive, preventive, and predictive strategies to maintain the scope, greatness, and importance that characterize the maritime freight transportation industry.

When it comes to the scope of the container shipping industry, its essence is to carry cargo across oceans and boost the link between goods produced internationally and customers worldwide. For global businesses, container shipping brings benefits such as volume, cost, durability, security, standardization, and green initiatives in supply chain networks. Parallel, as a highly capital-intensive industry, advanced risk management strategies are highly valued and required to face the last couple of year's global trade perspective as a consequence of the COVID-19 pandemic, where can be highlighted: environmental regulations, rising costs, demand, and

supply disruptions, scarcity of labor, shutdown of factories, geopolitics, macroeconomic factor as oil prices and exchange rates, ports congestion, and container shipping shortages.

In truth, the COVID-19 pandemic is a global pandemic of respiratory illness caused by SARS-CoV-2 and was identified in December 2019. Their consequences on the health, social and economic scope cause far-reaching effects that are being felt worldwide. Regarding global freight and trade, the industry was severely affected when the COVID-19 pandemic arose. The global economy was shocked by both supply and demand disruptions, and the emergence of new virus variants increased to disrupt the economy. For humanity, keeping commercial ships would ensure the flow of maritime trade and the delivery of vital medical supplies, the world's food, raw materials, energy, and manufactured products that were highly needed to afront the crisis. However, the stated restrictions in response to the pandemic caused industries, ports, shipping, and supply chains to face challenges such as shortages of raw material, lead time issues, port closures, reduced port hours, blank ocean sailings, equipment shortages, transportation capacity constraints, and some other barriers that delay the smooth flow of goods and supply chain activities.

Regards the container shipping shortage, as soon as governments-imposed lockdown restrictions to face the coronavirus spread and announced the temporary closure of seaports worldwide, the reduction in the number of operating ships and the logistics chaos became a priority for exports and imports globally. As a vast number of containers were in inland depots while others were piled up at cargo ports, the massive and severe shortage of shipping containers in some ports was an absolute reality, worsened by workforce issues and some other support functions related to

vessel delays, and container loading volume limitations, what distorted the usual trade flow and lengthy consequences.

As a result, the long-term consequences of the COVID-19 pandemic are yet to be fully known and understood; Up to now, all indicators, studies in the field, data, and expert statements affirm significant challenges in the industry and a revolution in risk management strategies. Thus, a good understanding of how the shipping container shortage due to the COVID-19 affects maritime supply chains is highly needed to develop strategic thinking by the key players and stakeholders to deploy effective solutions and minimize the consequences of the chaos.

Thus, this research paper aims to analyze and provide a clear presentation of the impact of the shipping container shortage due to the COVID-19 pandemic on maritime freight transportation and international trade by understanding the shortage disruption and consequences in the container shipping industry. Moreover, this analysis presents a higher appreciation of the current perspective of maritime freight and the importance of risk management strategies, preparedness, and resilience in companies and governments to be better prepared for future shortages and disruptions.

Specifically, with this analysis, professionals, researchers, companies, governments, stakeholders, and all actors interested in maritime freight transportation and risk management will benefit from added-value knowledge and literature for future academic and business purposes since this research cover an interdisciplinary and recent globally debated topic with a research gap that is important for the global economy and that has not been studied in such depth.

The paper is structured in six sections as follows: Section 1 introduces the topic and the research question background, with a brief outline of the subject and the origin of its study; Section 2 reviews the existing literature in the field and provides a brief overview of recent academic papers and valuable insights about international trade, freight transportation, maritime freight transportation, the container shipping industry, an overview of COVID-19 in global trade, the shipping containers shortage due to Covid-19, risk management, and global supply chain collaboration; Section 3 deploys the methodology and details of the research paper structure; Section 4 presents the analysis & results of the study, along with the adequate presentation of data and key findings of the research; Section 5 englobes conclusions & practical recommendations; Finally, Section 6 expose limitations & future directions.

2. Literature review

Introduction

This section provides high-quality academic research on the impact of the shipping container shortage due to the COVID-19 pandemic on maritime freight transportation and international trade. The conducted literature review was divided into eight well-explained main

topics that aim to synthesize valuable publications that contribute to the topic and to point out the basis of this paper's research as follows:

1. International trade
2. Freight transportation
3. Maritime freight transportation
4. The container shipping industry
5. Overview of Covid-19 in global trade
6. The shipping containers shortage due to Covid-19
7. Risk Management
8. Global supply chain collaboration

International Trade

Historical approaches evidence the existence of international trade throughout much of history as the Silk Road, Amber Road, Salt Road, and others. In principle, the beginnings remain in the ancient world when people first traveled far away to exchange goods and profit from the comparative advantage of producing certain goods or services in territories. Then, international trade can be defined as the exchange of goods, capital, and services across countries to promote the growth of economies, guarantee access to goods and services, and finally ameliorate life

quality. As opposed to local trade, international trade is a rigorous procedure due to variables such as currency, public policies, economy, law power, and market trends. They all impact trading when it occurs beyond nations and offer consumers and economies the opportunity to explore new markets and goods.

More in detail, from the time of the ancient Greeks to the present, international trade and commercial policy were the first subfields of economic theory under study. Over the years, government officials, philosophers, and economists have debated the variables that affect international trade, queried whether trade benefits or harms a country and, more importantly, have tried to identify the best trade policies for all nations.

Subsequently to the ancient Greeks, there have been two perspectives about trade between the defenders of trade and those who fear that foreign competition may destroy some domestic industries, workers, or cultural traditions. Depending on how much emphasis is placed on the advantages of trade or the disadvantages seen by those damaged by imports, several analysts have come to diverse conclusions on the benefits of free trade. The conflicts engendered by this dual perspective on trade have not been resolved, as evidenced by the heated arguments today. Then, when looking at the timeline of international trade to better understand the different perspectives, six economic theories can be found: Mercantilism, Absolute cost advantage, comparative cost advantage, H-O theory, porters diamond, and product life cycle theory.

Mercantilism was widely accepted in the 16th and 18th centuries since the nation's wealth was limited to gold or other types of precious metals. During this time, mercantilists claimed that all of these valuable stones represented a country's wealth and that it could only become stronger by increasing its exports and reducing its purchases. They claimed that this is a good trade balance and will contribute to a country's further advancement. Due to the rise of new nation-states and their leaders' desire to fortify their states, mercantilism prospered during the 1500s. The only way to accomplish this was to promote exports and trade, which is why these rulers were able to raise more money for their countries. By establishing restrictions on imports, exports were promoted, resulting in the protectionism strategy, which is still in use today. Even though mercantilism is one of the oldest theories, it is still used in modern understanding, such as in China, Taiwan, Japan, and other protectionist nations. To defend their industries, almost all nations have adopted protectionist policies in one form or another. Export-oriented nations prefer protectionist policies because they benefit them.

Absolute cost advantage was founded by Adam Smith, the father of modern economics. This theory was developed in response to the protectionist and mercantilist perspectives on world trade. Adam Smith believed free trade was essential since it was the only guarantee for trade growth. According to him, a nation should only create goods with a clear competitive edge. Smith claimed that free trade encouraged the global division of labor and that producing in faraway areas can always be a disadvantage for division of labor producers with differing absolute advantages. He strongly emphasized creating what a nation is better at to produce more at a lower cost than

other nations. According to this theory, a nation should export a good where it has a cost advantage, and a nation's prosperity should not be determined by how much gold and other precious metals it possesses but rather by the living conditions of its people.

Comparative cost advantage was first introduced by David Ricardo, and later on, J. S. Mill, Marshall, Taussig, and others expanded it. Based on Ricardo, absolute advantage is not required since a nation will profitably produce where it has a comparative advantage or the least disadvantages. Then, countries will export the goods they benefit from most and import the goods they pay the least to create a comparative advantage.

As mercantilism, comparative advantage, and comparative cost advantage do not determine which goods would provide greater profits to countries, the H-O theory arrived in the 1900s. Eli Heckscher and Bertil Ohlin discovered that the elements with stronger demand would be more expensive, and the factors with low demand compared to their supply would be cheaper. This theory can also be named the modern theory and the general equilibrium theory, in which the most significant factors of international trade are factor endowments and factor pricing.

Porter’s diamond is a highly recognized theory proposed by Michael Porter, who states that a corporation's success depends greatly on the characteristics of its native country. This theory has six model factors or determinants, and due to its diamond-like shape, it was given that name. The

determinants are 1. Factor Condition; 2. Demand Condition; 3. Related and Supporting Industries; 4. Firm Strategy, Structure, and Rivalry; 5. Chance; 6. Government.

According to Porter's diamond theory, domestic competition also helps organizations build unique and long-lasting strengths and competencies, which is essential for international trade since companies are increasingly driven to innovate and improve as domestic competition becomes more intense.

Product life cycle theory was developed in the 1960s by Professor Raymond Vernon at Harvard after the H-O theory when the United States of America was the world's manufacturing leader. This theory establishes that a product goes through 3 stages as it develops as follows: Stage 1" New product stage," introduces a new product in the market; Then, Stage 2 "Maturing product stage," arrives when the product has generated demand in developed countries; Finally, in Stage 3 "Standardized product stage" the product is exported to developed and underdeveloped nations, and the manufacturing process of it should be in the country where it was invented.

Along with the historical contributions, the academy states the importance of mastering the theories of trade but also differentiating the three types of international trade: import trade, export trade, and entrepot trade, to achieve countries' development and business success. The import trade is the process of bringing products or services into one country from another country where they were originally produced since the importer country is not able to produce sufficient quantities at

a competitive cost; The export trade is the opposite process of import trade, what means selling products made in a certain country to another country, thanks to their local advantages. Finally, the entrepot trade, also known as transshipment, englobes both processes. It is the type of trade to importing goods into a country, then shipping them back out again. This type of trade is used for a wide of purposes, such as accessibility to machinery, the development of technology, and supporting global ties.

Nowadays, indicators and market dynamics show that international trade brings benefits such as economic growth, more revenues, a greater variety of goods available for consumption, competitive advantage in companies, investment, better utilization of resources, the dynamism of markets, opportunities to specialize in a specific area, efficiency in production, more employment, and the participation of multiple countries in a global economic environment. In 2021, the world's highest trade-in goods values were by far those of the EU, the US, and China. Together, these nations were responsible for 44% of the world's exports and 45% of the world's imports of products. (UNCTAD, 2021). In 2022 the top 10 export countries are China, the United States, Germany, Japan, the United Kingdom, France, Netherlands, Hong Kong, Singapore, and South Korea (World Bank). Some of the most traded goods were: cars, refined petroleum, petroleum gas, chips, pharmaceuticals, jewelry, computers, telephones, broadcasting equipment, and others (World Atlas)

Then, to highly compete in international trade, companies, industries, and countries must focus on boosting the benefits of international trade by considering the four major cost components of international trade. The first component is the cost related to the economic exchange, known as transaction costs. If a transaction is made in a different currency, it might also include gathering information, negotiating and contract enforcement, letters of credit, and transactions, involving exchange rates. Then, transactions among countries are typically more costly than those that occur locally. The second component is the tariff and non-tariff costs imposed on a trade flow, gathering governmental taxes on a legitimate trade flow. Depending on the type of product traded, they may involve a direct financial cost or requirements that must be met before a product can enter a foreign market. The third component is the time cost associated with the delays between ordering and receiving an order. It is also known as "inventory transit" and is related to long distances, delays, goods inspections, and time limitations that supply chain management strategies can efficiently mitigate. And finally, the fourth component englobes the transport cost of shipping goods from the production point to the consumption point, that nowadays, with containerization, intermodal transportation, and economies of scale, have been positively impacted. Meaning that the development in trade is highly related to the growth in international transport since an increase in world trade brings an increase in freight that needs to be moved. Subsequently, the four primary modes of international transport (ground, sea, rail, and air) and their cost strategy plays an essential role in the global economy and countries' performance in international trade.

Freight Transportation

Freight transport can be described as the steps and means carried out when shipping products. As a significant role in effective, adaptable, and reliable supply chain networks, freight transportation directly affects domestic or international trade on a commercial level, severely impacting the global economy. There are various ways and channels via which freight can be transported, depending on the facilities. What refers to air and oceans, and also to ground and rail transportation. The word "freight" can, when it is used individually, mean both the cargo itself and the transportation-related activities.

It should be mentioned that multimodal transport comprises carrying out a freight operation employing many modes of transportation, specifically waterways. The objective is to optimize delivery lead times and lower transit-related expenses by putting its entrepreneurs on the principle of freight forwarding. Subsequently, before arriving at their end customer destination, raw materials, components, and finished goods frequently traverse across the globe. In order to accomplish this, freight shipments are carried between points by logistics and transport companies with the help of transportation intermediates. It takes a lot of interaction, organization, networking, and experience to deliver domestic or international freight on time and without damage. Then, a successful planification of the freight transported should consider The size of the goods; The type of goods (its nature); The quantity of the goods; The packaging; The destination, and finally, the most cost-efficient mode of transport.

Broadly speaking, the modes of transportation are ground, rail, air, and ocean. Their main characteristics are mentioned below: Road transportation: is composed of trucks that can go to every destination with a reasonable access-quantity cost. It can be a full truckload (FTL) when the entire truck is needed or a less than a truckload (LTL) when the freight does not fill an entire truck. Road transportation is also highly needed for intermodal (ITML) transportation when the freight arrives at a destination and then is transported by truck without opening the container; When it is asked to transport a container over the road, it is charged a "chassis fee," and a specific truck is needed. But if the container is opened and transferred to the truck, it is a multimodal mode of transportation (ML). To complete, FTL is less damaged and requires less time since one driver is in charge of the freight the entire way (from origin to destination). In LTL, the freight requires more time and faces some risks as it requires a coordinated network.

Rail transportation: is essential for global trade as it can move freight to long distances more economically. In recent years investments in technology applied to rail networks have increased the operational efficiency of this mode of transportation, saving fuel and reducing gas emissions compared to road transportation. Along with rail transportation, it can manage many raw materials and finished products such as intermodal, energy, and chemicals.

Air transportation is ideal for high-value and time-sensitive products. It englobes Next flight out: which means that the cargo is booked on the next flight; Consolidated, which means that the cargo is shipped beside the cargo of other shippers, and normally with a lower cost;

Deferred, which is the lowest cost option due to the time that takes the shipping, and the usage for low-value and non-perishable cargo; Finally, Air charter, which is used to large and high-valuable freight, represented in higher costs.

Finally, ocean transportation is the leader of bulk cargo in global trade and uses standardized shipping containers to make loading and unloading cargo easier without damaging the goods. As soon as the shipping agent and freight forwarder agree on a container trade, the shipment is moved to the port and confirmed through customs. Depending on the volume, it can be shipped in full container load (FCL) or less than container load (LCL), also known as shared containers. Then, the container is prepared for transit once it has been loaded and put onto the ship. Once at the destination point, duties and taxes have to be paid to pass to the delivery process on the same containers or pallets.

As presented, all modes of transportation have advantages and characteristics when shipping freight. Even though, as the global economy has become more volatile and as stated by Fatemeh & Amelia (2011), the demand for freight transportation will nearly double by 2035, which means pressure in the adaptability, and capacity of each mode of transportation to face coming challenges and the trade demand.

Maritime freight transportation

Today more than 80 percent of world trade by volume is moved by sea (UNCTAD, 2021), which means that the oceans are the core of transportation for global business and the oldest option for freight transportation. As benefits, there are the following five reasons that most traders agree on 1. Economic advantage; ocean freight offers the highest competitive freight cost to traders, especially for long distances. 2. Efficiency: ocean freight companies offer an alternative to all sizes of shipments. 3. Management of oversized, heavy, and bulk cargo: known as Not in Trailer (NIT) loads, ocean freight companies can handle large cargo without any problem. 4. Safety: the maritime transportation industry pays much attention to the regulations and safety of products shipped to avoid losses or damage, with different types of vessels for each type of product. 5. Environmental responsibility: compared to other modes of transportation, maritime freight transportation offers the most carbo-efficient mode of transport, adding to the industry's continuous technological improvements as the liquefied natural gas (LNG) ships.

As the oceans are the highways used for maritime freight transportation, some routes are more used than others, subject to the requirements that limit the influx of ships and cargo, affecting the freight charges and tariffs. According to the UCL Energy Institute (2022), the five major shipping routes used for global trade are:

1. The English Channel: Connects the North Sea to the Atlantic Ocean and divides the UK from the rest of Europe. It is roughly 350 miles long and welcomes 500 ships every day. The strait of Dover is the narrowest section of the channel and acts as the

gateway between Europe and UK. It is used daily by over 400 vessels that ship grain, minerals, steel, and oil.

2. Strait of Malacca: It is the second-busiest global canal and connects the major Asian economies with the rest of the world. It provides the fastest passage between the Indian and Pacific oceans. The strait of Malacca connects India, Indonesia, China, Japan, Malaysia, Singapore, and other Asian economies, with more than 83000 ships passing through it annually, mostly shipping natural gas and oil.

3. Panama Canal: It was constructed to facilitate travel between the Pacific and Atlantic oceans; thanks to three locks, ships carry up to 14000 TEUs and can cut down their travel time. Then, more than 14000 ships can transport everything from chemicals to lumber and industrial components to vegetable oil annually.

4. The Suez Canal: The fastest sea route connecting Europe and Asia is through the Suez Canal. About 12% of global trade passes through the Suez Canal each year. It is an essential route for the Middle East's oil, petroleum, coal, metals, timber, cement, and fertilizer.

5. The strait of Hormuz: The Gulf of Oman and the Persian Gulf are connected by the Strait of Hormuz. It is a crucial route for the transit of oil, with a focus on Asian markets, including China, Japan, India, South Korea, and Singapore.

Added to the description of the major shipping routes used for global trade; To understand the operations and strategies in maritime freight transportation, it should consider insights as container ships operate on fixed routes and predetermined ports, that maritime routes are

concentrated near ports. Some of these ports handle more ships than usual, and only a few countries have direct shipping routes to their trade partners. Which subsequently means a low possibility of making changes on established routes, traffic jams and bottlenecks in some areas, and complex supply chain networks.

Then, expanding the topic of port's importance in maritime freight transportation, according to the World Shipping Council (2020), The TEU (twenty-foot equivalent units) is globally used to determine cargo capacity from a standard 20-foot shipping container, and these are the 20 biggest ports by volume that keep international trade actively moving:

1. Shanghai, China 43.5 million TEU
2. Singapore, Singapore 36.6 million TEU
3. Ningbo-Zhoushan, China 28.72 million TEU
4. Shenzhen, China 26.55 million TEU
5. Guangzhou Harbor, China 23.19 million TEU
6. Busan, South Korea 21.59 million TEU
7. Qingdao, China 22.00 million TEU
8. Hong Kong, S.A.R, China 17.95 million TEU
9. Tianjin, China 18.35 million TEU
10. Rotterdam, The Netherlands 14.35 million TEU
11. Jebel Ali, Dubai, United Arab Emirates 13.5 million TEU
12. Port Klang, Malaysia 13.24 million TEU

13. Xiamen, China 11.41 million TEU
14. Antwerp, Belgium 12.04 million TEU
15. Kaohsiung, Taiwan, China 9.62 million TEU
16. Dalian, China 6.54 million TEU
17. Los Angeles, U.S.A 9.2 million TEU
18. Hamburg, Germany 8.7 million TEU
19. Tanjung Pelepas, Malaysia 9.85 million TEU
20. Laem Chabang, Thailand 7.55 million TEU

As evidenced by the data and as mentioned by the UNCTAD Secretary-General Mukhisa Kituy (2021), a port can only be as efficient as the people who work in it. Then, the efficiency of the Asian ports is also evidenced by their global manufacturing power. Even though, taking a look at the most prominent global shipping companies according to Alphaliner data (2022), the companies in the top 10 are:

1. AP Moller-Maersk Group, headquartered in Copenhagen, Denmark
2. Mediterranean Shipping Company S.A. (MSC), founded in Geneva, Switzerland
3. China Cosco, a government-owned company, concerned for the Republic of China
4. CMA CGM Group, operating from Marseille, France
5. Hapag-Lloyd stated in Hamburg, Germany

6. ONE (Ocean Network Express), headquartered in Singapore
7. Evergreen Marine Corporation , a mainstay in Taiwan
8. Yang Ming Marine Transport Corporation, headquartered in Taiwan
9. Pacific International Lines (PIL) , headquartered in Singapore
10. Hyundai Merchant Marine, headquartered in Seoul, South Korea

The previous rankings and review allow comprehension of the scope of the ocean industry and the variables to consider in a global economy and the relationship between international trade, freight transportation modes, maritime logistics services, and the shipping business.

The container shipping industry

A container ship is designed and equipped to carry containerized cargo in a containerization technique; this predominant system of intermodal freight transport using standard ISO containers originated several years ago and became widely applied after the Second World War. Containerization is an essential part of the logistics revolution as it reduces the cost of transportation, increases the speed of trade, changes the infrastructure of ports, reduces congestion in ports, and eliminated manual sorting of shipments, which boosts the international economy.

Since the first ships in the 1950s, the container shipping industry has responded to the trade requirements by developing a wide range of maritime and multimodal containers depending on the size and weight of the load; The nature of the cargo (High-value cargo, general cargo, cars, dry bulk cargo, liquid bulk cargo, hazardous materials, refrigerated cargo, food, livestock, animals, gas-based fuels, machinery or others); The degree of standardization of the cargo, and the spreader required for the shipment. According to Tec Container (2021), the eight most common types of containers are:

1. Dry storage container: The most typical in the shipping business, they are made to transport dry products and come in lengths of 20, 40, and 45 feet. These containers cannot regulate temperature, making them unsuitable for transporting refrigerated substances like food or chemicals.
2. Flat rack container: It only has two sides and no top. As a result, big loads can be positioned on the rack from the side or above. Most flat rack containers are 20 or 40 feet long and are composed of steel for durability and strength.
3. Open top container: It is designed to dry storage, but without a top. Bulky cargo may now be loaded quickly, thanks to this. The container has a plastic roof structure that can be fastened with ropes and protects against rain and other types of precipitation.
4. Open side storage container: Has one long side wholly opened, it benefits wide merchandise that may be difficult to fit through the end of a tunnel container or dry storage container.

5. Refrigerated ISO containers: Often known as a reefer is a type of intermodal container used in the transportation of refrigerated freight and sensitive cargo. Even though a reefer has an internal refrigeration unit, they still require external power from electrical power points) at a land-based location, a container ship, or on a dock. They can be powered by diesel-powered generators, which are attached to the container while traveling by road while being transported over the road on a truck or by rail wagon. Refrigerated containers can regulate temperatures between -65 °C and 40 °C.

6. ISO Tanks: They are storage containers made to accommodate liquids. Since they transport chemicals, they are often made of anti-corrosive materials. Tanks are most frequently used to store liquids, but they can also be used to store dry products like sugar.

7. Half-height containers: They are half as tall as full-sized containers and are primarily made of steel. They are used particularly for goods that require simple loading and unloading, such as coal, stones, etc. More and more containerized bulk freight is being transported in this container.

8. Special purpose containers: Almost any form or size can be created for special purpose containers. They are used to transport goods that need special requirements. Because they are expensive to produce and transport, shipping companies generally avoid special-purpose containers.

The versatility of containers in the shipping market, and the type of materials that can be transported to import and export goods overseas, are highly influential factors in maritime freight

transportation to become the worldwide popular mode of transportation. Since container shipping carries more than 90% of the world's goods and thus plays a vital role in facilitating international trade (Lai et al., 2013; Yang and Wei, 2013), understanding container movements is essential due to the role they play in freight transportation, global trade, and economic growth.

According to Alphaliner (2013), the container shipping industry is an oligopoly; the top 25 shipping companies occupy almost 60 percent of the global shipping market. This means that a small number of companies are responsible for transporting more than half of the containers in the industry. Rua (2014) documented that nearly all countries have container ports, constituting the global container shipping network nodes.

In consequence, to understand the ownership container dynamics, a look at supply, cost, and requirements is needed. The ownership of shipping containers is typically classified as either shipper-owned containers, which are containers held by leasing companies, NVOCCs, and freight forwarders, or carrier-owned containers, which are containers owned by shipping lines. In the business of shipping, five distinct entities commonly possess containers:

1. Shipping lines or ocean carriers: classified as carrier-owned containers (COC), they have direct control over supply, vessel capacity, and distribution. They are giving all-in-price rates to customers for moving the cargo from one point to another.
2. Shippers: They have a small portion of the containers in the market since it is costly, and all-in-price rates from carriers are sometimes better.

3. Leasing companies: They are owners of the most significant number of containers, owning about 52% of the market (World Bank, 2021). Due to trade and imbalances, leasing companies are better prepared to offset equipment shortages and disruption than other owners. Some recognized leasing companies are Triton international, Seaco global, and Textainer group.

4. NVOCCs: Non-Vessel-Operating Common Carriers own containers for project cargo with unique specifications. For them, it is quite an investment to hold them and facilitate shipments for their customers. Some NVOCC's companies are DHL global forwarding, Sinotrans, and Expeditors.

5. Freight forwarders: Even if freight forwarders are pretty rare to own containers, they take place in entities that own containers for similar reasons as carriers.

Geographically speaking, data from the World Bank (2021) shows that the countries with the most containers passing through their ports are China, the United States, Singapore, South Korea, Malaysia, Japan, U.A.E, Germany, Spain, and the Netherlands, which supports the statement about how the shipping container industry has made the world smaller and the economy bigger (Levinson, 2006). Subsequently, as global trade depends on the balance between resource allocations and the elements, the container shipping industry must be aware of international trade and economic imbalances since any disruption in this relationship makes the global system shake.

Nowadays, the most debated risks by stakeholders in the container shipping industry are natural catastrophes, cyber threats, technological shortcomings, and piracy. Moreover, even when the

literature review seems strong in previous historical approaches, statistics, data recompilation, market size, benefits, challenges, and technical information. It presents some gaps regards to what is currently happening in the container shipping industry after the Covid-19 pandemic, what possible solutions for today's challenges can be considered, and even more, what is predicted for the future of the container shipping industry, where risk management and on-time strategies are crucial to success.

Overview of Covid-19 in the global trade

At the beginning of 2020, the Covid-19 virus began to spread in China, which made them close their regions and dedicate themselves to managing the crisis first than the rest of the world. Therefore, while China was almost overcoming the problem, the rest of the world was gaining knowledge about it and making some efforts to be prepared. All this leaves world trade in an under-pressure scenario, where countries have had to play a role as buyers or sellers.

When America and Europe were in lockdowns, people stuck in homes caused changes in global consumption trends and the balance of consumption. Sanitary goods, technology devices, furniture, and other types of equipment were increasingly demanded, and China was prepared to play an essential role in this scenario. As it happened, China began fulfilling export needs, and

millions of containers with food, electronics, furniture, and other goods were sailed from the Asian ports to Europe and American ports and finally to the end consumers.

Nevertheless, since people stopped going to work and the production of goods was limited, countries didn't export, and containers were leaving the Asian ports, but they weren't coming back. This means that goods coming from Asia couldn't be loaded, and seaport operations were seriously slowed down.

As global container shipping is the heart of the worldwide supply chain, from manufacturing delays to traffic jams at ports and a scarcity of personnel combined with growing demand worldwide, all the supply chain networks feel the pressure. These had created substantial problems for businesses that rely on international shipping routes to reach clients; the first signs of collapse appeared in August 2020 when there were not enough containers and prices for transportation increased. It can be noted that experts define shipping container shortage as the reduction in the number of shipping ships operating. According to Brian M. Sondey (2021), CEO of Triton International, "Several of our major customers report that virtually every ship leaving China and other export areas is fully loaded, but because of the tight sailing schedules and the need to turn ships quickly, they are unable to wait for all the empty containers, and they leave with 5% - 8% fewer containers on the backhaul leg than they were on the fronthaul leg"

So, with the global trade imbalance, uncertainty, the shipping container shortage, cost adjustments, and the chaos in transportation, sources, and destinations, the level of business activity has been changing as well as prices. Which highly affects the shipping container industry

and its path to overcoming this crisis. Consequently, governments and companies had to adopt risk mitigation strategies to face the crisis and remain competitive in the economy.

The shipping container shortage due to Covid-19

Economically, the optimal equilibrium point in a market is reached when the quantity supplied matches the quantity demanded. Then, shortages occur when the amount required by customers exceeds the quantity offered by the suppliers. For experts, the three main causes of shortages are an increase in demand, a decrease in supply, or government intervention. In addition, they measure the cost of a shortage by determining its relation to its opportunity cost, which can be cataloged as follows: A loss of sale occurs when the product reaches the destination point late, and the deal is lost.; A loss of customers is when the business does not fulfill customer satisfaction and the company loses customer loyalty; Finally, Loos of Goodwill is when a relationship with a customer is negatively affected. In addition, experts establish the three leading causes of shortages as an increase in demand, a decrease in supply, or government intervention.

In a market economy, shortages are resolved by market forces, which means that supply and demand tend to adjust until they meet a new equilibrium point, even though when unexpected disruptions occur, reaching balance can be a complex and time-consuming path, as in the Covid-19 pandemic shortages.

The shipping container industry is the backbone of freight, maritime transportation, international trade, and the global economy. As discussed before, the Covid-19 pandemic has put the shipping container industry in the spotlight of the current global supply chain crisis, which has shut down the delivery of goods worldwide. The lack of enough ships available in the appropriate quantity at the proper time due to widespread manufacturing delays and bottlenecks worsened when too many containers were stocked at shipping terminals, avoiding the arrival of additional cargo.

In other words, due to the epidemic, seaports worldwide shut down, and there were fewer cargo ships in operation, which caused some areas to have an abundance of shipping containers while others experienced a severe shortage. With chronic container shortages at some ports, many containers were stuck in inland depots, and others were stacked up at cargo terminals.

Then, exporters had trouble locating the empty containers they typically use to ship their goods to buyers abroad. So, the issues with shipping containers are only worsening as the more extensive manufacturing sector struggles to adapt. As Levinson (2021) said, " The shipping container is a lot more complicated than it looks, and solving supply chain challenges will require far more than just producing more boxes." As building containers is highly expensive, the shipping containers development is concentrated among the same owners.

According to the World Trade Organization (2022), "Around 80% of the world's shipping containers are manufactured by three Chinese companies, China International Marine Containers (CIMC), Dubai International Financial Centre (FDIC), and Changzhou Xinhuachang

International Containers Co., Ltd. (CXIC)". To meet the demand for shipping containers, these companies are increasing their output at record rates. However, despite manufacturers increasing their production, the inventories of the new containers remain extremely low, causing the price increase. Even more, adding more ships would exacerbate the congestion at ports and lengthen the wait time. So, to balance containers globally, the ports should be adequately prepared to manage the volume of ships and containers.

As port infrastructure was not made any significant improvement to handle the needs of exporters, the inadequate port infrastructure was highly affecting the panorama of the shipping shortage during the pandemic. This means coordination and collaborative supply chains need to enhance operations and undercome the actual perspective. As established by OECD (2022), International trade plunged in 2020 but recovered sharply in 2021. Then, the global container shipping sector seemed to continue improving with the inclusion of vessels, advanced port infrastructure, transparent rules, and technology applied to predict quantities, pick optimal routes, and maximize port capacities. In short, to ensure that the shipping container market is stable again, shortage management should entail monitoring available supply and demand and boosting each player's strategies. Without effective shortage management, shortages will keep disrupting supply chains and will impact business costs extra money.

Risk Management

In business, risk management is understood as identifying, monitoring, and controlling potential risks in a company to minimize the negative impacts they may cause. An accurate risk management plan considers the full range of risks that can be faced and seeks to understand the relationship between risks and companies' strategic goals.

Every organization worldwide faces unexpected events that can cost it significant losses; the literature review indicates that over the past years in international trade, maritime transportation, and container shipping business, risk management has attracted considerable attention given its close relationship with the optimal flow of business and the fulfillment of its objectives.

Regarding maritime shipping, risk can be identified as Supply risk, known as a logistical risk since it studies the probability of perturbing the circulation of products through the supply chain. It includes bottlenecks in maritime routes, labor strikes, lack of equipment, and other factors that can enhance the resilience of the ocean systems. Demand risk is related to unexpected customer demand and preferences. In maritime companies, it is affected by the long-term demand and the spot market demand. Business risk is also called economic or financial risk because it includes the stability of the maritime company's finance management. Operational risk, evidenced during the operational transport process, is also understood as a technical or physical risk. Environmental risk is related to the events that can influence navigation, maritime transport, and cargo flow. So, it can be linked to uncertain weather, natural disasters, political conflicts, and crisis.

Organizational risk is understood as managerial, planning, and controlling risk. It cares about the performance and management level in shipping the companies. Infrastructural risk: It comprises the failures in resources, infrastructure, modes, or information in the maritime supply chain.

No matter the nature of the risk, business resilience results from a company's quickness and effectiveness in identifying risk and handling strategies. This cyclical process of identifying, assessing, managing, and monitoring risks is known as risk management and allows companies to protect themselves and remain profitable. Then, thanks to risk management strategies, a company can identify its strengths, weaknesses, opportunities, and threats and determine operational and business continuity.

Into the common risk responses, avoiding the risk might work to remove a possibility of a threat becoming true, and accepting the risk could be the path when the consequences are few or it does not affect the company projects. However, the best option is mitigating the risk since it can damage business performance and be costly. Then, in mitigating strategies, it is indeed the identification of the risk, the assessment of possible solutions, the target plan, the actions to take, and the continuous examination of the results. As sometimes, overwhelming risk attack business, transferring the risk to another party or an expert can result in a better choice.

Just as crises can happen suddenly as Covid-19, The evaluation and preparation for future disruptions are essential to mitigate the negative consequences and to decrease logistics failures that can delay the improvement of maritime logistics systems. Afterward, as Tom Soderstrom stated, "When you take risks, and they work out, they lead to new capabilities you never saw

before." Up to date, the risk management strategies perceived in the freight transportation companies once the Covid-19 pandemic started are identifying risk, data analysis, risk forecasting, risk assessment, early warning systems, contingency planning, leveraging best practices, risk-reward research, product development, strategical investment, and supportive supply chain networks.

Global supply chain collaboration

Supply chain collaboration in the container shipping context can be defined as the extent to which container shipping firms and their partners jointly work to ensure service reliability, value-added service, productivity, and superior logistics service performance (Seo et al., 2016). Then, to achieve high levels of satisfaction and performance and maintain global coverage levels, different entities and companies must work together toward common objectives to effectively manage their supply chains. Moreover, collaboration is undoubtedly the key to boosting economic growth and global trade, considering the amount of data, the daily transactions, and the flow of materials between suppliers, companies, contract manufacturers, logistics providers, and consumers.

Supply chain collaboration has been a crucial driver of superior performance (Kim and Lee, 2010). Historical approaches show that supply chain collaboration is exponentially growing,

and innovative paths to business are efficiently implemented. Concerning the container shipping industry, building trust, transparency, ethical standards, commitment, communication, and relationships with their partners in long-term scope can positively lead to better performance and competitiveness in maritime logistics. Suddenly, container shipping firms must share information and seek to collaborate with other supply chain stakeholders.

Many players have only been able to survive through collaborating with other operators to maintain their fill utilization rates, which is critical for their operating profitability (Nair, 2009). With the supply and demand challenges product of the COVID-19 pandemic, companies have learned that collaborative-decision making decreases the probability of failures, losses, and decision errors; As documented in the UNCTAD (2021) Report review of maritime transportation, "Successful trade relies on cooperation between public administrations and the business community. With trust and dialogue among stakeholders, the trade ecosystem can develop sustainably, and public reforms can respond to the needs of the trader community."

Also, case studies and literature reviews demonstrate that collaboration along the supply chain reduces the occurrence of logistics shortages and increases responsiveness to uncertain and dynamic marketplaces. As an example, maritime transportation companies and port sectors represented by a group of international industry associations with consultative status with the IMO (International Maritime Organization) were supported and promoted to cooperate between the Member States and stakeholders in the marine supply chain industry during the Covid-19 pandemic, along a call for intergovernmental cooperation at the national, and global levels. Then,

in a post-pandemic atmosphere, business along the seas must be characterized by collaboration and not coercion, which is traduced in moving from the mindset of few to many winners.

3. Methodology

Introduction

This section relates the methodological approach to determine the impact of the shipping container shortage due to the COVID-19 pandemic on maritime freight transportation and international trade. It presents the selection of the study area, research question, research design, research approach, study population, sampling and sample size, data collection, validity and reliability, data analysis, and the ethical consideration of the research paper. The details are described below.

Selection of the area of study

The shipping container shortage due to the COVID-19 pandemic is chosen as the study area because the impact that had on maritime freight transportation and international trade has led professionals, researchers, companies, governments, stakeholders, and all industry actors to look for added-value knowledge regards the importance of risk management strategies.

Research question

This research paper aims to answer the question, what is the impact of the shipping container shortage due to the COVID-19 pandemic on maritime freight transportation and international trade? And seeks to understand the shipping container shortage disruption to secure a higher appreciation of the current perspective of maritime freight and the importance of risk management strategies, preparedness, and resilience in companies to be better prepared for future shortages and disruptions.

Research design

Mixed methods research is becoming essential to analyze and understand complex constraints such as the impact of the shipping container shortage due to the COVID-19 pandemic on maritime freight transportation and international trade since it is an area of study that involves the global economy, a very dynamic industry, a complex health-related crisis, and the entire world population.

Therefore, this research paper looked for the why and the what to provide essential insights that allowed the study to compare and contrast the results obtained and deliver more profound conclusions that bring value to the field of study. Then, the coming research path is designed by purpose as descriptive research, which seeks to describe a phenomenon accurately; By type of data as a mix of qualitative and quantitative analysis, based on methodological triangulation, considering that it used both data types to reach the same topic through analyzing different perspectives, with rich and detailed qualitative approaches and hard-based quantitative analysis; By timescale as longitudinal research, since the study collects information at several points in time; And finally, by logical reasoning as inductive research, aiming to get conclusions from what is observed.

Research approach

This research was conducted between September 2021 and October 2022; the current review can have several limitations because the shipping container shortage due to the COVID-19 pandemic is a current crisis constrained by multifactorial and dynamic changes. Then, methodological triangulation research was employed to achieve a holistic perspective of the study area and research question with credibility and validity to find a response to the research question.

As this research paper analyzes qualitative and quantitative data, the study was divided into the following four phases with the upcoming collection methods, sources, and methodological processes:

The first phase involved collecting primary data for the research question and background. Then, a qualitative data collection technique was applied and, more specifically, an exploration of literature review, case studies, observations, and audio recording notes to discover and understand the main concepts and validate the appropriate information to conduct the study.

In the second phase, secondary sources of information such as the world bank, OECD reports, International Monetary Fund analysis, and national databases statistics were reviewed to guarantee that the findings and practical knowledge were well-based and that the study could demonstrate solid academic support.

In the third phase, 29 experts in the study area reviewed their perspectives on the COVID-19 effects on CEVA Logistics, a subsidiary of CMA CGM Group strategic management, resilience, and preparedness. Thus, they added new insights, experiences, and perspectives to the

existing data through a structured Microsoft questionnaire sent by email to previously selected company employees.

In the fourth and final phase, aiming to complement this research, a quantitative approach was conducted to add quantitively measurable information to confirm and complete previous non-numerical assumptions and theories with precise data.

The main reason for conducting qualitative and quantitative research approaches was to give value to non-numerical insights and personal experiences. Based on this understanding, a conceptual framework about the impact of the shipping container shortage due to the Covid-19 pandemic on maritime freight transportation and international trade was made to highlight the importance of risk management strategies, preparedness, and resilience in companies to be better prepared for future shortages and disruptions. Finally, a contribution to the current literature will be made with the competition of the study.

The population of the study

The study population in the third phase was 29 respondents that currently work for CEVA Logistics, a subsidiary of CMA CGM Group, and are considered experts in the study area compared to the rest of the population due to their years of experience in the field, studies, and

knowledge. In addition, the reason for choosing this target group is their involvement in the supply chain and freight transportation industry as employees of one of the world's leading companies in shipping and transportation, CMA CGM Group.

In-depth, the 29 respondents are currently part of the group company in the departments mentioned in the table below and were able to provide accurate and necessary information regarding their perspectives on the COVID-19 effects on the company's strategic management, resilience, and preparedness.

Respondent ID	Department to which belongs:	Position/role in the company:
1	Global Contract Logistics	Contract Logistics Solution Design Expert
2	Global Contract Logistics	Contract Logistics Solution Design Expert
3	Global Contract Logistics	Contract Logistics Solution Design Expert
4	Direct Procurement and fleet management	Senior Vice President
5	Digital Contract Logistics	Global CL Analyst

6	Global Contract Logistics	Automation professional
7	IT Contract Logistics Solution Design	IT Expert
8	Engineering	Solution Engineer
9	Commercial Deployment	Commercial Analyst
10	Global Contract Logistics	Global Manager Solutions Design
11	Global Contract Logistics	Contract Logistics Solution Design Expert
12	Global Contract Logistics	GM Solutions Design and Implementation
13	Global Contract Logistics	Project development supervisor
14	Ocean product	Global expert reefer
15	Global Contract Logistics	Contract Logistics Solution Design Expert
16	Solution Operation Excellence	SVP Solution Operation Excellence Contract Logistics
17	Global Contract Logistics	Head of Automation
18	Global Contract Logistics	Solution Design professional
19	Ocean product	Ocean agent
20	Strategy	Supply chain supervisor

21	Ocean product	Support specialist
22	Ocean product	Ocean controller
23	Global Project Management	Department Head
24	Operations	Ocean Specialist
25	Strategy	Business Implementation Expert
26	Human Resources	Human Resources business partner
27	Operations	Freight Operations lead
28	Business development	Senior analyst
29	Finance	Financial performance and prospective advisory

Fig 1 Respondents Department and position

Source: Author's own work

Sampling and Sample size

For the purpose of the study, it was necessary to select a sample of the whole population to minimize the time. Then, CEVA Logistics, a subsidiary of CMA CGM Group, was selected. The sample size included 29 expert respondents from different departments and positions who could represent the whole population. Then, as those included in the sample are actively immersed

in the freight transportation industry and were freely available and motivated to participate by giving their perspectives and experiences, the information concerning the study area can be used accurately in the present research paper.

Data collection

To collect quality evidence that could be analyzed and answer the research question with credibility, both primary and secondary data were collected as follows:

Primary Data

Primary data was built thanks to data collection tools and the 29 experts' review of the topic through the structured questionnaire created on Microsoft forms and applied to gather the following content and a mixture of open and closed-ended questions:

Questionnaire:

1. Indicate the name of the company you are currently working for: *

2. Check the box if your company has operations in the following regions: *

- ☐ North America
- ☐ South America
- ☐ Europe
- ☐ Asia
- ☐ Africa

3. Indicate the department to which you belong: *

4. Indicate your position/role in the company: *

5. How many years of experience do you have in the Supply Chain Industry? *

6. How informed/familiar are you with the current news and trends in international trade? *

- ○ Very familiar
- ○ Familiar
- ○ Somewhat familiar
- ○ Unfamiliar
- ○ Very unfamiliar

7. For you, who are the three main competitors in the shipping container industry? *

8. Indicate the level of sensitiveness of the supply chain industry to: *

Political factors

Economic factors

Environmental factors

Technological factors

Legal factors

Price competition

9. Check the box if your company has a specific plan to invest in: *

- □ Resilience and risk management
- □ Operations and equipment
- □ Acquisition’s
- □ Environmental sustainability
- □ Infrastructure
- □ Market development research
- □ None of them
- □ Other

10. Check the box if your company has a specific plan to mitigate or to face: *

- □ Natural disasters

- □ Pandemics/sanitary emergencies
- □ Economic fluctuations
- □ Climate changes
- □ None of them
- □ Other

11. Check the box if the following risk investment strategies are included in your company: *

- □ Forecasting Risk
- □ Early Warning Systems
- □ Risk Management
- □ Resilience Building
- □ Promote Stakeholders' Relations
- □ None of them
- □ Other

12. Has COVID-19 negatively impacted your company? *

- ○ Yes
- ○ No
- ○ Do not know

13. Indicate the type of impact that your company experienced due to COVID-19:

Market Share

Competitiveness

Profitability

Use of technology

Labour force

14. Please state which of the following initiatives your company has taken to reduce the effects of the COVID-19 crisis *

- □ Operational adjustments
- □ Labor adjustments
- □ Financial adjustments
- □ Contingency plans
- □ Stakeholder's adjustments
- □ Greater use of technology tools
- □ Improvements in communication strategies
- □ Prioritization in the purchase of raw materials
- □ Follow government decisions
- □ None of the above
- □ Other

15. Please rate the success of the measures taken in reaction to the COVID- 19 disruption's effects on your company *

- ○ Very effective
- ○ Somewhat effective
- ○ Neither effective nor ineffective
- ○ Somewhat ineffective
- ○ Very ineffective
- ○ Do not know

16. Has COVID-19 resulted in any positive benefits or opportunities for your company? *

- ○ Yes
- ○ No
- ○ Do not know

17. If yes, Indicate

18. Looking ahead, how important do you think that is to invest in risk and crisis management strategies to face future disruptions? *

- ○ Extremely important

- ○ Somewhat important
- ○ Neutral
- ○ Somewhat not important
- ○ Extremely not important

19. Indicate the areas that require strengthening for your company to be more resilient to crisis and disruptions *

- □ Risk forecasting
- □ Risk Management
- □ Communication strategies
- □ Identifying Good practices in crisis and disruptions management
- □ Digital tools
- □ Investment strategies
- □ Other

20. Please add any other information that you may consider useful or relevant regards the impact of COVID-19 on your company

Secondary Data

Secondary data was extracted from further documentation in the study area found in OECD articles, journals, videos, market reports, financial analysis, databases, the World Bank database, Drewry's world container database, International Monetary Fund reports, and national statistics reports.

In-depth, the secondary data collected and applied to the research paper englobe: cargo traffic, number of containers in the world, consumption patterns, seaport operations, transportation cost of one container, container turnover imbalance, rates of carriers, business activity (volume of containers), and global exports and imports.

Validity and reliability

To guarantee the validity and reliability of the research, the research supervisor provided guidance and approved the instruments applied to address the research question. In addition, the researcher tried to be as impartial, neutral, and objective as possible. All the data extracted is related to the study area and is analyzed in a clear and practical format to avoid misinterpretations.

Data Analysis

The qualitative data was sorted, classified, linked, and interpreted, while the quantitative data were analyzed and reduced to practical and manageable findings thanks to descriptive analysis and statistics. Then, the interpretation of the data analyzed solves the research question, generates conclusions, gives recommendations, and proposes future directions.

Ethical consideration

In the context of this research paper, truth and ethics are promoted, as well as avoiding errors and misunderstandings. Thus, the researcher protects the respondent's identity and takes care of all sensitive information throughout the research. Then, all statements and theories from other resources that were incorporated into the study are adequately referenced to avoid plagiarism and credit the owner of the contributor.

4. Analysis & Results

For the purpose of this research paper, the main findings derived from the four phases of the applied methodology explained before will be presented in a chronological sequence, along with their explanation and discussion. So, the impact of the shipping container shortage due to the COVID-19 pandemic on maritime freight transportation and international trade, as well as the importance of risk management strategies, preparedness, and resilience in companies to future shortages and disruptions, will be put into words, graphs, and tables throughout this section as a result of the data obtained.

To start, balance is where trade revolves around. Their stability depends on the strength of the connections between the elements and the resource allocation. If any disruption affects the equilibrium, the global economy starts to shake and change, as presented below:

Covid-19 effects on international trade timeline

Pre-pandemic	January 2020	May 2020	Spring 2020	Middle 2020	August 2020	August 2021

Pre-pandemic Drewry's world container data shows that in one year alone, cargo traffic was estimated at 811000000 million 20-foot containers, with the presence of 180000000 containers worldwide.

In January 2020, Covid-19 began to spread, and China was focused on overcoming the chaos by closing its frontiers, applying quarantines and lockdowns, and disinfecting the whole nation.

Then, by May 2020, China was in a better situation where people could return to calm and deep breathing. At this time, other countries began to suffer the hard pick of the virus and were encouraged to transform and adapt their operations. As a result, the global economy was divided into buyer or seller nations. China had already overcome the chaos and was ready to sell its products to American and European countries.

As people were locked down in their houses, the consumption patterns of the markets began to change; for example, the hospitality industry (Hotels, travel agencies and services, and restaurants) took a nosedive, while the consumption of electronics, healthcare, and furniture produced in China went up.

By the spring of 2020, China was fulfilling the world's needs. Millions of containers were exported with food, electronics, sanitizers, masks, and other products to European and American ports and then to end customers.

The big “but” arrived when containers were leaving China ports, but they were not coming back as other countries were operating under restrictions.

In the middle of 2020, the global economy ground to a halt since lockdowns and restrictions prohibited people from going to work, producing goods, and finally exporting them. Then, seaport operations were seriously impacted and slowed down by the lack of labor.

The containers were not returned to China and were stored in European and American ports. Data evidence that only 4 out of 10 containers were coming back to Asia at that time and the goods produced in Asia could not be loaded into the containers.

The first big sign of collapse was documented in August 2020, when there were not enough containers, and the price for the transportation of one container exceeded 2000 dollars. The normal price in the pre-pandemic era was around 1500 dollars.

Month	Composite Freight Cost / 1 unit	
Aug-18	$	1.696
Aug-19	$	1.463
Aug-20	$	2.176
Aug-21	$	9.817
Aug-22	$	6.430

Fig 2 Table - Composite Freight Cost / 1 unit per year

Source: Author's own work

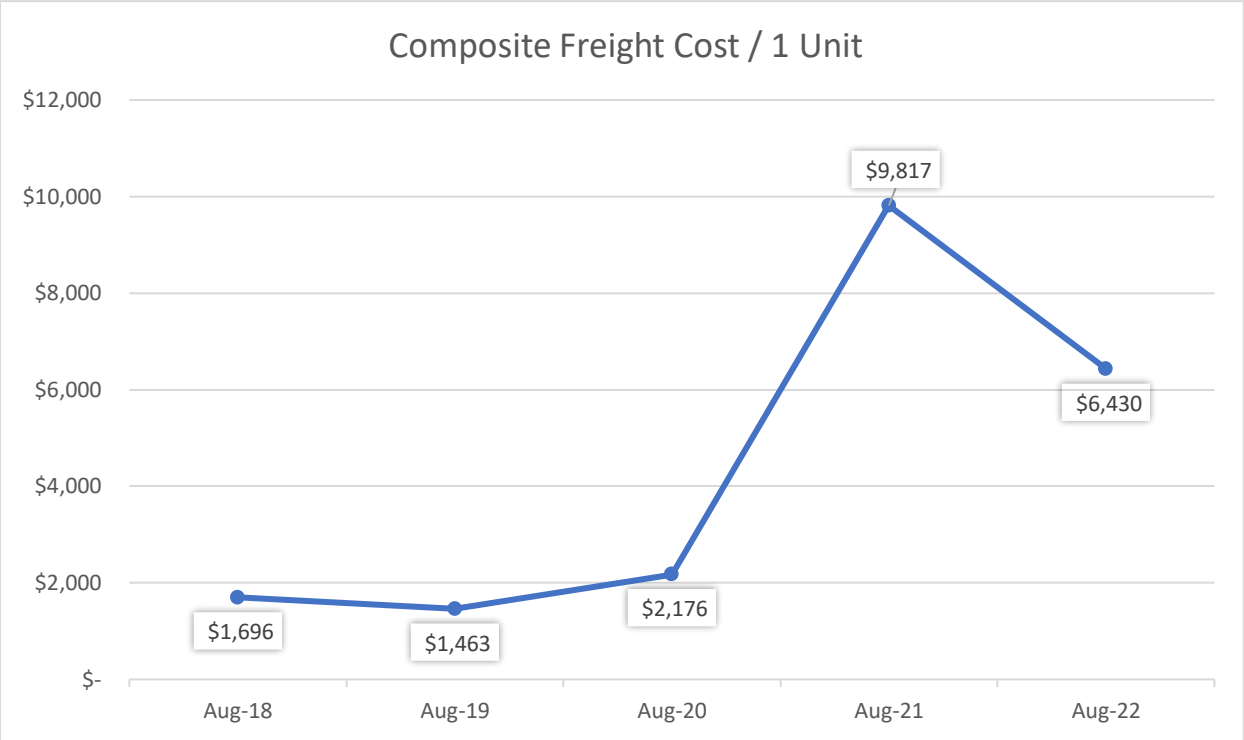


Fig 3 Line graph - Composite Freight Cost / 1 unit per year

Source: Author's own work

For August 2021 the transportation cost arrived at $9800 dollars, (almost 6 times compared to pre-pandemic data); At this time, for some specific routes as Shanghai to Rotterdam the price was $8371 dollars to transport one full container, but transporting it back was costing $1394 dollars (six times difference). For another route Shanghai to Los Angeles, it was costing $5211 dollars to transport a full container, and the way back was costing $589 dollars (nine times difference) documented as a record rate in the entire history of sea freight.

Route	Transportation Cost / 1 Unit
Shanghai - Rotterdam	$ 8.371
Rotterdam - Shanghai	$ 1.394
Shangai - Los Angeles	$ 5.211
Los Angeles - Shanghai	$ 589

Fig 4 Table - Transportation Cost / 1 Unit per Route

Source: Author's own work

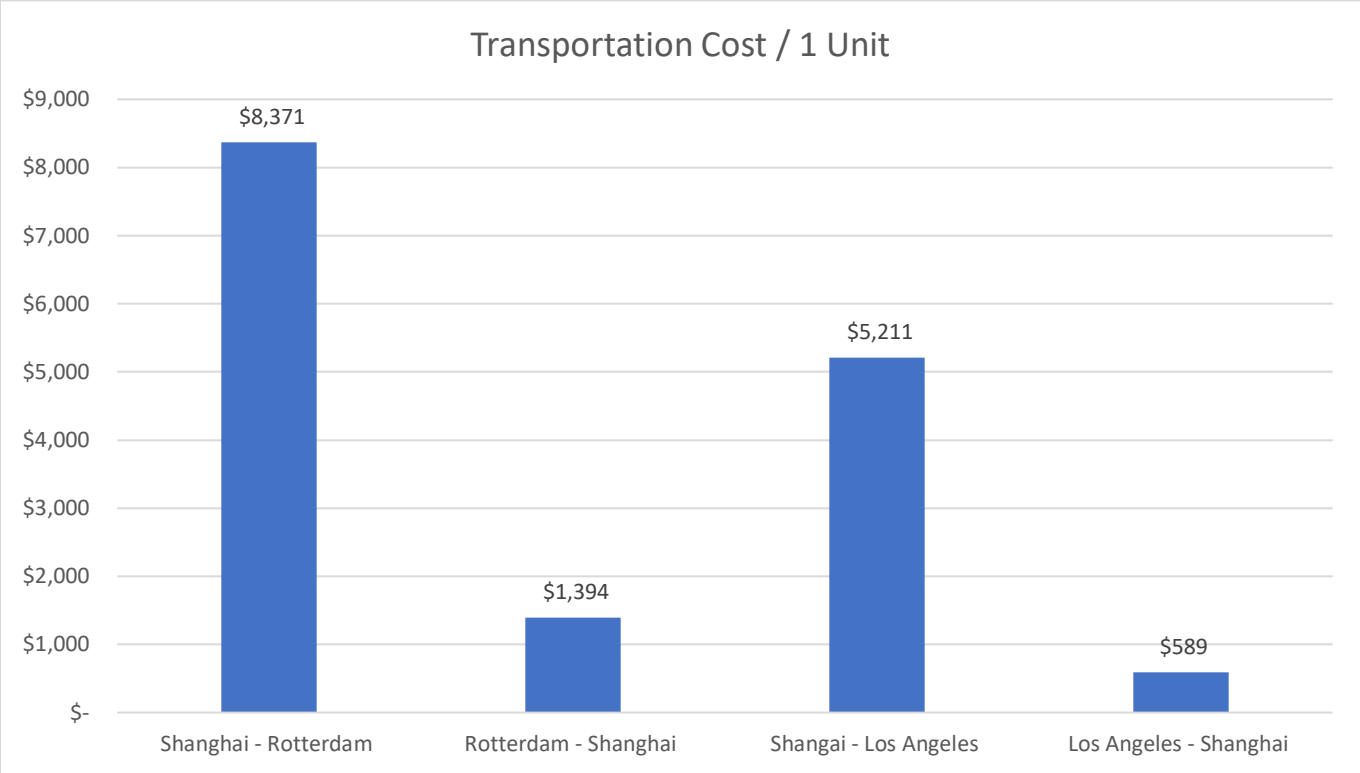
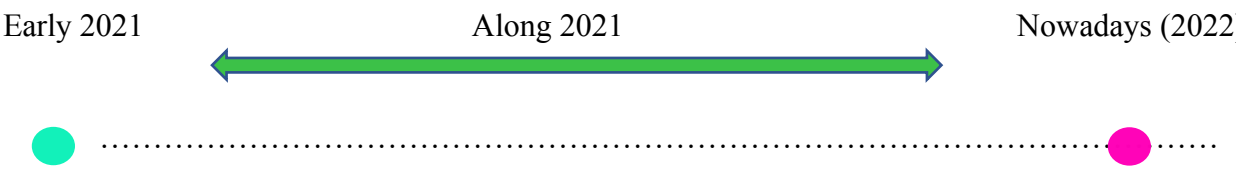


Fig 5 Bar graph - Transportation Cost / 1 Unit per Route

Source: Author's own work

At this time, for carriers, a journey from Shanghai to Los Angeles take 12 days, and for the unloading process 4 days more. For each container, they get paid $5211 dollars, but they had to wait 4 days to take the way back for a trip that was paid 9 times less. (Based on the idea that the cargo was just in time at port)



But, as America and Europe were still getting vaccinated and they had neither enough cargo to export nor the labor force in port (drivers, workers, loaders, terminal workers, etc.) due to restrictions; Carriers were leaving China fully loaded but they were not waiting for an empty container for turning back, then they left with fewer containers

Then, it is not only the balance of container turnover disruption that affects global trade due to the reductions of exports, from the USA and Europe to Asia. But also, for the high rates of carries.

The situation was worsened because Asia was supplying high amounts of goods that exceed pre-pandemic expectations, as in the port of Los Angeles which in 2021 exported as much as before the lockdown (122,899 vs 121,146) but with a 4 times difference between imports and exports (490,115 vs 122,899) with a 122% increase in business activity (volume of containers)

Loaded TEUs - Port of Los Angeles	2020	2021	% Change
Imports	220,255	490,115	122,5%
Exports	121,146	122,899	1,4%

Fig 6 Table - Loaded TEUs in Los Angeles Port per year

Source: Author's own work

As consequence, one strategic decision taken by China was to pay more to carriers in order to bring them back the empty containers, which somewhat resulted effectively. Another decision was to build more containers, even when the prices of manufacturing them raised too. As container manufacturers, leasing companies, and carriers were increasing and increasing their fees and rates, the end customer was assuming all the effects and being dramatically affected as almost all prices were strongly affected by transportation costs.

Can be said that until the moment, the global economy is still facing a shortage of containers, high transportation costs, and a trade imbalance. This highlights the fact that supply chain networks and global trade success depend on the carefully planned collaboration of thousands of people, companies, governments, and organizations. Then, the transport sector continued to focus on its recovery but remain the pressure on risk management strategies, preparedness, and resilience to future shortages and disruptions.

In-depth, as established by the majority of the 29 experts' reviews on the topic through the Microsoft questionnaire applied, it can be analyzed that the level of sensitivity of the supply chain industry to economic, political, and technological factors, as well as to price competition is high, while the sensitivity of the industry to environmental, and legal aspects is medium.

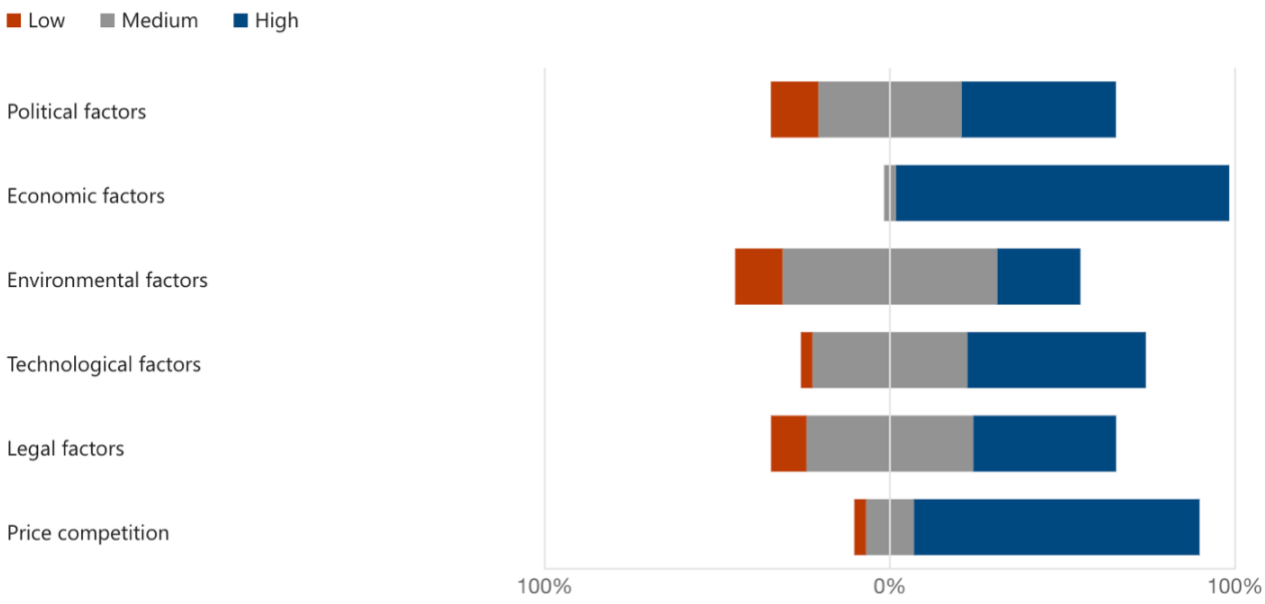


Fig 7 Level of sensitivity of the supply chain to factors

Source: Author's own work

Regards investments at the CMA CGM Group, one of the world's leading companies in shipping and transportation, Acquisitions, resilience and risk management, and sustainability are the priorities.

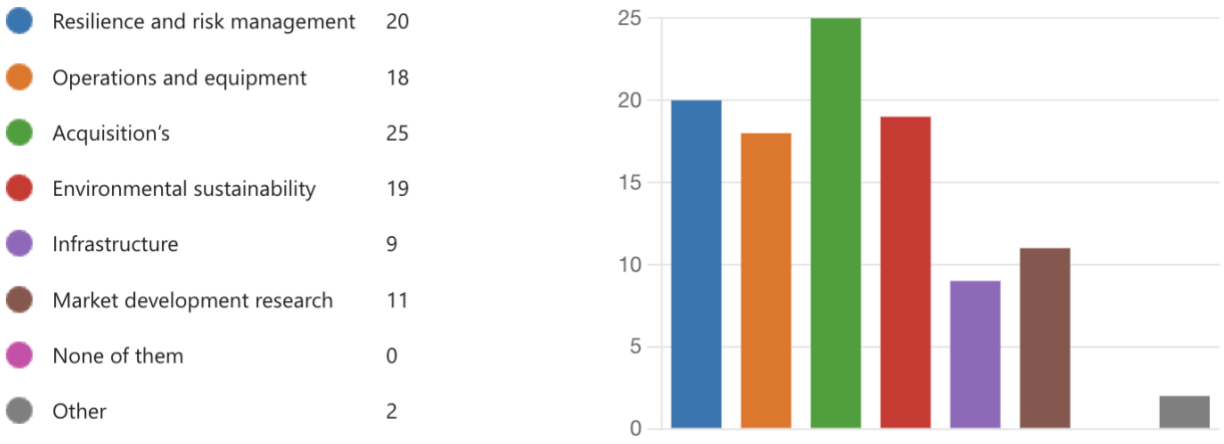


Fig 8 Investments priorities for the company

Source: Author's own work

The company focuses more on economic fluctuation and pandemics/ sanitary emergencies for mitigation plans than climate change and natural disasters.

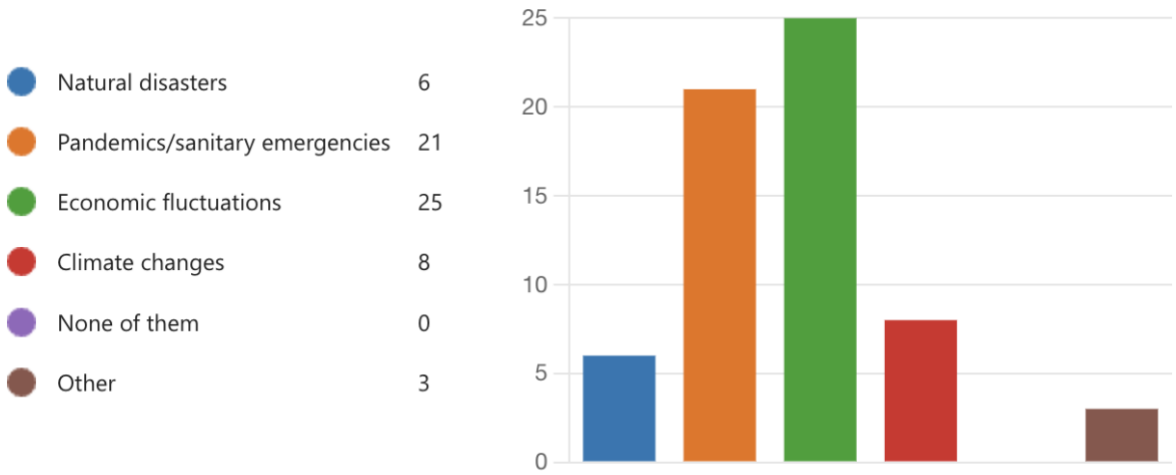


Fig 9 Mitigations plans in the company's culture

Source: Author's own work

In-depth, the respondents highlighted risk investment strategies at their company as risk management, forecasting risk, and early warning systems.

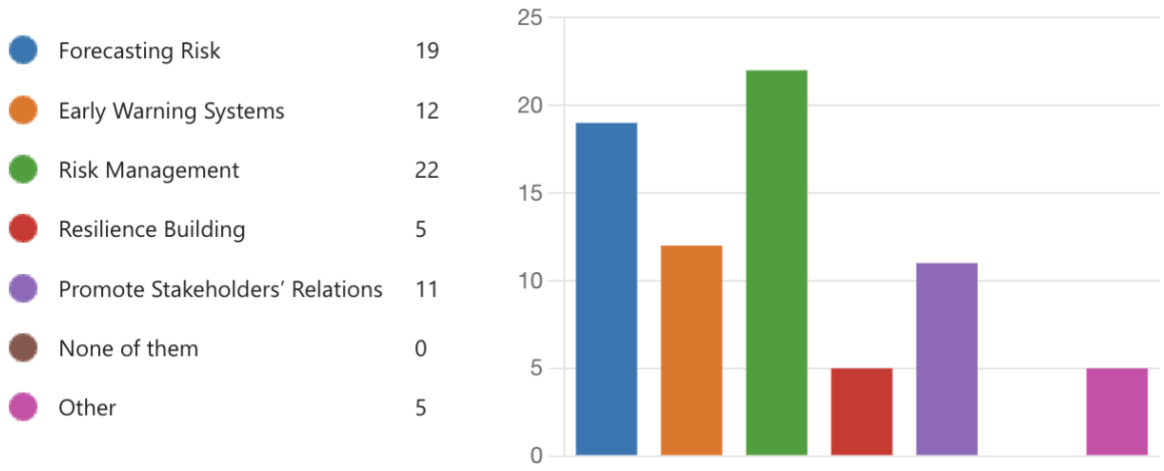


Fig 10 Risk Investment Strategies at the company

Source: Author's own work

Undoubtedly, as mentioned before and as stated by the employees, the Covid-19 scenario does not negatively impact the company. In addition, some of the quotes from the respondents established:

Respondent ID	Quote about the Covid-19 impact on the company
2	Containers shortage also helped to increase pricing and margin
3	More volumes with higher prices

4	Increased turnover
5	Prices went really high in some product lines resulting in super-profit
6	increased importance of E-commerce channel
8	Created a new perspective on how to work and have work-life balance aka hybrid work schedules.
10	Opportunity in Airfreight
12	More eCom opportunities and more interest for austomation
16	BENEFIT FROM THE HIGH DEMAND VS OFFER
17	Growth in Ecommerce and Healthcare sector
18	More products and exchanges around the world basically because everyone was home more or less and had time to spend consuming, ex : Amazon.
19	It brought a lot of measures that were essentials. And it even had external impact for development of technology to improve the comunication between the department. It gave also a lot of opportunities for pharma market of course thanks to laboratory, research and vaccin all around the world.
20	we can also put the impact of E commerce because of the special period that was covid (without travel, some restrictions, everybody at home)

21	It is not a good thing for humanity a disease, but the period was able to propose good opportunities to focus on our behaviour and adjustments on the market. Even inside the company between each department.
22	better understanding of risk and importance of comunication
23	Flexibility in home work
24	Profitability, Supply network stronger
25	Profitability, technological uses, new operations, fast adaptability
26	Technology upgrades, profitability
27	profitability
28	Better understanding of risk, tech improvement, e commerce opportunities, pharma , flexibility
29	profitability, higher turnover, competitiveness, health sector penetration

Fig 11 Table of respondent's quotes about Covid-19 impact on the company

Source: Author's own work

Regarding the company's forces, after the Covid-19 crisis, the company's Market share, competitiveness, profitability, and use of technology experienced a positive impact. Still, the labor force experienced a negative effect.

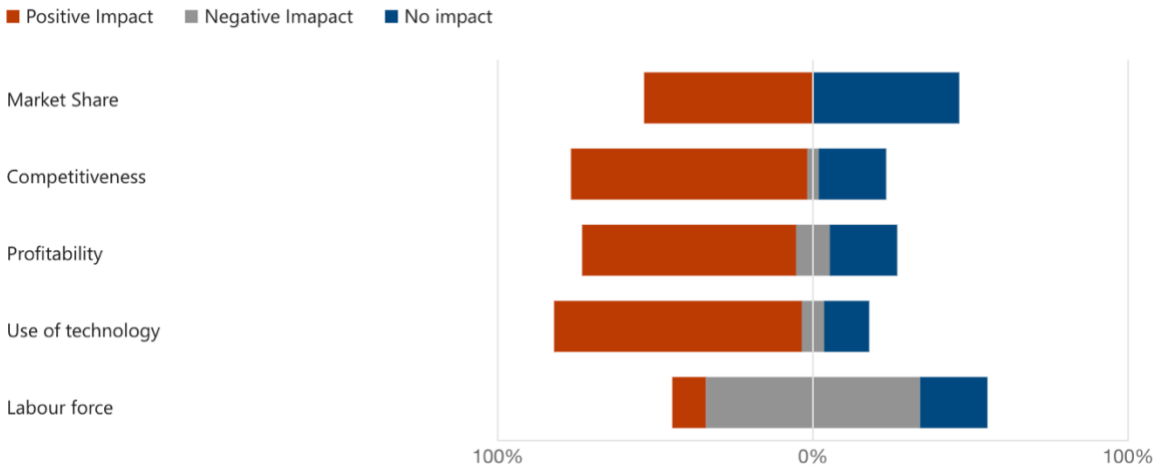


Fig 12 Type of impact experienced due to Covid-19 on the company's Porter forces

Source: Author's own work

As initiatives, the improvement of communications, contingency plans, operational and labor adjustments, and the use of technology tools were the most effective measures taken to reduce the impacts of the crisis.

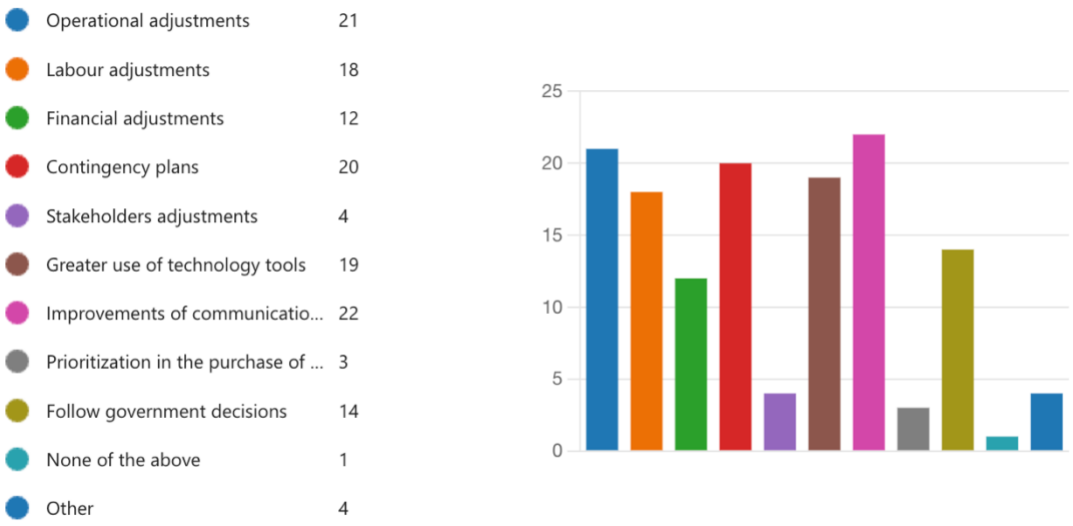


Fig 13 Initiatives taken by the company to face Covid-19 impacts

Source: Author's own work

Looking ahead, the respondents agree that investing in risk and crisis management strategies is extremely important to face future disruptions. They indicate that digital tools, communication strategies, risk management, and identifying good practices in crisis and disruption management are the areas that require strengthening.

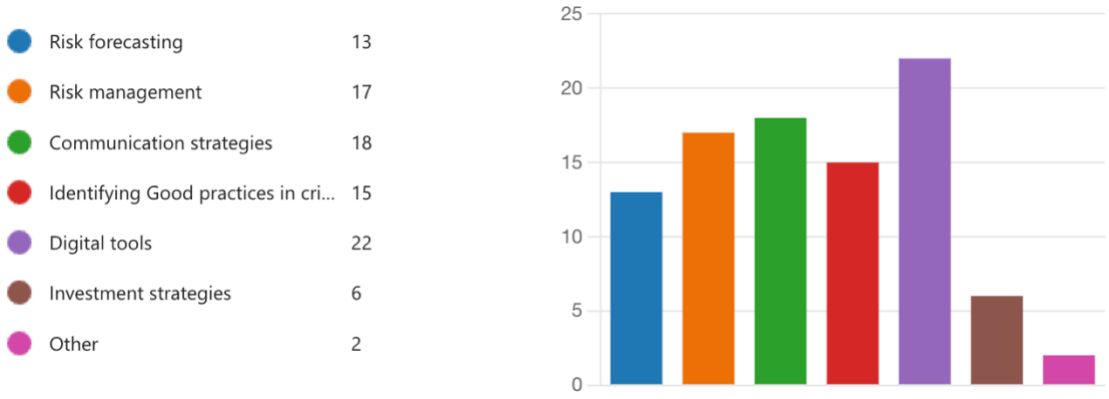


Fig 14 Areas to be strengthened at the company to be more resilient.

Source: Author's own work

5. Conclusions & Practical recommendations

Based on the research question of the current study, " what is the impact of the shipping container shortage due to the COVID-19 pandemic on maritime freight transportation and international trade?" It was able to determine, measure, and explain the impact of the shipping container shortage due to the methodology and analysis applied. In addition, the current study measured the importance of risk management strategies, preparedness, and resilience in companies to be better prepared for future shortages and disruptions. This is why considering the previous findings can establish the following five conclusions and recommendations:

1. The COVID-19 pandemic significantly and quickly impacted the global economy, international trade, and maritime freight transportation. The impact on effective shipping and transportation was so hard due to the shortage of shipping containers as a result of supply chain interruptions; lockdowns, and restrictions that disrupted the movement, production, and facility of goods while the consumer's global demand was increasing; a slowdown in the worldwide market; an imbalance in international trade; higher transportation costs; and unpredictable economic conditions.

2. As secondary consequences, the COVID-19 pandemic has exposed the weakness of port efficiency and connectivity of maritime networks and the importance of supply chain collaboration to afront an unexpected crisis. In support of best practices, companies and governments emphasized that the maritime transportation system will only be viable if it can convey commodities around the globe in a way that is safe, dependable, and efficient.

3. The major participants in the global economy have yet to undergo a strategic revolution. It was stated that the COVID-19 epidemic potentially offers the freight transportation industry an opportunity to rethink how the sector functions. Then the links and relationships between maritime freight transport and rail, ground, and air freight transport modes were affected.

4. In terms of strategic management, resilience, and preparedness in shipping companies such as CEVA Logistics, a subsidiary of CMA CGM Group. It can be stated that Covid-19 disruptions brought opportunities to the company, profitability, and new

markets. The contingency plans, use of technologies, and adjustments in operational, financial, and labor measures let the company reduce the adverse effects and remain competitive and profitable. In addition, it can be highlighted the importance of digital tools, communication strategies, good practices in crisis disruptions, investments, risk forecasting, and management strategies to be more resilient and prepared for future disruptions.

5. For the shipping industry and international trade, mid-and long-term recovery would focus on adaptability to new circumstances, stronger relationships, and dynamic supply chain networks and operations.

6. Limitations & Future directions

Although this research paper accomplished its objective, this study has limitations since the shipping container shortage due to the COVID-19 pandemic is a current crisis constrained by multifactorial and dynamic changes. Even more, there is a lack of previous academic research studies on this specific topic that can address at the same time the impact of the shipping shortage due to the COVID-19 pandemic on maritime freight transportation and international trade, and also the importance of risk management strategies, preparedness, and resilience in companies to be better prepared for future shortages and disruptions.

Regards the methods and techniques used to collect the data, huge reports and data address the same phenomenon using different perspectives and measurement techniques. Quantitative data and statistics can differ from research to research and are challenging to synthesize and collect. In addition, limited access to certain people in the organization led to restructuring the investigation. Then, in the future, addressing a large number of observations, interview perspectives, and questions could add more data that help to include missing variables.

Due to deadlines for the researcher, this study was conducted between September 2021 and October 2022. More data and insights can be added for future studies to answer the current research question as the study englobes a longitudinal perspective on time.

7. References

Agamez-Arias, A.-M., & Moyano-Fuentes, J. (2017). Intermodal transport in freight distribution: a literature review. Transport Reviews, 37(6), 782–80, from https://doi.org/10.1080/01441647.2017.1297868

Alphaliner (2013), "Top 100 operated fleets", available at: www.alphaliner.com/top100/ (accessed 17 March 2022).

Arbour, G. (2022, March 25). What are the 4 types of maintenance strategies? Fiix. Retrieved October 25, 2022, from

https://www.fiixsoftware.com/blog/evaluating-maintenance-strategies-select-model-asset-management/

Armbruster, W. (2008). Missing the boat on exports. Florida Shipper, 33(21), 6–10.

Bai, X., Xu, M., Han, T., & Yang, D. (2022). Quantifying the impact of pandemic lockdown policies on global port calls. Transportation research. Part A, Policy and practice, 164, 224–241. https://doi.org/10.1016/j.tra.2022.08.002

Balgah, R.A. and Kimengsi, J.N. (2022), "Glossary of Disaster Risk Management – Related Terms", Balgah, R.A. and Kimengsi, J.N. (Ed.) Disaster Management in Sub-Saharan Africa: Policies, Institutions and Processes, Emerald Publishing Limited, Bingley, pp. 225-265. https://doi-org.rennes-sb.idm.oclc.org/10.1108/978-1-80262-817-320221010

Burnson, P. (2021, July 1). Container shortage continues to restrict options on the high seas. Logistics Management (Highlands Ranch, Co.), 60(7), 25.

Chang, C.-H., Xu, J. and Song, D.-P. (2015), "Risk analysis for container shipping: from a logistics perspective", The International Journal of Logistics Management, Vol. 26 No. 1, pp. 147-171. https://doi-org.rennes-sb.idm.oclc.org/10.1108/IJLM-07-2012-0068

Chang, C.-H., Xu, J., Dong, J. and Yang, Z. (2019), "Selection of effective risk mitigation strategies in container shipping operations," Maritime Business Review, Vol. 4 No. 4, pp. 413-431. https://doi-org.rennes-sb.idm.oclc.org/10.1108/MABR-04-2019-0013

Container, T., & *, N. (2022, June 22). The 8 most common types of containers: Tec Container. Tec Container Cargo securing and lifting equipment since 1976. Retrieved October 25, 2022, from https://www.teccontainer.com/blog/most-common-types-of-containers/#flat-rack-container

Covid-19 and maritime transport: Impact and responses. UNCTAD. (2021, March 23). https://unctad.org/webflyer/covid-19-and-maritime-transport-impact-and-responses#:~:text=Maritime%20transport%20underpins%20global%20supply,more%20than%2070%25%20by%20value.

David Guerrero, Lucie Letrouit, Carlos Pais Montes. The container transport system during Covid19: An analysis through the prism of complex networks. Transport Policy, Elsevier, 2021, 24p. ffhal-03384986f

Desk, N. (2020, August 22). 42% will change supply chain strategies post Covid-19 - Impact Survey. Shipping and Freight Resource. Retrieved October 25, 2022, from https://www.shippingandfreightresource.com/supply-chain-strategies-post-covid-19-impact-survey/

Documents & Reports - all documents: The World Bank. World Bank, from https://documents.worldbank.org/en/publication/documents-reports

Dong, C., Akram, A., Andersson, D., Arnäs, P.-O. and Stefansson, G. (2021), "The impact of emerging and disruptive technologies on freight transportation in the digital era: current state and future trends", The International Journal of

Logistics Management, Vol. 32 No. 2, pp. 386-412. https://doi-org.rennes-sb.idm.oclc.org/10.1108/IJLM-01-2020-0043

Dong, J., Xu, J. and Song, D. (2013), "Assessment of empty container repositioning policies in maritime transport", The International Journal of Logistics Management, Vol. 24 No. 1, pp. 49-72. https://doi-org.rennes-sb.idm.oclc.org/10.1108/IJLM-05-2013-0054

Drewry World Container index: Maritime shipping: Collection. MacroMicro. (2022, July 15), from https://en.macromicro.me/collections/4356/freight/44756/drewry-world-container-index

Factoria. (2021, March 11). ¿Qué es el blank sailing y cómo afecta al transporte marítimo? APR. Retrieved October 27, 2022, from https://www.apr.es/que-es-el-blank-sailing-y-como-afecta-al-transporte-maritimo/

Faupel, C. and Michels, R. (2014), "Value-Based Risk Management: Costs and Benefits", Advances in Management Accounting (Advances in Management Accounting, Vol. 24), Emerald Group Publishing Limited, Bingley, pp. 239-257. https://doi-org.rennes-sb.idm.oclc.org/10.1108/S1474-787120140000024007

Fulzele, V., Shankar, R. and Choudhary, D. (2019), "A model for the selection of transportation modes in the context of sustainable freight transportation", Industrial Management & Data Systems, Vol. 119 No. 8, pp.

1764-1784. https://doi-org.rennes-sb.idm.oclc.org/10.1108/IMDS-03-2019-0169

Gabriel Crainic, T. and Dejax, P.J. (1989), "Freight Distribution and Transportation Systems Planning", International Journal of Physical Distribution & Materials Management, Vol. 19 No. 1, pp. 3-12. https://doi-org.rennes-sb.idm.oclc.org/10.1108/EUM0000000000302

Gavalas, D., Syriopoulos, T., & Tsatsaronis, M. (2022). COVID-19 impact on the shipping industry: An event study approach. Transport policy, 116, 157–164. https://doi.org/10.1016/j.tranpol.2021.11.016

Global survey on impact of COVID19 on ports: Regional differences becoming more pronounced. World Port Sustainability Program. (2020, May 22). Retrieved October 25, 2022, from https://sustainableworldports.org/global-survey-on-impact-of-covid19-on-ports-regional-differences-becoming-more-pronounced/

Harris, A. (2000), "Risk management in practice: how are we managing?", British Journal of Clinical Governance, Vol. 5 No. 3, pp. 142-149. https://doi-org.rennes-sb.idm.oclc.org/10.1108/14664100010351251

Hohenstein, N.-O. (2022), "Supply chain risk management in the COVID-19 pandemic: strategies and empirical lessons for improving global logistics service providers' performance", The International Journal of Logistics Management, Vol. ahead-of-print No. ahead-of-print. https://doi-org.rennes-

sb.idm.oclc.org/10.1108/IJLM-02-2021-0109

International trade during the COVID-19 pandemic: Big shifts and uncertainty. OECD. (2022, March 10). Retrieved October 25, 2022, from https://www.oecd.org/coronavirus/policy-responses/international-trade-during-the-covid-19-pandemic-big-shifts-and-uncertainty-d1131663/

Impacts of the COVID-19 pandemic on ports and maritime transport in the Mediterranean region - union for the Mediterranean. UfM. (2020, June 4). Retrieved October 30, 2022, from https://ufmsecretariat.org/impacts-covid-ports-maritime-transport-mediterranean/

Ivanov D. Predicting the impacts of epidemic outbreaks on global supply chains: A simulation-based analysis on the coronavirus outbreak (COVID-19/SARS-CoV-2) case. Transp Res E Logist Transp. https://pubmed.ncbi.nlm.nih.gov/32288597/

Johnson, E. (2019). High standards: Freight data standardization's long stretch. (cover story). Journal of Commerce (1542-3867), 20(3), 10–16.

Kawasaki, T., Matsuda, T., Lau, Y.-y. and Fu, X. (2021), "The durability of economic indicators in container shipping demand: a case study of East Asia–US container transport", Maritime Business Review, Vol. ahead-of-print No. ahead-of-print. https://doi-org.rennes-sb.idm.oclc.org/10.1108/MABR-12-2020-0075

Ke, J.-y.F., Windle, R.J., Han, C. and Britto, R. (2015), "Aligning supply chain

transportation strategy with industry characteristics: Evidence from the US-Asia supply chain", International Journal of Physical Distribution & Logistics Management, Vol. 45 No. 9/10, pp. 837-860. https://doi-org.rennes-sb.idm.oclc.org/10.1108/IJPDLM-06-2014-0130

Kim, D. and Lee, R.P. (2010), "Systems collaboration and strategic collaboration: their impacts on supply chain responsiveness and market performance", Decision Sciences, Vol. 41 No. 4, pp. 955-981.

Lai, P.-L., Su, D.-T., Tai, H.-H. and Yang, C.-C. (2020), "The impact of collaborative decision-making on logistics service performance for container shipping services", Maritime Business Review, Vol. 5 No. 2, pp. 175-191. https://doi-org.rennes-sb.idm.oclc.org/10.1108/MABR-12-2019-0061

Lin, H., Zeng, W., Luo, J., & Nan, G. (2022). An analysis of port congestion alleviation strategy based on system dynamics. Ocean & coastal management, 229, 106336. https://doi.org/10.1016/j.ocecoaman.2022.106336

Manaadiar, H. (2020, April 24). Covid-19 pandemic - supply chain impact survey and results. Shipping and Freight Resource. Retrieved October 25, 2022, from https://www.shippingandfreightresource.com/covid-19-pandemic-supply-chain-impact-survey/

Mason, R. and Nair, R. (2013), "Supply-side strategic flexibility capabilities in container liner shipping", The International Journal of Logistics Management,

Vol. 24 No. 1, pp. 22-48. https://doi-org.rennes-sb.idm.oclc.org/10.1108/IJLM-05-2013-0053

Matsuda, T., Hirata, E. and Kawasaki, T. (2021), "Monopoly in the container shipping market: an econometric approach", Maritime Business Review, Vol. ahead-of-print No. ahead-of-print. https://doi-org.rennes-sb.idm.oclc.org/10.1108/MABR-12-2020-0071

More containers can't solve shortage. (2021). Journal of Commerce (1542-3867), 22(4), 6–7.

Nair, R. (2009), Economic Regulation and Structural Changes: Liner Shipping Industry, VDM Verlag, Saarbrucken.

Ng, A.S.F. (2012), "Container Flows and Empty Container Repositioning", Song, D.-W. and Panayides, P.M. (Ed.) Maritime Logistics, Emerald Group Publishing Limited, Bingley, pp. 29-48. https://doi-org.rennes-sb.idm.oclc.org/10.1108/9781780523415-003

Pan, J. J., Zhang, Y. F., & Fan, B. (2022). Strengthening container shipping network connectivity during COVID-19: A graph theory approach. Ocean & coastal management, 229, 106338. https://doi.org/10.1016/j.ocecoaman.2022.106338

Park, M. and Singh, N.P. (2022), "Predicting supply chain risks through big data analytics: role of risk alert tool in mitigating business disruption", Benchmarking: An International Journal, Vol. ahead-of-print No.

ahead-of-print. https://doi-org.rennes-sb.idm.oclc.org/10.1108/BIJ-03-2022-0169

Paul, S. K., Chowdhury, P., Chakrabortty, R. K., Ivanov, D., & Sallam, K. (2022). A mathematical model for managing the multi-dimensional impacts of the COVID-19 pandemic in supply chain of a high-demand item. Annals of operations research, 1–46. Advance online publication. https://doi.org/10.1007/s10479-022-04650-2

Paul, S. K., Chowdhury, P., Moktadir, M. A., & Lau, K. H. (2021). Supply chain recovery challenges in the wake of COVID-19 pandemic. Journal of business research, 136, 316–329. https://doi.org/10.1016/j.jbusres.2021.07.056

Pham, H.T., Truong Quang, H., Sampaio, P., Carvalho, M., Tran, D.L.A., Vo, V.X. and Duong, B.A.T. (2022), "The impact of global risks on supply chain performance. An empirical study on construction sector in the COVID-19 pandemic", International Journal of Quality & Reliability Management, Vol. ahead-of-print No. ahead-of-print. https://doi-org.rennes-sb.idm.oclc.org/10.1108/IJQRM-03-2022-0084

Review of Maritime Transport 2021. UNCTAD. (2021, November 18). Retrieved March 27, 2022, from https://unctad.org/webflyer/review-maritime-transport-2021

Seo, Y.J., Dinwoodie, J. and Roe, M. (2016), “The influence of supply chain collaboration on collaborative advantage and port performance in maritime

logistics", International Journal of Logistics Research and Applications, Vol. 19 No. 6, pp. 562-582.

Shackman, J., Dai, Q., Schumacher-Dowell, B. and Tobin, J. (2021), "The interrelationship between ocean, rail, truck and air freight rates", Maritime Business Review, Vol. 6 No. 3, pp. 256-267. https://doi-org.rennes-sb.idm.oclc.org/10.1108/MABR-08-2020-0047

Shardeo, V., Madaan, J. and Chan, F.T.S. (2022), "An empirical analysis of freight mode choice factors amid the COVID-19 outbreak", Industrial Management & Data Systems, Vol. ahead-of-print No. ahead-of-print. https://doi-org.rennes-sb.idm.oclc.org/10.1108/IMDS-03-2022-0133

Shih, W. (2020, February 21). Covid-19 and global supply chains: Watch Out for bullwhip effects. Forbes. Retrieved October 25, 2022, from https://www.forbes.com/sites/willyshih/2020/02/21/covid-19-and-global-supply-chains-watch-out-for-bullwhip-effects/?sh=2119f7ed7195

Sun, Z., & Zhang, Y. (2022). Strategic Crisis Response of Shipping Industry in the Post COVID-19 Era: A Case of the Top 10 Shipping Lines. Journal of Marine Science and Engineering.

Survey reveals covid-19 impact on ocean carriers, next steps for shippers. Kearney. (2020, April 20). Retrieved October 25, 2022, from https://www.kearney.com/covid-19/article/-/insights/survey-reveals-covid-19-impact-on-ocean-carriers-next-steps-for-shippers

TECHSCI RESEARCH. (2021, November). Shipping Containers Shortage and Its Impact on Global Economy. Shipping. Retrieved October 25, 2022, from https://www.techsciresearch.com/blog/shipping-containers-shortage-and-its-impact-on-global-economy/259.html

The basics of freight, transportation and Logistics. Datex Corporation. (2021, December 16). Retrieved October 25, 2022, from https://www.datexcorp.com/the-basics-of-freight-transportation-and-logistics/

The Researcher. (July 4th 2021). Container Shortage: Why the Prices of Goods Are Rising in 2021 [Video]. Youtube. https://www.youtube.com/watch?v=VJH5W0ijdWc

Tong H. (2022). The future development and restructuring of the international shipping industry: Conference report. Marine policy, 137, 104956. https://doi.org/10.1016/j.marpol.2022.104956

Top 50 ports. World Shipping Council. (n.d.). Retrieved October 25, 2022, from https://www.worldshipping.org/top-50-ports

Toygar, A., Yildirim, U. & İnegöl, G.M. Investigation of empty container shortage based on SWARA-ARAS methods in the COVID-19 era. Eur. Transp. Res. Rev. 14, 8 (2022). https://doi.org/10.1186/s12544-022-00531-8

Tripathi, S., Hudnurkar, M. and Ambekar, S.S. (2021), "Selection of mode of transport for freight movement", International Journal of Innovation Science,

Vol. 13 No. 3, pp. 268-285. https://doi-org.rennes-sb.idm.oclc.org/10.1108/IJIS-09-2020-0173

UNCTAD (2008), Review of Maritime Transport, United Nations, Geneva.

UNCTAD. (2021). Trade and development report 2021: From recovery to resilience: the development dimension. https://unctad.org/system/files/official-document/tdr2021_en.pdf. Accessed August 25, 2021.

United Nations Conference on Trade and Development. (2021). Review of Maritime Transport 2020. PDF: UN iLibrary.

United Nations. (2018). 50 years of Review of Maritime Transport, 1968–2018. 2021, by ONU Website: https://unctad.org/system/filesl/official-document/dtl2018d1_en.pdf

Xu, L., Shi, J., Chen, J., & Li, L. (2021). Estimating the effect of COVID-19 epidemic on shipping trade: An empirical analysis using panel data. Marine policy, 133, 104768. https://doi.org/10.1016/j.marpol.2021.104768

Yang, C. and Wei, H. (2013), "The effect of supply chain security management on security performance in container shipping operations", Supply Chain Management, Vol. 18 No. 1, pp. 74-85. https://doi-org.rennes-sb.idm.oclc.org/10.1108/13598541311293195

Yang, C.C. and Wei, H.H. (2013), “The effect of supply chain security management on security performance in container shipping operations”, Supply Chain Management: An International Journal, Vol. 18 No. 1, pp. 74-85.

Zhang, Yan & Zhikuan, Sun. (2021). The Coevolutionary Process of Maritime Management of Shipping Industry in the Context of the COVID-19 Pandemic. Journal of Marine Science and Engineering.

Zhou, X., Dai, L., Jing, D., Hu, H., & Wang, Y. (2022). Estimating the economic loss of a seaport due to the impact of COVID-19. Regional studies in marine science, 52, 102258. https://doi.org/10.1016/j.rsma.2022.102258

Zhou, X., Jing, D., Dai, L., Wang, Y., Guo, S., & Hu, H. (2022). Evaluating the economic impacts of COVID-19 pandemic on shipping and port industry: A case study of the port of Shanghai. Ocean & coastal management, 230, 106339. https://doi.org/10.1016/j.ocecoaman.2022.106339