

# **Analysis of Ocean Freight Forwarding in China-U.S. Trade: Pre- and Post-COVID-19**

**End of Bachelor's Degree Thesis**



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## **Abstract**

This project looks at the development of ocean freight forwarding between China and the United States before and during the COVID-19 pandemic, concentrating on significant disruptions and challenges in the global supply chain. The research includes critical periods such as trade growth from 1990 to 2015, pre-pandemic dynamics, the immediate impact of the pandemic, and the industry's prospects. Applying supply chain management theories like the Theory of Constraints (TOC), the study brings up areas of weakness in logistics operations and suggests ways to improve resilience and effectiveness. It also looks at how changes in regulations, geopolitical concerns, and technology developments have affected ocean freight forwarding as it is right now.

The research combines qualitative and quantitative approaches to assess the difficulties with port congestion, infrastructural constraints, and trade policy changes. The results emphasise the need for flexibility and digital innovation to maintain effective logistics operations in the context of global disruptions. Better operating strategies are suggested, with a focus on automation, blockchain, and flexible supply chains to protect the China-U.S. trade route from unexpected future challenges.

**Keywords:** Ocean Freight Forwarding, Supply Chain Disruptions, China-U.S. Trade. COVID-19 Impact, Logistics Resilience.

## Resum

Aquest projecte examina el desenvolupament del transport marítim entre la Xina i els Estats Units abans i durant la pandèmia provocada per la COVID-19, concentrant-se en les interrupcions i reptes rellevants a la cadena de subministrament a nivell global. L'anàlisi abarca períodes com el creixement del comerç des de 1990 fins al 2015, la dinàmica prèvia a la pandèmia, l'impacte immediat de la pandèmia i les perspectives per a la indústria. Aplicant teories de gestió de la cadena de subministrament (SCMT) com la "Theory Of Constraints (TOC)", l'estudi identifica àrees de debilitat en les operacions logístiques i suggereix formes de millorar la resiliència i l'efectivitat. També s'analitza com els canvis en les regulacions, les tensions geopolítiques i els avenços tecnològics han afectat el transport marítim en l'actualitat.

Combinant enfocaments qualitatius i quantitius, la investigació avalua les dificultats relacionades amb la congestió portuària, les limitacions infraestructurals i els canvis en les polítiques comercials. Els resultats emfatitzen la necessitat de flexibilitat i innovació digital per mantenir operacions logístiques eficaces en el context de disrupcions globals. Es suggereixen estratègies operatives, amb un enfocament en l'automatització, el blockchain i cadenes de subministrament flexibles per protegir la ruta comercial entre la Xina i els Estats Units davant de futurs desafiaments.

**Paraules clau:** Transport marítim de Càrrega, Disrupcions a la Cadena de Subministrament, Comerç Xina-Estats Units, Impacte de la COVID-19, Resiliència Logística

## Resumen

Este proyecto examina el desarrollo del transporte marítimo entre China y Estados Unidos antes y durante la pandemia provocada por el COVID-19, concentrándose en las interrupciones y desafíos relevantes en la cadena de suministro globalmente. El análisis abarca períodos como el crecimiento del comercio desde 1990 hasta 2015, la dinámica previa a la pandemia, el impacto inmediato de la pandemia y las perspectivas para la industria. Aplicando teorías de gestión de la cadena de suministro (SCMT) como la “Theory Of Constraints (TOC)”, el estudio identifica áreas de debilidad en las operaciones logísticas y sugiere formas de mejorar la resiliencia y la efectividad. También se analiza cómo los cambios en las regulaciones, las tensiones geopolíticas y los avances tecnológicos han afectado al transporte marítimo en la actualidad.

Combinando enfoques cualitativos y cuantitativos, la investigación evalúa las dificultades relacionadas con la congestión portuaria, las limitaciones infraestructurales y los cambios en las políticas comerciales. Los resultados enfatizan la necesidad de flexibilidad e innovación digital para mantener operaciones logísticas eficaces en el contexto de disrupciones globales. Se sugieren estrategias operativas, con un enfoque en la automatización, blockchain y cadenas de suministro flexibles para proteger la ruta comercial entre China y Estados Unidos de futuros desafíos.

**Palabras clave:** Transporte Marítimo de Carga, Disrupciones en la Cadena de Suministro, Comercio China-Estados Unidos, Impacto del COVID-19, Resiliencia Logística

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## **1. Introduction**

### **1.1. Overview of the China-U.S. Ocean Freight Route**

One of the most important global trade routes, connecting the two biggest economies on earth, is the ocean freight route between China and the United States. Global supply chains are supported by this channel of trade, which has historically made it easier to carry a wide range of products, from electronics to large machinery. With China's admission to the World Trade Organisation (WTO) in 2001, trade volumes increased and China's standing as a key player in global manufacturing was established, greatly boosting the relevance of this route. It is impossible to overestimate the crucial role of ports like Shanghai, Long Beach, and Los Angeles in managing the annual flow of millions of containers.

However, serious weaknesses in this important trade route were exposed by the COVID-19 pandemic. In addition to affecting port operations, the pandemic revealed inefficiencies in infrastructure and logistical procedures, which are currently under careful review. The previously mentioned vulnerabilities have led to the development of modern, adaptable, and resilient supply chain solutions that can resist similar disruptions in the future.

### **1.2. Objective of the project**

The objective of this project is to analyze the dynamics of ocean freight forwarding between China and the United States before and after the COVID-19 pandemic, focusing on the critical disruptions and challenges faced by the supply chain. Through this analysis, the project aims to identify key vulnerabilities in the logistics operations along this trade route and propose strategic recommendations for enhancing resilience, flexibility, and efficiency in the face of future disruptions.

In order to ensure long-term progress in the industry, in the project I will also use theories of supply chain management to evaluate how businesses can adjust to the changing trade environment and technology improvements. The final objective is to offer suggestions for strengthening the ocean freight route between China and the United States in the face of uncertainty throughout the globe.

### 1.3. Motivation

The reason I chose to focus on the China-U.S. ocean freight route is because of my work experience and personal interests in freight forwarding and marine transportation:

- Deck Cadet Internship: I started my career at the sea as a deck cadet intern aboard a Ro-Ro vessel, where I gained experience navigating the complex operation of cargo operations. I gained a basic understanding of ocean freight operations from this practical experience, which also introduced me to the logistical and operational difficulties associated with shipping.
- Experience in Freight Forwarding: Following my internship, I worked as a corporate trainer for a freight forwarding company, where I trained operations agents on internal regulations, procedures, and forwarding-management software. I now have a thorough understanding of the operational and strategic difficulties facing the freight forwarding sector because of my experience.
- Interest in Global Trade: The importance of the China-US trade route to the world economy makes it a perfect case study to comprehend the wider effects of supply chain disruptions, especially in the context of the COVID-19 pandemic. The pandemic showed how important it is for global logistics to be able to change and be resilient.

## **1.4. Scope of the Study**

This study analyses the potential solutions for resolving these issues in the future while concentrating on the current consequences of the COVID-19 pandemic on maritime freight forwarding between China and the United States. I will apply a wide range of supply chain management theories to evaluate how businesses may improve their adaptability and resistance to unexpected challenges. The research covers three separate time periods:

- 1990 to 2015: This time period provides background on how trade between China and the United States has grown and how ocean freight services have increased. During this time, China emerged as a major hub for global manufacturing, and vital infrastructure was developed to support this growth.
- 2015 to 2019: An analysis of the state of ocean freight before the pandemic, including how political issues, especially the trade war between the U.S. and China, affected shipping operations.
- 2020 to 2023: The pandemic's immediate effects and post-COVID developments, with an emphasis on the incorporation of cutting-edge technology (AI, blockchain, automation), the rise of alternative shipping lanes, and changes in the dynamics of international trade.
- 2023 into the future: Future prospects for the ocean freight forwarding business on the US-China route from 2023, based on trends and studies, with strategic advice for stakeholders.

The project also takes into account the geopolitical implications of tariffs, trade agreements, and U.S.-China relationships as significant factors affecting the ocean freight sector.

## 1.5. Limitations of the Study

Geographical Focus: The research is restricted to the trade route between China and the United States, with allusions to other growing logistical centres that are becoming more and more important as a result of global trade route adjustments

Data Availability: All future projections are based on current trends and prospects from reliable sources. The study is dependent on data sources that are currently available until 2024.

Technological Assumptions: Depending on governmental regulations and private sector investment, there may be variations in the pace at which technology is adopted in ports and logistics infrastructure.

## 1.6. Initial Questions

The following six questions will be explored and discussed throughout the project. In the conclusion of this project, I will answer these questions based on my findings and analysis:

**Q1:** How did the COVID-19 pandemic worsen already-existing logistical challenges and reveal weak points in the ocean route between China and the United States?

**Q2:** How has the dynamics of ocean freight forwarding between the United States and China been altered by geopolitical concerns like the trade war and changing trade policies?

**Q3:** How might technology innovations like automation, blockchain, and artificial intelligence enhance the resilience and operational effectiveness of the China-US trade route?

**Q4:** Using the lessons learnt from the COVID-19 crisis, what strategic actions can ocean freight businesses take to improve supply chain resilience and flexibility against potential global disruptions?

**Q5:** How can the sustainability of international trade along the China-U.S. route be guaranteed and the impact of future interruptions to global trade minimised by supply chain diversification and flexible logistics systems?

**Q6:** Taking in consideration the unpredictability of the global economy, what are the critical elements that will determine the long-term viability of the ocean freight route between the United States and China, and how can businesses and policymakers meet these challenges?

## 2. Literature Review

### 2.1. Pre-COVID-19 Ocean Freight Industry

The ocean freight forwarding sector expanded greatly and developed consistently before COVID-19. I will examine the historical background of China-U.S. trade relations in this section as well as the key players and market dynamics that shaped it.

#### 2.1.1. Historical Context and Development of China-U.S. Trade Relations

Over the past several years, China's commercial link with the United States has evolved significantly and now forms a major component of world commerce. This relationship originated in the late 20th century when China began under Deng Xiaoping to open its economy. This era saw the beginning of China's ascent to become a significant industrial powerhouse.

China-U.S. commerce grew rapidly as it became a member of the World Trade Organisation (WTO) in 2001<sup>1</sup>. China's access to foreign markets and reduced trade restrictions resulting from its membership helped to greatly boost exports. Electronics, machinery, textiles, and consumer goods constituted Chinese exports to the United States. The United States traded to China aeroplanes, agricultural goods, cars, and cutting-edge technologies in exchange.

The growth of important ports in both nations was vital in supporting this commerce. Important centres for international shipping emerged from ports including Los Angeles, Long Beach, and New York/New Jersey in the United States and Shanghai, Shenzhen, and Ningbo in China. Millions of containers were carried at these ports annually, therefore facilitating the trade between the two economic giants.

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<sup>1</sup>*"20 Years in WTO: China's Transformation into World's Second-Largest Economy."*

China's free trade zones and special economic zones improved conditions for international production and investment, therefore stimulating commerce. Multinational companies attracted by these zones established manufacturing facilities to benefit from reduced production costs and sell goods to worldwide markets, including the United States.

Growing commerce between China and the United States also resulted in the creation of complex supply networks covering several sectors. The interrelationship reinforced the need to keep good economic connections as disruptions in this trade path might have major effects on the world.

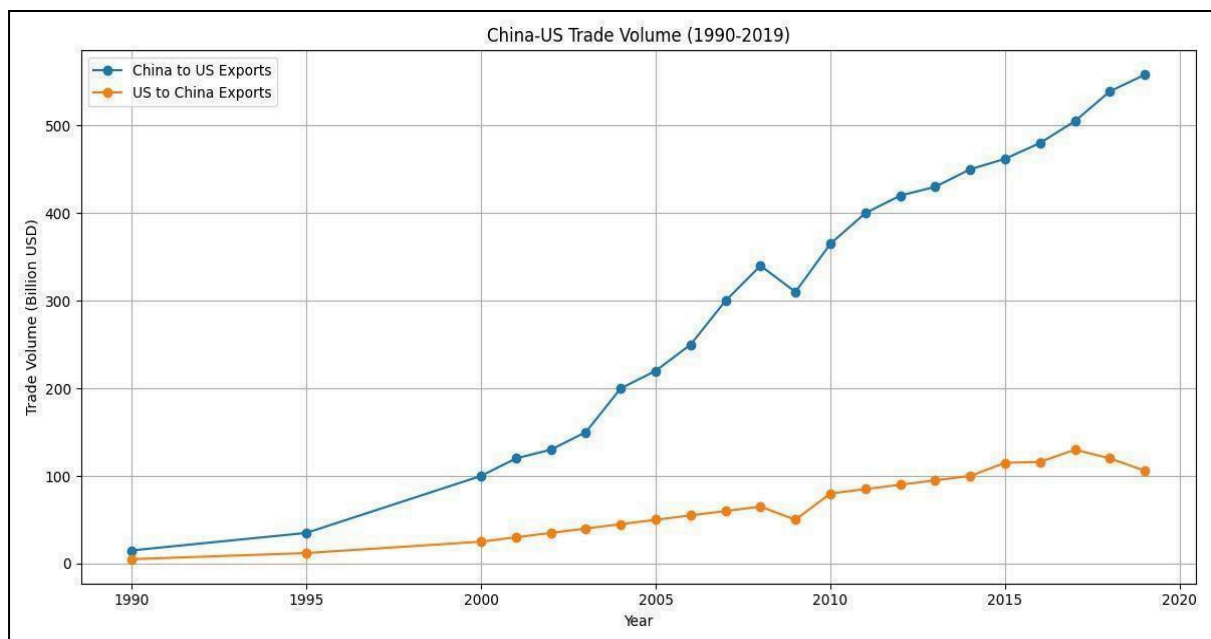


Figure 1. China-US Trade Volume (1990-2019)

Data source: US Census Bureau, "International Trade," April 15, 2019.

<https://www.census.gov/foreign-trade/balance/c5700.html>.

From 1990 to 2019, the *Figure 1* illustrates the yearly trade volume between China and the United States, therefore showing the notable increase in trade especially following China's WTO admission in 2001. The graph reveals the growing economic relations between China and the United States by showing a consistent rise in both of their shipments to the other country.

Supported by the growth of significant ports and the creation of economic zones in China, *Figure 1* reveals the fast increase in trade patterns. Emphasising the important role infrastructure and policies play in supporting world commerce, the consistent rising trend in trade volumes shows the mutual economic advantages received from this relationship.

### **2.1.2. Key Players and Market Dynamics**

Several big multinational corporations controlled the ocean freight forwarding sector and were vital for world logistics in the pre-COVID-19 era. Leading companies in the sector offering a wide range of logistics services to support worldwide commerce were Apex Group, Kuehne + Nagel, C.H. Robinson, DB Schenker, and Expeditors International.<sup>2</sup>

These important companies provided complete logistics solutions covering supply chain management, customs broking, goods shipping, and warehouse space. Their extensive worldwide networks and experience helped them to effectively manage challenging logistical operations. The competition among these businesses motivated ongoing enhancements in operational effectiveness and service quality.

During this time, technological developments greatly affected the dynamics of markets. The sector was transformed by the acceptance of digital goods management systems, automated container terminals and real-time tracking systems. This technology lowered operating expenses, increased cargo handling efficiency, and raised awareness throughout supply

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<sup>2</sup> "JOC Top 25 Asia-US Import NVO Rankings 2019 | Journal of Commerce."

networks. Real-time tracking systems, for instance, let shippers and consignees keep an eye on the state of their goods, thus enhancing planning and reducing delays.

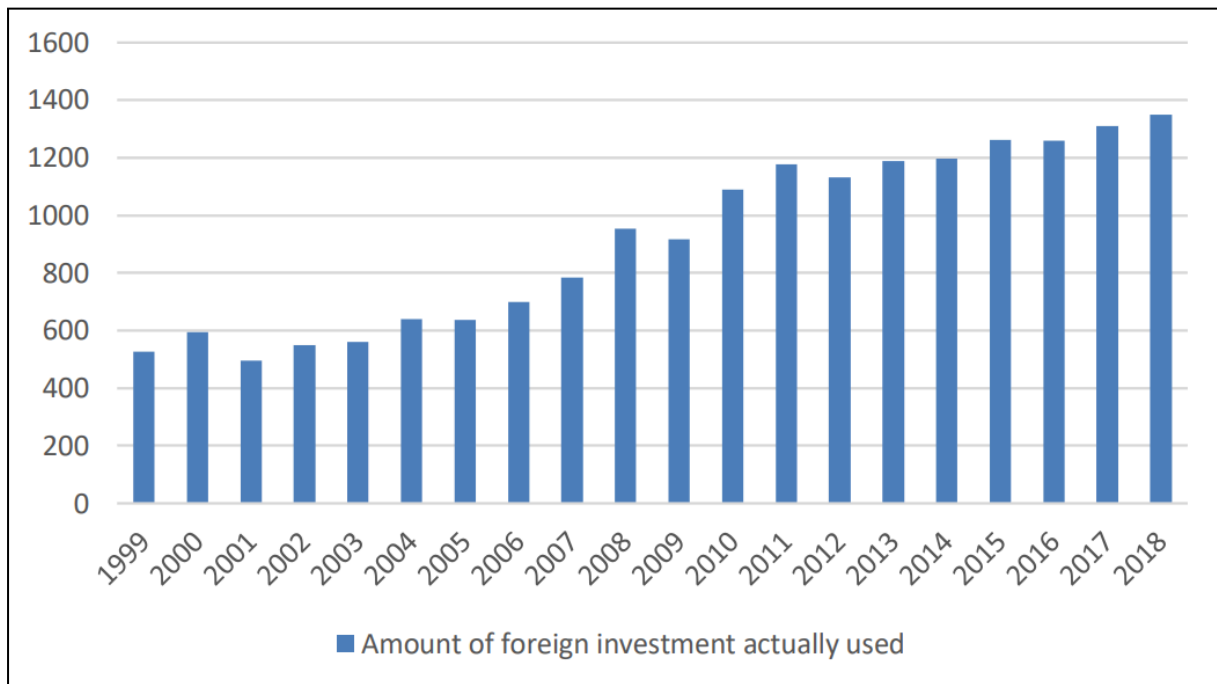


Figure 2. Amount of foreign investment actually used in China (100 million USD)

Data source: National Bureau of Statistics of China<sup>3</sup>

Important infrastructural investments helped the sector expand as well. As part of the Belt and Road Initiative (BRI)<sup>4</sup>, China's government significantly financed port developments and enhancements. The government also made its efforts to optimise the investment environment to increase foreign investment, an initiative that was successful as can be seen in *Figure 2*. This massive infrastructure project aims to improve commercial connections

<sup>3</sup> Retrieved from: Zhang et al., "South-South Integration and the SDGs: Enhancing Structural Transformation in Key Partner Countries of the Belt and Road Initiative."

<sup>4</sup> Lu et al., "China Belt and Road Initiative: Measuring the Impact of Improving Transportation Connectivity on Trade in the Region."

between Asia, Europe, and Africa, consequently confirming China's position as a worldwide trading engine. In order to facilitate the effective flow of products in the United States, investments concentrated on modernising port infrastructure and enhancing internal transportation systems.

Globalisation changed market dynamics even further, which raised demand from customers and boosted worldwide commerce. The globalisation of markets gave freight forwarders chances to increase their range of products and enter new markets. It did, however, come with difficulties like managing geopolitical risks and negotiating difficult legal conditions.

Understanding the historical background and main market dynamics of the pre-COVID-19 ocean freight forwarding sector helps me to grasp the fundamental factors affecting how it has developed. This information facilitates the analysis of how the sector responded to the previously unprecedented challenges that the COVID-19 epidemic brought along.

## 2.2. Impact of Global Disruption on Freight

The ocean freight sector has been significantly impacted by global disruptions like natural catastrophes and financial crises. In this section, I will investigate how these disturbances have influenced the sector with an eye towards past disturbances and current research on their effects.

### 2.2.1. Previous Disruptions

The maritime goods sector has faced major difficulties from global disruptions, which have changed shipping volumes, freight rates, and operational effectiveness.

#### Financial Crises

Like the worldwide financial crisis of 2008, financial crises drastically lowered world trade. Consumer demand fell and companies decreased production during these times, therefore affecting shipment volumes. As a result of less demand for goods transport, shipping companies had to make cuts to their operations and lower freight rates in order to stay profitable. Many businesses were forced to merge or leave the market if they were to survive. Financial uncertainty also limited loan availability, therefore hindering new shipping capacity and technological expenditures.

The *Figure 3* shows the global commerce volume through the financial crisis of 2008. It clearly demonstrates a drop in trade volumes in 2008 and 2009, therefore emphasising the significant effect of the financial crisis on global trade. The immediate consequences of the drop in trade volumes on the maritime freight sector were lower freight rates, fewer ships, and operational difficulties.

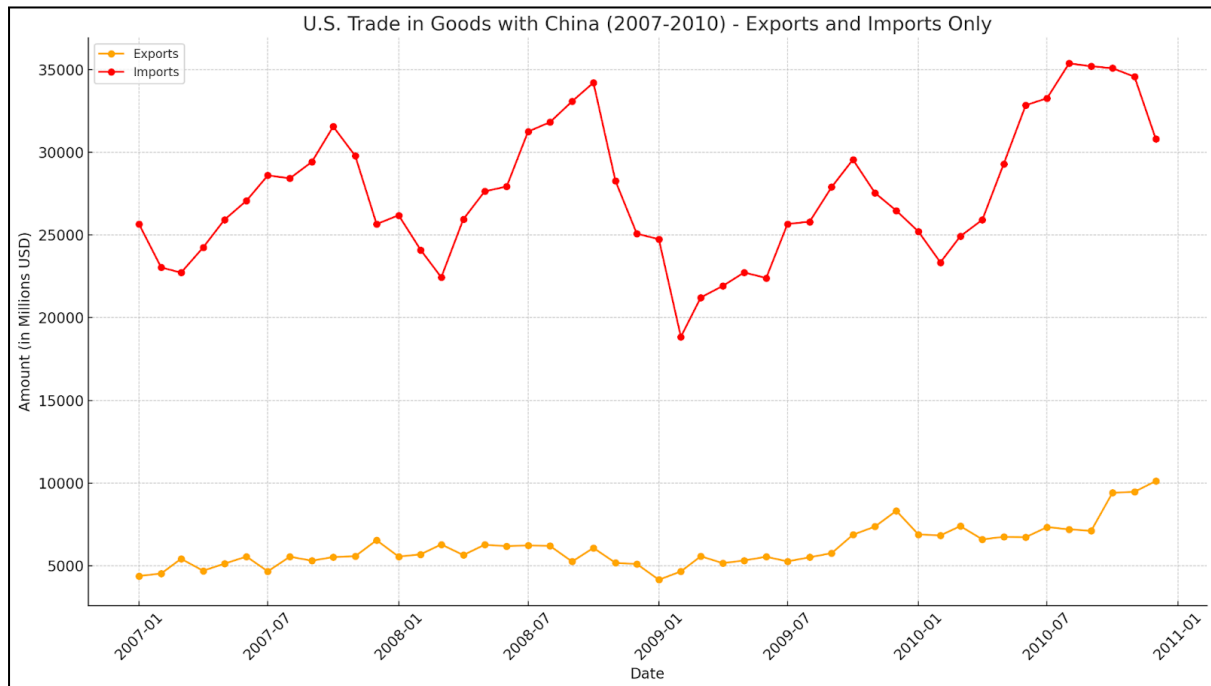


Figure 3. U.S. Trade in Goods with China (2007-2010). Exports and Imports Only.

Data source: US Census Bureau, "International Trade," April 15, 2019.

<https://www.census.gov/foreign-trade/balance/c5700.html>.

## Natural Disasters

Natural catastrophes like the 2011 Tōhoku earthquake and tsunami in Japan have also seriously impacted port operations and world supply chains. Along with delays and rerouting of commodities, the Tōhoku earthquake also damaged port infrastructure. Essential parts from Japan were delayed, which had a big effect on supply lines all over the world and had a big effect on the electronics and car industries.

The earthquake made it clear how hard it can be to coordinate rebuilding efforts across large, complicated supply chains. Companies, particularly in sectors strongly dependent on Japanese exports, struggled to keep connections with suppliers and consumers and paid more coordinating expenses. Many businesses simplified their supply chains to improve

resilience and lower future disruption risk resulting in structural changes in supply networks as well.<sup>5</sup>

Likewise, Gulf of Mexico storms have periodically interfered with port operations and shipping routes, therefore influencing the movement of products into and out of the United States.<sup>6</sup> These kinds of natural disasters create a lot of volatility in goods rates; shipping expenses increase after such incidents. These disruptions highlight the need for strong disaster management plans and illustrate the vulnerability of the marine goods sector to unexpected events.

### **2.2.2. Existing Literature on the Impact of Global Disruptions on Ocean Freight**

Many studies have examined how world events affect the ocean freight sector, therefore providing insightful analysis of how these events affect maritime operations, freight prices, and supply chain dynamics.

#### **Impact on Shipping Operations**

Studies reveal that world events create major operational difficulties. Research on the 2008 financial crisis shows that shipping firms had to cope with more empty days and underused vessels. In response to lower demand and financial limitations, they also started slow steaming to cut petrol expenses.<sup>7</sup> Dealing with the economic crisis required these operational adjustments.

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<sup>5</sup> Son, Chae, and Kocabasoglu-Hillmer, "Catastrophic Supply Chain Disruptions and Supply Network Changes: A Study of the 2011 Japanese Earthquake."

<sup>6</sup> Marpro, "Ports Exposed to Climate Hazards."

<sup>7</sup> "Slow Steaming in Container Shipping | Port Economics, Management and Policy."

## Effect on Freight Rates

Disturbances cause volatility in the pricing of freight. Usually, goods rates drop in times of recession because of less demand for delivering goods. Natural disasters, on the other hand, may cause cargo prices to climb as demand for other shipping routes increases and supply networks are interrupted. For instance, goods prices jumped during Hurricane Katrina in 2005 as shipping firms diverted goods and controlled rising risks related to compromised infrastructure.<sup>8</sup>

## Supply Chain Dynamics

The literature stresses how much world events affect supply chains. For sectors depending on just-in-time delivery, natural catastrophes can cause major delays and rerouting of supplies, therefore impacting them. Global supply chains are linked, hence disturbances in one area can have far-reaching consequences on manufacturing and distribution systems all around. Reducing the effects of such disturbances depends mostly on supply chain resilience. Businesses which have diversified their supply chains and made investments in adaptable logistics solutions will be more suited to manage unanticipated circumstances.

The body of current research also emphasises certain tactics businesses have taken to improve their resilience to worldwide disturbances. Among these tactics include building strong contingency plans, diversifying supply sources, and funding innovative technologies. The adoption of digital technologies like IoT<sup>9</sup> and blockchain, for instance, has enhanced supply chain transparency and traceability, therefore allowing businesses to react faster to disturbances. Strategic stocks of key components and multi-sourced agreements can also help to lower supply chain congestion risk.

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<sup>8</sup> Barraco, "Surviving Supply Chain Disasters: Lessons Learned from Hurricane Katrina."

<sup>9</sup> **Internet of Things:** In ocean freight, IoT helps track shipments in real-time, monitor cargo conditions, and improve supply chain efficiency by providing better visibility and quicker responses to problems.

"Chapter 2.4 – The Digital Transformation of Ports | Port Economics, Management and Policy."

Analysing these studies allows me to better appreciate how the maritime freight sector has always responded to world events. This information is necessary to study how the industry dealt with the COVID-19 pandemic and to come up with ways to make it more resilient and efficient in case of future problems.

## **2.3. Theoretical Framework**

### **2.3.1. Supply Chain Management Theories**

The theory of supply chain management (SCM) provides methodical ways to control and maximise the movement of money, knowledge, and products in a supply chain. In transportation and logistics, these ideas help to increase customer satisfaction, save costs, and improve efficiency. SCM theories simplify processes in maritime freight so that commodities may flow from origin to destination without complications.

Using SCM theories, in this project I want to examine and enhance various aspects of ocean freight operations between China and the United States. Applying these ideas helps me to find inefficiencies, optimise procedures, and create plans of action to properly manage disruptions.

### **Porter's Value Chain**

Focussing on value at every level, Porter's Value Chain design divides business operations into main and supplementary activities. Primary tasks include inbound and outbound logistics, marketing, and after-sales service, while support activities include procurement, technological development, human resources, and infrastructure. This approach helps ocean freight companies maximise operational efficiency, optimise logistics, and raise customer satisfaction by making every stage provide value to the end result. Including Porter's Value Chain helps me to examine every stage of the ocean freight process, identify places where

value may be generated, and lower inefficiencies thereby enhancing customer happiness and service quality.

### **Theory of Constraints (TOC)**

The Theory of Constraints (TOC) aims to identify and systematically improve the most significant limiting factor (constraint) in a supply chain. In ocean freight, this might involve simplifying customs processes or clearing port congestion. Through addressing these limitations, businesses may increase efficiency and productivity. Including TOC helps me find ocean freight process bottlenecks, allowing me to establish strategies to maximise the whole supply chain, thus improving operations and lowering delays.

### **Just-In-Time (JIT)**

JIT, or just-in-time, intends to save inventory costs by ordering items only when they are required for manufacture or sale. This approach requires both exact timing and supplier cooperation. JIT can assist in reducing storage costs at ports and warehouses for ocean freight, but it also requires very accurate shipment schedules and real-time tracking to prevent delays that can cause perturbation of the supply chain. Including JIT in my study illustrates how, by enhancing inventory control and supplier coordination, maritime freight firms may save costs and boost efficiency.

### **Lean Supply Chain**

The principles of Lean focus on waste elimination and process optimisation to improve value. This method uses Kaizen and 5S among other continuous improvement techniques. Lean ideas can help to simplify cargo processing, shorten waiting times at ports, and increase fuel economy, thereby cutting costs and improving service quality in ocean goods. Including lean concepts shows how logistics may benefit from constant improvement, therefore lowering costs and raising the quality of services.

## **Agile Supply Chain**

Agile supply chains are meant to be adaptable and responsive to changes in demand and supply situations. This involves maintaining the ability to react fast to unexpected circumstances such as supply route interruptions or shifts in customer demand. For maritime goods, this may involve including many shipping routes and backup plans to manage unanticipated delays. The idea of an agile supply chain emphasises the need for adaptability and reactivity in ocean freight logistics, which is especially important in a fast-changing worldwide market.

Applying these SCM theories will help me to understand different strategies to improve the dependability and efficiency of maritime freight operations, therefore guaranteeing that the supply chain is strong enough to meet future requirements.

### **2.3.2. Logistics Risk Management**

In logistics, risk management is the identification, evaluation, and reduction of hazards that could cause interference in the supply chain. This covers handling hazards like operational issues, international conflicts, disasters caused by nature, and market volatility. Good risk management guarantees that, even in the presence of unanticipated occurrences, supply chains remain strong and ongoing.<sup>10</sup>

In this project, I will use risk management ideas to examine weaknesses and create plans to improve the resilience of the maritime goods supply chain running between China and the US. Using risk matrices entails determining the probability and influence of important hazards such as natural catastrophes and port congestion.

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<sup>10</sup> “5. Port Risk Management and Resilience-Building Toolbox | United Nations.”

These evaluations will guide my recommendations for ways to reduce these risks: diversifying freight routes, funding advanced tracking systems, and creating strategic alliances across several carriers. I will also advise methods to strengthen a supply chain, like keeping buffer inventories, enhancing infrastructure, and creating strong backup plans. Including risk management can help to increase resilience by guaranteeing ongoing operations, avoiding expensive interruptions, and improving under uncertainty decision-making. By guaranteeing a consistent supply chain, this method of organisation also increases consumer satisfaction.

Understanding and implementing these risk management techniques can help ocean freight companies better prepare for handling interruptions, guaranteeing continuity and reducing the effect on their business.

### **3. Methodology**

This study will use a mixed-methodologies approach combining qualitative and quantitative research methods to fully investigate, before and after the COVID-19 epidemic, the effect of world events on China-U.S. commerce, especially in the ocean freight forwarding industry.

#### **3.1. Techniques for Data Gathering**

##### **3.1.1. Primary Data**

To establish a robust basis for the research, primary data will be gathered from reliable sources.

##### **Industry Reports**

I will look at detailed studies from important logistics and shipping companies like Maersk and COSCO to better understand current trends, problems, and operational strategies in the China-US maritime trade. These studies offer insightful information on industry estimates, freight rates, and shipping volumes.

##### **Trade Statistics**

The U.S. Census Bureau, the World Trade Organisation (WTO), and the World Bank are all reliable sources that will be used to get numbers about trade amounts, import and export prices, and trade balances between China and the U.S.

## **Government Publications**

Publications from organisations such as the Chinese Ministry of Commerce and the United States Department of Transportation will be examined to provide policy updates, economic analysis, and transportation infrastructure data, all of which are critical for understanding the bigger picture of maritime logistics between China and the United States.

### **3.1.2. Secondary Data**

Secondary data will be acquired from current literature and sources to complement the main data and offer further background and insights.

## **Interviews with Industry Experts**

Assessing current interviews with key stakeholders in the China-U.S. maritime goods sector, easily available in industry publications and online platforms, will provide insightful qualitative analysis of the difficulties and tactics used within this trade route.

## **Surveys of Freight Companies**

Industry associations and research companies' published surveys of goods companies will offer combined statistics on industry trends, operational difficulties, and the effect of world events on goods operations between China and the United States.

## **Published Articles**

Examined will be academic papers, international trade journals, and press releases to gather data on the latest developments and research results in the China-U.S. marine goods industry. These resources will help find comparable topics and new trends that are related to the project's main topic.

This method will guarantee that the analysis is thorough, well-supported, and composed of both quantitative trends and qualitative insights by combining primary and secondary data, therefore producing a comprehensive knowledge of the dynamics of the China-U.S. trade route and how global disruptions impact this particular ocean route.

## 4. Ocean Freight Forwarding in China-U.S. Trade Before COVID-19

### 4.1 Industry Overview

#### 4.1.1. Market Size, Trade Volumes, and Growth Trends

##### Globalisation

Particularly with China's admission to the World Trade Organisation (WTO) in 2001, globalisation greatly impacted the economic relationship between China and the United States. Because of this integration, China was able to increase the amount of goods it could sell, and the U.S. became its biggest trade partner. The flow of commodities between the two nations was considerably accelerated by the lowering of trade restrictions and the worldwide movement towards interconnected supply chains.

China's bilateral trade volume with the United States increased from around \$121 billion to \$558 billion between 2001 and 2019.<sup>11</sup> While the United States sold aeroplanes, soybeans, and cars to China, this trade primarily included electronics, machinery, textiles, and everyday goods sent from China.

Walmart, the world's largest retailer, imports a major amount of its items from China due to lower costs and more efficient manufacturing.<sup>12</sup> By keeping low pricing for American customers, this approach helped Walmart keep demand for Chinese goods by means of stability. This relationship best illustrates how globalisation affects trade flows between China and the United States.

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<sup>11</sup> Data source: US Census Bureau, "International Trade," April 15  
<https://www.census.gov/foreign-trade/balance/c5700.html>

<sup>12</sup> "A Conservative Estimate of 'The Wal-Mart Effect': Wal-Mart's Growing Trade Deficit with China Has Displaced More than 400,000 U.S. Jobs."

## **Technological Advancements**

Trade between China and the United States reliability and effectiveness was much improved by technological developments in supply chains and logistics. Especially for satisfying the great demand for quick shipping in areas such as electronics and everyday items, the development of digital goods management systems, real-time tracking systems, and automated container handling has increased the speed and accuracy of shipments.

Businesses like Flexport have put digital technologies into use that increase operational efficiency and supply chain accessibility. Including tools like Maersk Flow and TradeLens, helped improve operational transparency and reduce manual errors. From Maersk's data, however, certain percentage increases in delivery times are not definitely confirmed.<sup>13</sup>

One of the busiest ports in the world, the Port of Shanghai has adopted innovative automation technologies including automated guided vehicles (AGVs) and automated stacking cranes (ASCs)<sup>14</sup>, which will help the port to effectively handle big volumes of goods, especially during busy seasons like the lead-up to Black Friday in the United States.

## **Infrastructure Investments**

Particularly under China's Belt and Road Initiative (BRI), infrastructure projects greatly improved the capacity and efficiency of trade routes connecting China to the United States. All of these were vital for handling the growing amount of trade, these investments concentrated on boosting transportation networks, expanding and modernising port facilities, and strengthening logistics infrastructure.

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<sup>13</sup> *Adhish Alawani, "Transforming Logistics through Technology-Enabled, Digital Supply Chain Solutions."*

<sup>14</sup> *"The World's Largest Automated Container Port — Huawei Case Studies."*

The growth of ports such as Ningbo-Zhoushan enabled them to handle over 1 billion tonnes of cargo per year, with this milestone achieved in 2017<sup>15</sup>, making them critical nodes in the China-US trade route (Ningbo-Zhoushan Port Group).

Though the BRI primarily intends to connect Asia with Europe and Africa, improvements in infrastructure along these routes have indirectly helped China-U.S. commerce by improving the general effectiveness of China's logistical networks.

Almost half of U.S. imports from China transit via the Los Angeles and Long Beach ports, consequently major upgrades were made to them. Important for handling significant imports from China, especially in the electronics and textile industries, these improvements included enhancing accessibility by rail and port automation.

Up until late 2019, China-U.S. trade grew mostly driven by globalisation, technical developments, and infrastructural investments. Every element helped to improve the dependability and efficiency of supply chains and logistics in addition to supporting the increase of trade volumes. Reflecting the strong economic connections and mutual dependence of the pre-COVID-19 era, these events confirmed the China-U.S. trade route as the foundation of world trade.

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<sup>15</sup> Team, "Chinese Port Hits 1 Billion Tonnes of Cargo."

#### 4.1.2. Key Shipping Routes and Major Ports

The main shipping routes between China and the U.S. were trans-Pacific routes. These routes made it easier for electronics, machinery, textiles, and consumer goods to move from China to the U.S., and for cars, planes, agricultural products, and new technologies to move from the U.S. to China.

#### Main ports in China

I will use container export and import movement as the criteria to show the significance of the traded volume in China, in *Figure 4*, it is notable that from the top 10 ports by container throughput in 2019, 9 of them were Chinese.

Ranking	Port	2019 (million TEUs)	2018 (million TEUs)	Growth Rate
1	Shanghai	43.31	42.01	3.1%
2	Singapore	37.20	36.60	1.6%
3	Ningbo-Zhoushan	27.53	26.35	4.5%
4	Shenzhen	25.77	25.74	0.1%
5	Guangzhou	22.83	21.53	5.7%
6	Busan	21.91	21.66	1.1%
7	Qingdao	21.01	19.32	8.8%
8	Hong Kong	18.36	19.60	-6.3%
9	Tianjin	17.30	15.90	8.1%
10	Rotterdam	14.81	14.51	2.1%

*Figure 4. Global Top 20 Ports by Container Throughput in 2019 compared to 2018.*

Data source: "Global Port Development Report (2019)," Shanghai International Shipping Institute (SISI), May 2020. <http://sisi.gstta.org/uploads/2021/10/291409176464.pdf>.

It's worth going a bit more in-depth on the ones who have the most consolidated relationship with the U.S.:

- Shanghai Port

The world's busiest container port, handling approximately 43.3 million TEUs in 2019. Especially for electronics and consumer items headed for the United States, Shanghai was a major export gateway. Advanced automated technology in Shanghai helped accelerate loading and unloading operations, therefore reducing port delays.

- Shenzhen Port

This port handled over 25.7 million TEUs in 2019 and served as a major export hub for high-value items like electronics. Being close to Guangdong's manufacturing zones, Shenzhen became a major gateway for Chinese exports to the United States.

- Ningbo-Zhoushan Port

One of the world's largest ports, handling 27.5 million TEUs in 2019. This port was critical in controlling the overflow of cargo from Shanghai and played an important part in the Belt and Road Initiative (BRI).

## Main ports in the United States

- Los Angeles Port

With 9.7 million TEUs handled in 2019, it is the busiest port in the United States. From China, it mainly concentrated on everyday goods, electronics, and cars.<sup>16</sup>

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<sup>16</sup> Data source: "Comprehensive Annual Financial Report Port of Los Angeles. Years 2018-2019."

- Long Beach Port

Located next to Los Angeles, it handled 7.63 million TEUs in 2019<sup>17</sup>. Together with Los Angeles, managing around 40% of U.S. imports from China, these two ports are vital hubs in the U.S.-China commerce

- Port of New York/New Jersey

The third largest US port, with 7.5 million TEUs in 2019. Covering the East Coast, this port strategically controlled imports of goods for consumption from China and machinery, therefore helping to manage the amount of imports.<sup>18</sup>

To manage the significant volumes of products passing between China and the United States, each of these ports had sophisticated infrastructure and automation systems. Their positions and capacity enabled effective trade flows, therefore guaranteeing the timely delivery of products to satisfy market needs. Infrastructure investments, including those under China's Belt and Road Initiative, improved port efficiency, which in turn helped facilitate the fast-growing trade volumes.

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<sup>17</sup> Data source: "Port of Long Beach," <https://polb.com/business/port-statistics/#yearly-teus>.

<sup>18</sup> Data source: "2019 Annual Report," Port Authority NY/NJ, 2019.

## **4.2 Operational Practices**

The ocean freight forwarding business between China and the U.S. depended on structured operating practices to stay reliable, efficient, and in line with international standards. These policies guaranteed that both nations could satisfy the needs of their own markets by including solid regulations, service standards, and shipping schedules.

### **4.2.1 Typical Shipping Schedules and Service Levels**

Shipping plans before the COVID-19 pandemic between China and the United States followed steady and regular patterns to meet the great demand for goods, including electronics for consumers, machinery, and textiles exported from China, and agricultural products and technology from the United States. To guarantee smooth Pacific shipping of products, major shipping lines kept consistent and frequent services.

#### **Typical Shipping Schedules**

Shipping schedules were carefully coordinated to optimize trade efficiency and respond to market demands. Key routes like Shanghai to Los Angeles, for instance, saw many voyages per week to satisfy the excessive demand for industrial resources and consumer products.

Important carriers providing weekly or bi-weekly services between China and the United States were Maersk, COSCO, and MSC, which helped to account for the significant number of products being moved. The regularity of these services provided stable supply chain management and reduced delays for manufacturers and stores depending on trustworthy shipment intervals.

Direct lines between China's main ports, including Shanghai, and American ports usually had an average transit time of around 40 days for Door to Door shipments. These transit schedules were strictly followed to ensure the timely delivery of products across the Pacific.

In *Figure 5* the trend shows that since the COVID-19 pandemic, the average transit time has not been able to recover, on the contrary as it keeps increasing. Later in this project, I will analyse the possible causes of this ongoing situation.

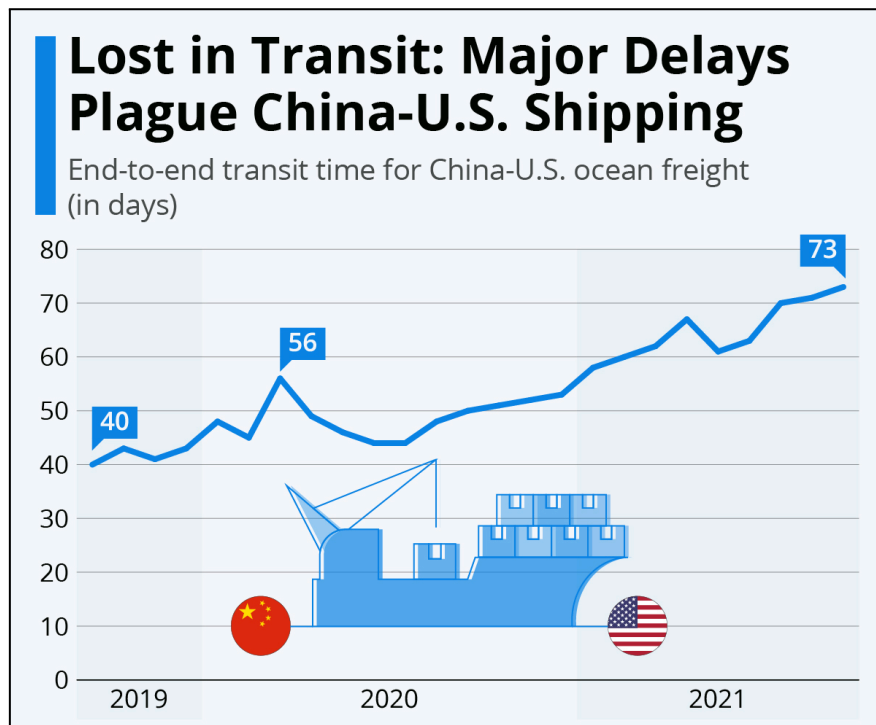


Figure 5. End-to-end transit time for China-U.S. ocean freight

Data source: Freightos

#### 4.2.2 Regulatory Environment and Compliance Requirements

Between China and the United States, the regulatory structure controlling the ocean freight forwarding sector was complex and included several degrees of compliance. The effective functioning of this economic route depends mostly on international agreements, national rules, and customs procedures.

#### Regulatory Environment

- International Regulations

International rules were mostly under the control of groups like the International Maritime Organisation (IMO), which defined security and safety criteria. In China and the United States, national-level rules guarantee adherence to regional trade rules and environmental standards.

While the International Maritime Dangerous Goods (IMDG) Code controlled the handling of hazardous goods, the IMO's International Convention for the Safety of Life at Sea (SOLAS) guaranteed ship and cargo safety. Both were essential to maintaining safe and secure transportation methods.

- National Regulations

The Federal Maritime Commission (FMC) controlled the maritime goods forwarding business in the United States to guarantee a competitive environment and stop unfair activities. Similar responsibility fell to the Ministry of Transport in China, supervising logistical operations and guaranteeing adherence to national trade policy.

## **Compliance Requirements**

Compliance needs focused attention to customs documentation, cargo security, and environmental rules. Ignoring rules might cause delays, penalties, or perhaps goods confiscation.

- **Customs Documentation**

Freight forwarders were in charge of compiling and turning in required customs paperwork, including bills of lading, certificates of origin, and packing lists, thereby guaranteeing that products were cleared without incident through Chinese and American customs.

- **Cargo Security**

Maintaining security in the supply chain depended critically on programs like China's customs measures and the U.S. Customs-Trade Partnership Against Terrorism (C-TPAT). Following these initiatives guaranteed commodities passed safely through ports without delay resulting from security breaches

Following these operational guidelines and policies helped the ocean freight forwarding sector guarantee the fast and effective movement of products between the two biggest economies of the planet. Knowing and following these requirements helped stakeholders to reduce risks, prevent delays, and guarantee timely delivery in a pre-COVID-19 environment.

## 4.3 Challenges

Prior to the COVID-19 epidemic, a number of difficulties affected the ocean freight forwarding sector's performance, economy, and general reliability. Even though many of these problems were ongoing, the pandemic revealed deeper weaknesses in international trade systems, making their entire impact apparent. For the purpose of this project, it is necessary to gain a better understanding of how the business was unprepared for the size of the changes that followed by examining these pre-COVID challenges.

### 4.3.1 Infrastructure Limitations and Bottlenecks

Prior to COVID-19, one of the biggest obstacles to commerce between China and the United States was limited infrastructure and bottlenecks. The commodities forwarding business was susceptible to significant disruptions due to its dependence on outdated infrastructure and ineffective port systems, despite its increased efficiency in transporting substantial amounts of products.

#### Port Congestion

Problems with port congestion before COVID can be seen in *Figure 6*, which shows long waits and poor efficiency at the Ports of Los Angeles and Long Beach. Waiting times for ships to dock and unload were often very long. The whole process could take days. Furthermore, the problems were made worse by the limited yard space, the lack of available truckers, and the delays on the railway. For example, truck turn times could go over 90 minutes, and truckers often missed important time windows because they had difficulties keeping their scheduled times. These operating errors made it much harder for cargo to move from the port to inland distribution centres, which helped cause traffic jams during times of high demand.

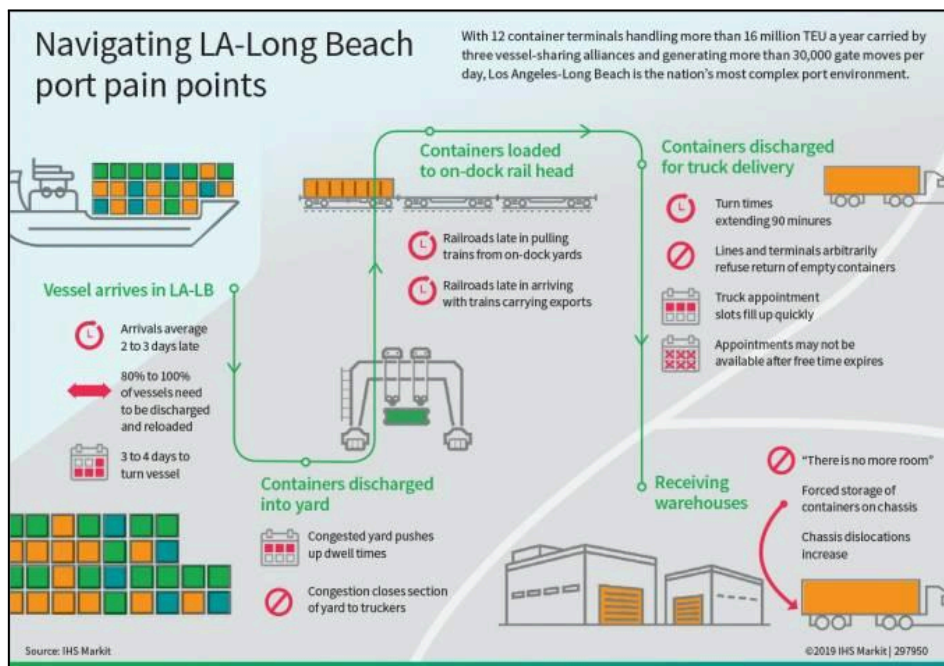


Figure 6. Infographic: Navigating LA-Long Beach port pain points (2019)

Data source: Journal of Commerce

## Ageing Infrastructure

The deteriorating state of the port infrastructure in the United States was a major worry prior to COVID-19. The primary goal of investments has been increasing capacity and efficiency, especially because the size of vessels has quadrupled in the previous 15 years and the tonnage at the top 25 ports increased by 4.4% between 2015 and 2019. With the help of multimodal competitive award programs, federal funding has expanded. But *"a funding gap of over \$12 billion for waterside infrastructure, such as dredging, over the next 10 years, with additional billions needed for landside infrastructure"* still exists, according to the American Society of Civil Engineers<sup>19</sup>.

<sup>19</sup> American Society of Civil Engineers, "2021 INFRASTRUCTURE REPORT CARD."

The unsuccessfulness of American ports to adjust to the changing needs of modern shipping and keep up with growing trade volumes has resulted from this unbalance. These issues are made worse by a lack of modern equipment, such as automated cranes, and a shortage of storage space, which increases traffic and inefficiency.

These infrastructure conditions prior to COVID-19 were not a symptom of readiness to major disruptions that were unexpectedly coming.

### **Technological Gaps**

Many U.S. ports fell behind while major Chinese ports, such as Shanghai and Ningbo-Zhoushan, achieved notable advancements in automation and the use of digital technology. Some automation technologies, like automated guided vehicles (AGVs), blockchain for customs clearance, and real-time tracking systems, were not fully merged across all U.S. ports. This made it longer to handle goods and clear customs. Due to this technology gap, American ports were potentially more sensitive to major disruptions such as the pandemic.

#### **4.3.2. Trade Policies, Tariffs, and Geopolitical Tensions**

The ocean freight forwarding business between China and the United States had significant obstacles due to trade policy, tariffs, and geopolitical issues. These elements considerably altered the commerce route by adding operational expenses, causing uncertainty, and delaying the movement of goods. The most important problems affecting the trading environment at that time are outlined in the sections that follow.

#### **Trade Policies and Tariffs**

Substantial tariffs on products exchanged between the United States and China were implemented in 2018 as a result of the trade war between the two countries. Trade volumes,

expenses, and the general efficiency of the supply chain were all directly impacted by these fees.

- **Economic Impact:** In an effort to reduce trade tensions that grew during the trade war, the United States and China agreed on the Phase One Trade Deal in January 2020. China agreed to buy \$200 billion more in products and services from the United States over the course of two years under this deal than it did in 2017, with a focus on industries including manufacturing, services, energy, and agriculture. In return, the United States reduced tariffs but kept others in place.<sup>20</sup> As the *Figure 7* illustrates, shipments to China did not meet these targets. Even after the agreement was implemented, the effects of the trade war persisted, restricting American exports to China, and the predicted economic benefits were not achieved as predicted.

By the end of 2019, Chinese exports to the United States had decreased by 16% as a result of the trade war, according to the Peterson Institute for International Economics<sup>21</sup>. Increased tariffs and trade disputes were expected to cost the US economy \$316 billion in GDP<sup>22</sup> by the end of 2020, with \$134 billion already lost by 2019.<sup>23</sup> Additionally, nearly 300,000 U.S. jobs were lost due to the trade war, significantly affecting sectors reliant on imports and exports between the two countries, such as manufacturing and agriculture.<sup>24</sup> The decrease in trade activity led to higher expenses for American and Chinese businesses, increasing the cost of importing essential commodities like equipment, textiles, and electronics.

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<sup>20</sup> Chad P. Bown and Yilin Wang, "Five Years into the Trade War, China Continues Its Slow Decoupling from US Exports."

<sup>21</sup> *Ibid.*

<sup>22</sup> Heeb, "Even after Trump's Trade Deal, China Tariffs Will Cost the American Economy \$316 Billion by the End of 2020."

<sup>23</sup> Hass and Denmark, "More Pain than Gain: How the U.S.-China Trade War Hurt America."

<sup>24</sup> "Moody's," <https://www.moody.com/>

Even with the Phase One Trade Deal in place prior to COVID-19, U.S. exports to China struggled to recover, revealing the long-term challenges for global trade and the ocean freight industry.

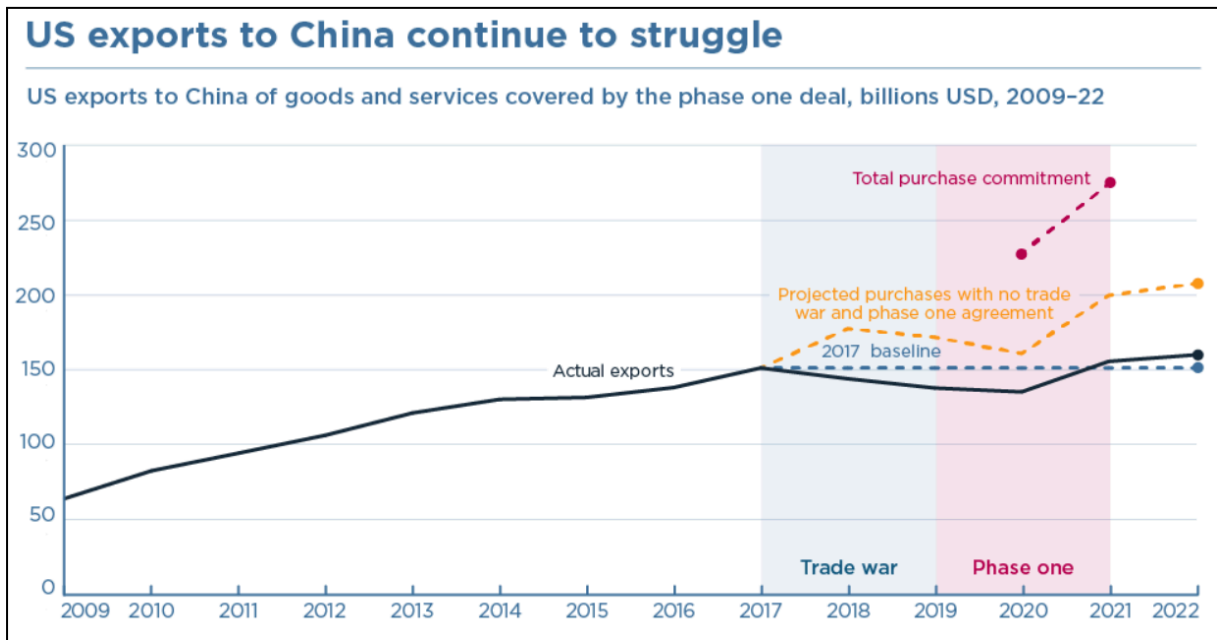


Figure 7. US exports to China of goods and services covered by the phase one deal.

Source: Chad P. Bown and Yilin Wang, “Five Years into the Trade War, China Continues Its Slow Decoupling from US Exports.”<sup>25</sup>

- **Supply Chain Adjustments:** Rethinking the supply chain strategy was necessary for several American companies that depended on Chinese imports. Businesses moved industrial facilities, looked for substitute suppliers abroad, or moved production closer to the United States.<sup>26</sup>

<sup>25</sup> Chad P. Bown and Yilin Wang, “Five years into the trade war, China continues its slow decoupling from US exports,” Peter Institute for International Economics, March 16, 2023. <https://www.piie.com/blogs/realtime-economics/five-years-trade-war-china-continues-its-slow-decoupling-us-exports>.

<sup>26</sup> Wolf and Kalish, “Supply Chain Resilience in the Face of Geopolitical Risks.”

Due to the disruption of trade routes, several industries, such as electronics and consumer products, experienced considerable delays and higher expenses as a result of these modifications, which also raised operational difficulties and costs. This put more pressure on freight forwarders to handle more complex logistics and reroute shipments.

## **Geopolitical Tensions**

Commerce through the China-US route was made more difficult by geopolitical tensions between the United States and China, which included disagreements over intellectual property rights, trade practices, and territorial concerns. Businesses that depend on stable trade relationships face increased risk and unpredictability as a result of these tensions.

- **Geopolitical Risks:** The South China Sea turned into an epicentre of territorial disputes and is an important maritime route for trade between China and the United States.<sup>27</sup> Tensions escalated as a result of the U.S. contesting China's claims in the area, raising worries about potential obstacles to maritime routes.

Businesses operating along this trade route experienced greater concern due to the instability caused by these geopolitical events, even if there was no direct impact on the flow of goods at the time.

- **Business Impact:** According to a 2019 survey conducted by the USC Centre for Health Journalism, approximately 80% of American businesses doing business in China reported difficulties as a result of current geopolitical tensions and resulting

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<sup>27</sup> "Territorial Disputes in the South China Sea | *Global Conflict Tracker*."

tariffs.<sup>28</sup> In an effort to reduce their reliance on China and cover future risks, several companies have diversified their supply chains in response to the geopolitical unpredictability and the economic impact of tariffs.

## Regulatory Changes

The environment for ocean freight forwarders working between China and the United States was made more difficult by frequent regulatory changes. Trade agreements, customs processes, and compliance standards changed, creating new difficulties that caused delays and added to the administrative workload.

- **Compliance Challenges:** With the advent of new trade agreements, such as the U.S.-Mexico-Canada Agreement (USMCA), freight forwarders have to modify their operations on a regular basis to comply with changing regulations.<sup>29</sup>

Updates to paperwork, tariff classifications, and regulatory structures were necessary during this costly procedure. The smooth processing of products through customs was delayed and expenditures increased as a result of adapting to these new laws.

- **Customs Procedures:** The processing of customs was an essential part of conducting business internationally. Modest adjustments to paperwork requirements and customs laws might cause major delays at ports and aggravate supply chain bottlenecks. For example, tighter customs regulation and more frequent inspections increased when economic ties between the United States and China deteriorated, significantly limiting the flow of products.

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<sup>28</sup> "Growth Continues Amid Heightened Uncertainty," *Deloitte China*, n.d., <https://www2.deloitte.com/cn/en/pages/about-deloitte/articles/deloitte-amcham-2019-china-business-climate-survey-report.html>.

<sup>29</sup> "North America's Shifting Supply Chains: The USMCA, COVID-19, and the U.S.-China Trade War | Baker Institute."

Figure 8 illustrates the changes in both statutory and effective tariff rates on U.S. imports from China from 2017 through 2021<sup>30</sup>. The statutory rate reached a peak of 17.5% in late 2019, while the effective rate peaked at 15.4%. Following the implementation of the Phase One Deal in early 2020, tariffs were slightly reduced, but the effective tariff remained high at 12.5%, reflecting ongoing trade tensions and the limited advantages provided by the deal. These tariff fluctuations increased administrative complexity for businesses and freight forwarders, contributing to delays in customs clearance and additional operational costs.

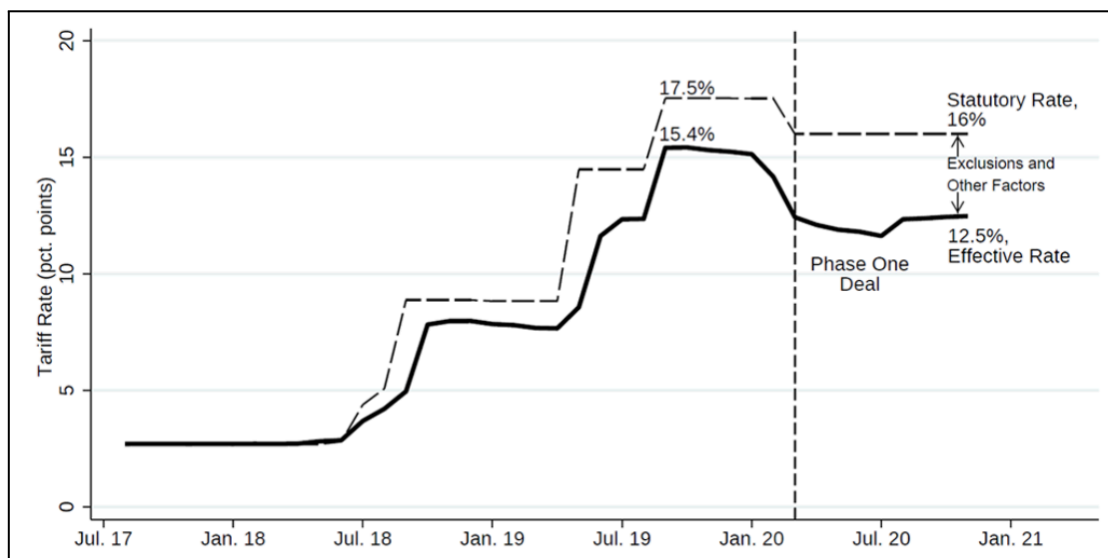


Figure 8. Effective vs Statutory Tariff Rate: U.S. Imports from China

Source: Flaaen, Langemeier, and Pierce, “Factors Affecting Recent U.S. Tariffs on Imports from China.”<sup>31</sup>

<sup>30</sup> The **statutory rate** is the official tariff set by law, while the **effective rate** is what businesses actually pay after exemptions and exclusions are applied, often resulting in a lower rate.

<sup>31</sup> Aaron Flaaen, Kathryn Langemeier, and Justin Pierce, “Factors Affecting Recent U.S. Tariffs on Imports from China,” February 17, 2021 <https://www.federalreserve.gov/econres/notes/feds-notes/factors-affecting-recent-us-tariffs-on-imports-from-china-20210217.html>.

An important difficulty facing the ocean freight forwarding sector prior to the beginning of Covid-19 was dealing with trade regulations, tariffs, and geopolitical issues. These elements raised operating expenses, supply chain interruptions, and unpredictability. Businesses have to continuously modify their approaches to stay in compliance with changing legislation and reorganise their supply chains. Gaining an understanding of these pre-COVID difficulties emphasises the significance of developing more robust supply chains going forward and offers valuable knowledge about the industry's weaknesses.

## **5. Impact of COVID-19 on China-U.S. Ocean Freight Forwarding**

The COVID-19 epidemic significantly affected the China-United States trade route and had major effects on world trade. Lasting changes in the ocean freight forwarding industry resulted from these disruptions impacting trade volumes, shipping schedules, port operations, and supply networks. With a focus on port closures, rising shipping costs, and supply chain interruptions, this section looks at the pandemic's direct effects on the industry.

### **5.1. Port and Shipping Effects**

#### **Supply Chain Disruptions and Port Closures**

Governments all across the world initiated lockdowns and travel restrictions at the start of the COVID-19 pandemic in early 2020, which caused disruptions in supply chains right away. Due to a lack of labour, major ports like Shanghai, Ningbo, and Shenzhen had to close or operate at reduced capacity, causing China, the world's largest exporter, to experience considerable delays.<sup>32</sup>

The closing of these ports and factories caused major problems along the China-U.S. commerce route. Significantly fewer goods were being shipped between the two nations, which resulted in backlogs and irregular shipping timetables. Consequently, there was a significant drop in the worldwide containership capacity.

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<sup>32</sup> *China Briefing, "China Port Closures: Are They to Blame for More Supply Chain Disruption?"*

The *Figure 9* shows six different times when world container shipping capacity dropped because of high demand and traffic:

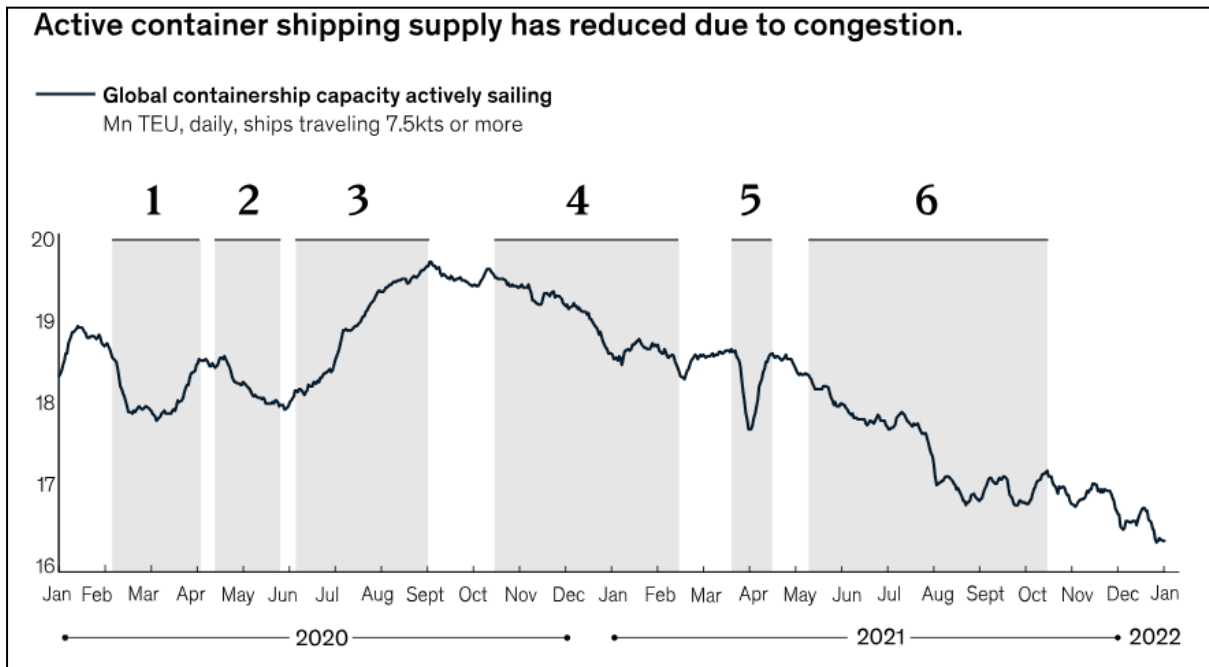


Figure 9: Global containership capacity actively sailing

Source: Dierker et al., "Navigating the Current Disruption in Containerized Logistics."<sup>33</sup>

- **January-March 2020:** The first lockdowns in China greatly slowed down the movement of containers.
- **April-August 2020:** China's reopening helped the economy recover slightly, but backlogs and changing demand remained.
- **September-December 2020:** Less container availability resulted from deteriorating labour shortages at international ports due to increased U.S. demand ahead of the holiday season.

<sup>33</sup> Dierker, David, Ezra Greenberg, Steve Saxon, and Tewodros Tiruneh. "Navigating the current disruption in containerized logistics." McKinsey & Company, March 14, 2022. <https://www.mckinsey.com/industries/travel-logistics-and-infrastructure/our-insights/navigating-the-current-disruption-in-containerized-logistics>.

- **January-April 2021:** The availability of containers was further limited by a second wave of COVID-19 lockdowns in Asia.
- **May-September 2021:** Because of the rise in demand, U.S. ports, particularly those in Los Angeles and Long Beach, had substantial backlogs..
- **October 2021-January 2022:** Shipment capacity limitations were made worse by ongoing port congestion, labour shortages, and supply-demand inconsistencies.

### **Changes in Trade Volumes and Shipping Schedules**

At first, COVID-19 led to an important decrease in trade volumes between China and the United States. Many "blank sailings" (cancelled voyages) resulted from factory closures and lower production capacity, as many vessels left Chinese ports partially or completely empty to meet the reduced demand.

The number of scheduled sailings and blank sailings broken down by month in 2020 is shown in *Figure 10*. It shows that, with over 20% of scheduled sailings cancelled, blank sailings occurred most frequently from March through May. During this time, China was experiencing its highest level of lockdowns and production stops, which resulted in a shortage of cargo causing shipping companies to cancel multiple voyages.

The percentage of blank sailings decreased over the year, especially after June, when manufacturing and the Chinese economy both began to improve. The spike in demand for imports into the United States, however, continued to pressure the shipping capacity despite this recovery, leading to more congestion at U.S. ports. Supply and demand continued to be out of balance, resulting in lasting interruptions to shipping schedules.

This graph highlights the unpredictability of shipping schedules during the first year of the pandemic and shows how blank sailings affected international shipping, especially on the China-U.S. commerce route.

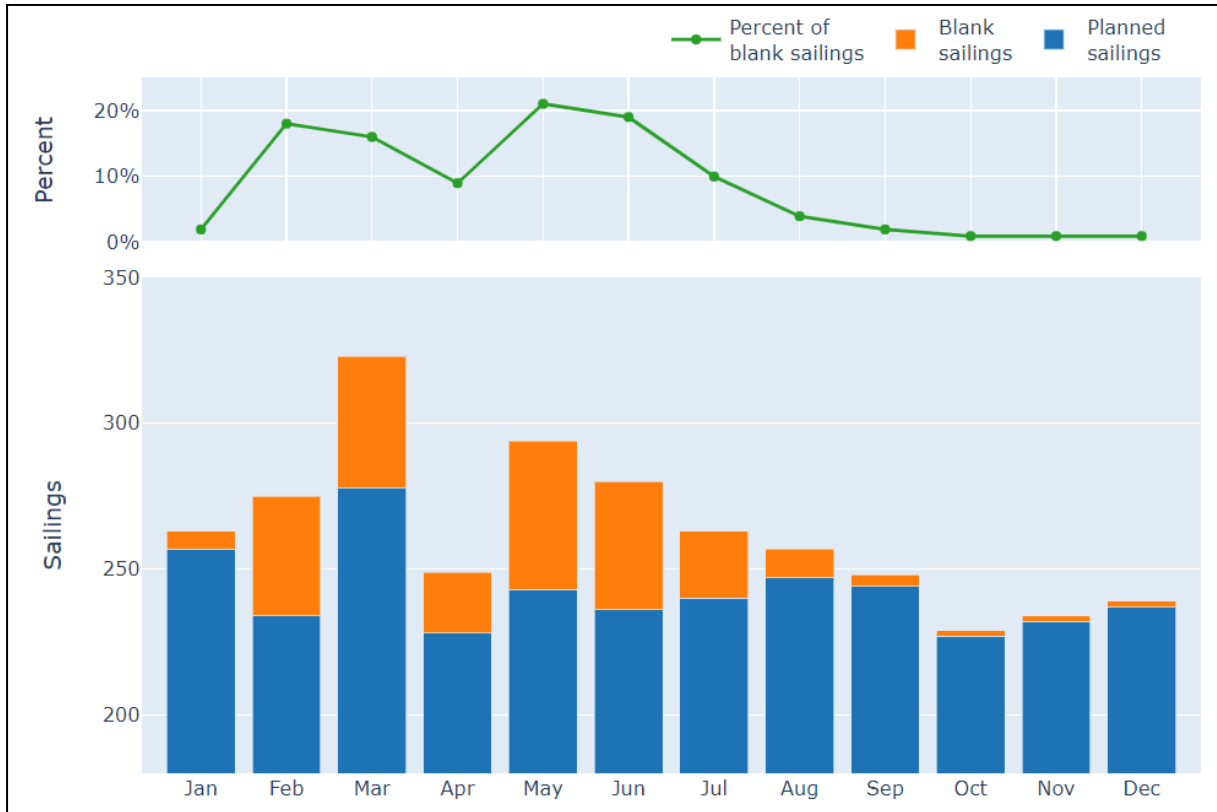


Figure 10: Global Cancelled Sailings by Major Container Shipping Firms by Month, 2020.

Source: "The Impact of the COVID-19 Pandemic on Freight Transportation Services and U.S. Merchandise Imports."<sup>34</sup>

<sup>34</sup> "The Impact of the COVID-19 Pandemic on Freight Transportation Services and U.S. Merchandise Imports," United States International Trade Commission. [https://www.usitc.gov/research\\_and\\_analysis/tradeshifts/2020/special\\_topic.html](https://www.usitc.gov/research_and_analysis/tradeshifts/2020/special_topic.html).

## 5.2 Economic Impact

The pandemic had a significant financial impact on ocean freight forwarders. Businesses had to deal with declining sales, skyrocketing expenses, and changes in import/export trends.

### 5.2.1 Revenue Losses and Cost Increases for Freight Forwarders

Due to the pandemic's severe effects on demand and production capacity, U.S. container imports from Asia fell by 10.7% in the first half of 2020. However, imports increased by 16.9% as economies rebounded in the second half of the year, presenting serious difficulties for freight forwarders attempting to handle the sudden spike in demand.<sup>35</sup>

The cost of shipping containers skyrocketed due to container shortages, port congestion, and escalating insurance and labour expenses associated with COVID-19 safety measures. Costs of shipping a 40-foot container from China to the West Coast of the United States rose more than 12 times between February 2020 and September 2021, reaching a high point of about \$20,000 (peak, but not the average).<sup>36</sup>

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<sup>35</sup> "The Impact of the COVID-19 Pandemic on Freight Transportation Services and U.S. Merchandise Imports," United States International Trade Commission.

<sup>36</sup> "International Shipping Costs During and After COVID-19," Federal Reserve Bank of St. Louis, May 11, 2022,

Figure 11 shows container prices remaining stable around \$1,500 in early 2020, but rapidly increasing from May, going over \$4,000 by December due to increased U.S. demand and ongoing supply chain disruptions. This price surge heightened the financial pressures on freight forwarders, reflecting the volatile shipping environment created by the pandemic.

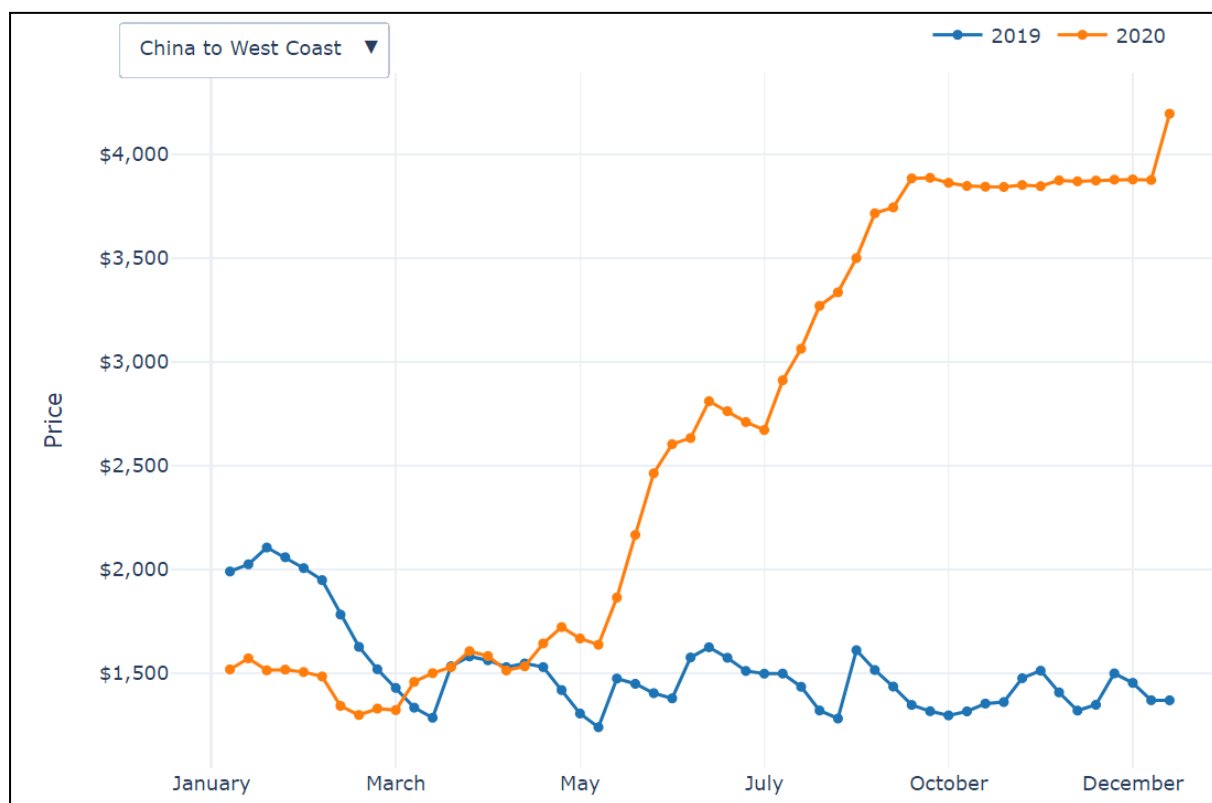


Figure 11: Weekly Index Price to Ship a Container By Vessel on China-West U.S. Coast, 2019-20

Source: “The Impact of the COVID-19 Pandemic on Freight Transportation Services and U.S. Merchandise Imports.”<sup>37</sup>

<sup>37</sup> “The Impact of the COVID-19 Pandemic on Freight Transportation Services and U.S. Merchandise Imports,” United States International Trade Commission. [https://www.usitc.gov/research\\_and\\_analysis/tradeshifts/2020/special\\_topic.html](https://www.usitc.gov/research_and_analysis/tradeshifts/2020/special_topic.html).

### **5.2.2 Shifts in Import/Export Patterns**

World trade patterns saw significant changes as a result of the pandemic. Initially, consumers cut back on spending on unnecessary things, which caused a drop in demand for non-essential goods. Yet freight forwarders had to modify their operations as a result of the explosive demand for necessities like medical supplies and personal protective equipment

Many American companies responded to these disruptions by diversifying their supply networks and reducing their reliance on China by using other sourcing nations like Vietnam and India. Due to the increased logistical complexity, freight forwarders were forced to establish new relationships and adjust to changing dynamics in the market.<sup>38</sup>

### **5.3. Accelerated Adoption of Digital Technologies**

During the COVID-19 pandemic, digital technologies were quickly adopted throughout global supply chains. Cloud-based technologies were rapidly encouraged by numerous companies to manage shipments remotely, eliminating the requirement for physical presence at ports and factories. For instance, solutions like Flexport enabled firms to carry on with operations even during lockdowns by offering real-time insight into shipments and inventories.<sup>39</sup>

However, there were difficulties with this adaptation. Businesses were more susceptible to cyber security risks as a result of the quick adoption of digital technologies and the growing usage of remote and cloud-based platforms.<sup>40</sup> Many organisations lacked the necessary resources to adequately protect themselves against these threats. Furthermore, while trying to integrate different platforms across international boundaries, several businesses encountered problems with connection and interoperability due to imbalances in digital infrastructure.

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<sup>38</sup> Ibid.

<sup>39</sup> Flexport, "Exploring the Future of Freight During COVID-19."

<sup>40</sup> UNCTAD, "DIGITAL ECONOMY REPORT 2021."

## Statistical analysis and artificial intelligence (AI)

Statistical analysis and artificial intelligence (AI) were also essential in enhancing demand forecasts and route planning.<sup>41</sup> AI models are being used by companies such as DHL and Amazon to anticipate supply chain disruptions and optimise delivery routes. Nevertheless, there was a learning curve for certain companies when putting these tools into practice since it was challenging to integrate modern technology into traditional systems.

## Blockchain technology adoption

Blockchain technology has also been used more frequently since the pandemic to enhance the security and transparency of critical shipments. Blockchain has been utilised in the pharmaceutical and other sectors to guarantee the authenticity and traceability of goods like vaccinations. However, substantial upfront costs and infrastructure requirements—which were especially difficult for smaller businesses—slowed down the adoption of blockchain throughout global supply chains.

Platforms like ONE's CargoSmart have increased supply chain transparency by using blockchain, allowing for real-time monitoring and minimising complicated paperwork.<sup>42</sup> However, data standardisation remains a significant challenge. Many shipping organisations are still experiencing compatibility challenges due to a lack of defined data formats across digital platforms, resulting in inefficiencies in data exchange and shipment tracking.<sup>43</sup>

## Automation in Ports and Uneven Implementation

Automation technology such as AI-powered cranes and automated guided vehicles (AGVs) assisted in port operations during pandemic-related workforce shortages. Ports such as Shanghai used these technologies extensively, allowing them to maintain operations during lockdowns. In the United States, only a few of mid-tier ports had implemented any type of

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<sup>41</sup> Downie and Finn, "AI Supply Chain."

<sup>42</sup> Oracle: "Use of Blockchain Helps Speed Global Shipping Transactions."

<sup>43</sup> PYMNTS.com: "Shipping Industry Trade Group Calls for Digital and Standards to Fix Supply Chain Disruption."

automation by 2023. This gap in automation investment has resulted in bottlenecks along critical trade routes, as less automated ports struggle to handle the number of goods.<sup>44</sup>

### **Cybersecurity Risks and Vulnerabilities**

The industry's big dependence on digital technology has left it vulnerable to increasing cybersecurity risks. Ransomware attacks on shipping and logistics companies tripled between 2019 and 2020, as these companies became prime targets for cybercriminals. Phishing and other cyberattacks have disrupted operations and presented serious threats to global supply chains.<sup>45</sup> The Maersk NotPetya cyber attack of 2017 remains a famous example of the industry's weaknesses, but following trends indicate that cyberattacks have gotten more sophisticated.<sup>46</sup> Smaller businesses, which lack adequate cybersecurity protections, are especially vulnerable.

As more and more of the industry digitises, the lack of extensive international cybersecurity laws makes it easier for attacks to happen in the future. Shipping businesses are investing in multi-layered security systems and blockchain to secure sensitive data, but the challenges are still significant.

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<sup>44</sup> *International Transport Forum, "Container Port Automation: Impacts and Implications."*

<sup>45</sup> *"Shipping Companies Confront Cyber Crooks as Economies Reopen | Bloomberg Government."*

<sup>46</sup> *"NotPetya Ransomware Attack on Maersk – Key Learnings | LRQA Nettitude."*

## 6. Post-COVID-19 Regulatory, Logistical, and Trade Challenges

### 6.1. Regulatory Pressures and Environmental Standards

The regulatory framework for ocean freight forwarding, especially along the China-US trade route, grew more restrictive following COVID. The International Maritime Organization's (IMO) 2020 Sulphur Cap, which required ships to use fuels with no more than 0.5% sulphur content, continued to place pressure on operational expenses until 2023.<sup>47</sup> This rule, which attempted to reduce emissions, happened at the same time as the decreased trade volumes caused by the pandemic. Low-sulphur fuels were 25%-40% more expensive than standard fuels, drastically reducing profit margins.<sup>48</sup>

This rising cost reflects the shipping industry's delayed transition to greener technologies. Companies who were slow to invest in environmentally friendly methods faced considerably higher operational costs by 2023. Case studies from companies like Maersk demonstrate the competitive benefit of making early investments in low-sulphur and LNG-powered vessels. Companies that quickly adopted green technology saw reduced compliance costs compared to those who waited longer.

In addition, environmental rules became more complex. The European Union's Emissions Trading System (ETS), which was planned to include the shipping industry by 2024, already had an impact on investment decisions in 2022 and 2023<sup>49</sup>. Shipping companies were not just investing in LNG-powered vessels, which accounted for 12% of new ship orders in 2023, but also looking into technologies like hydrogen and biofuels to keep ahead of potential regulatory changes.<sup>50</sup> However, higher investment costs for green technology pressured companies facing varying global demand.

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<sup>47</sup> "IMO 2020 – Cutting Sulphur Oxide Emissions."

<sup>48</sup> "New Maritime Fuel Rule Will Increase Shipping Costs - IER."

<sup>49</sup> European Commission: "Reducing Emissions from the Shipping Sector."

<sup>50</sup> "Clarksons: 50% of Orderbook Tonnage Is Alternative-Fuel Capable Vessels."

## **Changes in Trade Policy and Supply Chain Diversification**

The US-China trade war remained a major problem in 2023, altering global supply chains and forcing diversification. By 2023, taxes on Chinese imports had risen to \$335 billion, creating big changes in freight prices and operational logistics. In response, American businesses expanded their supply chains by buying products from other regions of Southeast Asia. U.S. imports from China decreased from 21.6% in 2017 to 13.9% in 2023, while Vietnam's exports to the US increased by 26%.<sup>51</sup>

While diversification towards Southeast Asia eased certain risks associated with US-China trade wars, it also created new logistical issues. Despite its rapid export expansion, Vietnam faced infrastructural challenges, such as port congestion and outdated railways. These infrastructural issues in Vietnam and other Southeast Asian nations resulted in higher transportation costs and longer delays, limiting some of the potential benefits of supply chain diversity. Delays in infrastructure construction in Thailand and Vietnam created bottlenecks, complicating operations for companies.

Freight forwarders were faced with managing a dispersed network of suppliers, needing more coordination and the capacity to quickly shift operations in response to regulatory changes across countries.

## **The impact of USMCA and geopolitical tensions**

The United States-Mexico-Canada Agreement (USMCA), which was adopted in 2020, continued to impact the regulatory environment in 2023.<sup>52</sup> Stricter laws on digital commerce and country-of-origin standards, particularly in the automotive and high-tech industries, have driven businesses to restructure their supply chains. The increased complexity of commodities transiting between North America and Asia necessitated thorough logistics management and coordination across regions.

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<sup>51</sup> *Leibovici and Dunn, "Decoupling Where It Matters? US Imports from China in Critical Sectors."*

<sup>52</sup> *Bitar, Wayne, and Meltzer, "USMCA at 3: Reflecting on Impact and Charting the Future."*

Furthermore, geopolitical tensions between the United States and China increased operational risks for freight forwarders. Global supply chains were becoming more complicated due to ongoing intellectual property disputes, territorial conflicts in the South China Sea, and the 2022 introduction of the CHIPS Act, which intends to reduce U.S. dependence on Chinese semiconductors.<sup>53</sup> The CHIPS Act resulted in a restructure of high-tech supply chains, with corporations transferring their semiconductor sourcing to Taiwan and South Korea.

## 6.2 Workforce Shortages and Labour Strikes

Labour shortages have been an important factor in increasing supply chain issues along the China-US route after COVID-19. The American Trucking Associations claims that there was a shortage of about 80,000 truck drivers in 2021, which had a big effect on inland transportation in the U.S. This shortage was expected to increase up to 100,000 up to 2023 and make it longer to move freight from ports to inland distribution centres.<sup>54</sup>

When it comes to workforce shortages, the dockworker labour strikes at US ports must be taken into account, as these were also the cause of major issues. *Figure 12* shows that labour strikes affected 18% of the workforce at large ports such as Los Angeles and Long Beach in 2023, up from 15% in 2022<sup>55</sup>. These strikes, motivated by demands for higher salaries and working conditions, delayed the movement of freight and increased transport costs for companies that rely on the China-US trade route. Labour shortage was less severe than in Europe, where up to 25% of the workforce was impacted, however, the impact on American ports was strong enough to disrupt global supply chains.<sup>56</sup>

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<sup>53</sup> "United States–China Semiconductor Standoff: A Supply Chain under Stress."

<sup>54</sup> Economics Department American Trucking Associations, Inc., "Driver Shortage Update 2021."

<sup>55</sup> Bloomberg, "Labor Disruptions at World's Ports Quadrupled in 2022 as Discontent Grows."

<sup>56</sup> Lanktree, "Wave of Port Strikes Put Global Supply Chains under Fresh Pressure."

The shipping sector is still significantly reliant on human labour, especially in essential areas such as dockwork and inland transportation, making it vulnerable to potential strikes.

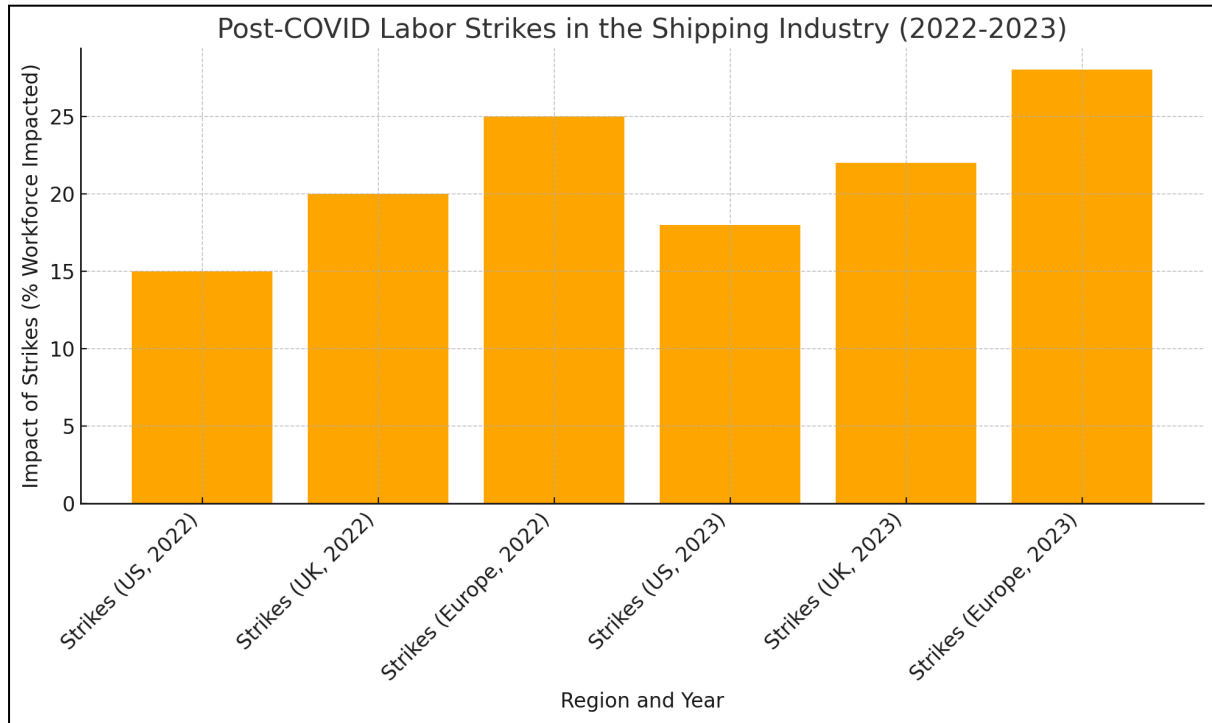


Figure 12. Post-Covid Labour Strikes in the Shipping Industry (2022-2023)

Data source: Multiple sources referenced in the above text

## 7. Case Studies

### 7.1 Examples from Major Shipping Companies and Ports

#### Maersk's Strategic Adaptations

The largest container shipping company in the world, Maersk, quickly accelerated its digital transformation during the COVID-19 pandemic to lessen the disruptions in global supply chains. The pandemic revealed serious weaknesses, such as labour shortages, port congestion, and erratic demand patterns, which forced Maersk to use technology in order to maintain its competitiveness.

Expanding its end-to-end logistics services, which integrated warehousing, customs clearance, shipping, and even delivery on the last mile, was one of the main pillars of Maersk's strategy. By using a comprehensive strategy, the business was able to manage additional supply chain stages assisting clients in managing port bottlenecks and guaranteeing more efficient cargo movements.

The increase in the use of Maersk's digital platforms highlighted the company's emphasis on digitisation. Compared to 2019, digital platform income went up by almost 90% in 2021.<sup>57</sup> This was due to more online orders and real-time tracking services for shipments. The demand for real-time visibility and remote operations in a highly disrupted environment can be seen in the Maersk Mobile App, which saw a 270% increase in users in 2020.<sup>58</sup> The app allows customers to track logistics milestones, monitor shipments remotely, and receive personalised notifications

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<sup>57</sup> Adhish Alawani, "Transforming Logistics through Technology-Enabled, Digital Supply Chain Solutions."

<sup>58</sup> Maersk, "Adopting New Technology to Simplify and Connect Supply Chains."

Maersk has adopted big data analytics and AI-powered prediction technologies to speed up forecasts of demand and route planning. With the use of these technologies, the business was able to plan delivery routes to reduce delays and foresee supply chain interruptions. Maersk has improved security and transparency throughout its supply chains by incorporating blockchain technology, especially when managing fragile products like medications. Blockchain lowered the amount of paperwork and offered a centralised platform for exchanging papers in real time, reducing the possibility of missing or delayed documents.

There were underlying issues, even if Maersk's quick adherence to technology put the company in a strong position to handle pandemic concerns. The quicker transition to digital platforms increased cybersecurity threats as data breaches and cyberattacks were becoming more common for businesses worldwide. Maersk had to make significant investments in protecting its digital assets while expanding its infrastructure. Furthermore, not all of Maersk's customers were prepared to make a smooth transition to this new era of logistics due to the high cost of digitisation, which included training and integrating modern technologies like AI.

Finding a way to balance the initial expenses of putting these technologies into practice with the pressing need to keep operations running during periods of high demand for shipping throughout the world was another significant problem. But Maersk's ability to successfully implement digital solutions like Maersk Flow and TradeLens highlights how the business not only adjusted but also developed into a leader in digital logistics.

The pandemic caused by COVID-19 was an important moment in Maersk's strategic development. The company was able to cope with the crisis better than many of its rivals thanks to its investments in end-to-end logistics and its emphasis on digital transformation. Maersk established itself as a dependable and forward-thinking logistics company. These changes not only helped Maersk deal with the pandemic's immediate problems, but they also got the company ready to take advantage of future growth possibilities in the logistics and supply chain business.

## The Ports of Los Angeles and Long Beach

The Ports of Los Angeles and Long Beach experienced significant congestion during the COVID-19 pandemic. The blue line in the *Figure 11* shows the increase in anchored vessels in 2021, demonstrating how the demand for imports greatly exceeded the ports' ability to process them. Ships waiting to unload faced weeks-long delays as a result of the ports' inadequacy to handle the increased volume of containers despite a constant flow of vessels at dock (black line - *Figure 11*).

Congestion has a direct influence on shipping costs, as seen by the dramatic rise in freight charges from Shanghai to the U.S. West Coast (red line - *Figure 11*), which exceeded an average of \$8,000 per FEU (Forty-foot Equivalent Unit) in 2021. Global supply chains were impacted, leading to delays and shortages of supplies for US companies.

The ports' lack of automation in comparison to more developed ports like Shanghai and Singapore was one of the main problems. The American ports' reliance on manual labour made it difficult for them to manage the increase in traffic. The backlog of more than 30 vessels anchored offshore during peak hours is a result of labour shortages and the requirement for social isolation, which further impacted operations.

The ports ended up implementing weekend shifts, expanded to 24/7 operations, and started implementing automated technology in an effort to relieve the congestion. Self-driving trucks and automated cranes were deployed to increase the efficiency of container handling.<sup>59</sup>

By the beginning of 2022, the vessel congestion (blue line - *Figure 11*) and freight charges (red line - *Figure 11*) had gradually decreased as a result of these actions. But the crisis also highlighted the underfunding of infrastructure and automation, which made the ports susceptible to interruptions.

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<sup>59</sup> White House, "Recent Progress and Actions on Port Congestion."

The pandemic was an important wake-up call to the necessity of robust supply chains and modern infrastructure. In order to prevent future bottlenecks, the Ports of Los Angeles and Long Beach served as prime examples of the significance of digital transformation, enhanced automation, and diversification of logistics techniques. While the actions taken reduced the congestion, they also exposed deeper structural flaws that need to be addressed over time in order to guarantee smoother operations in the event of future global disruptions.

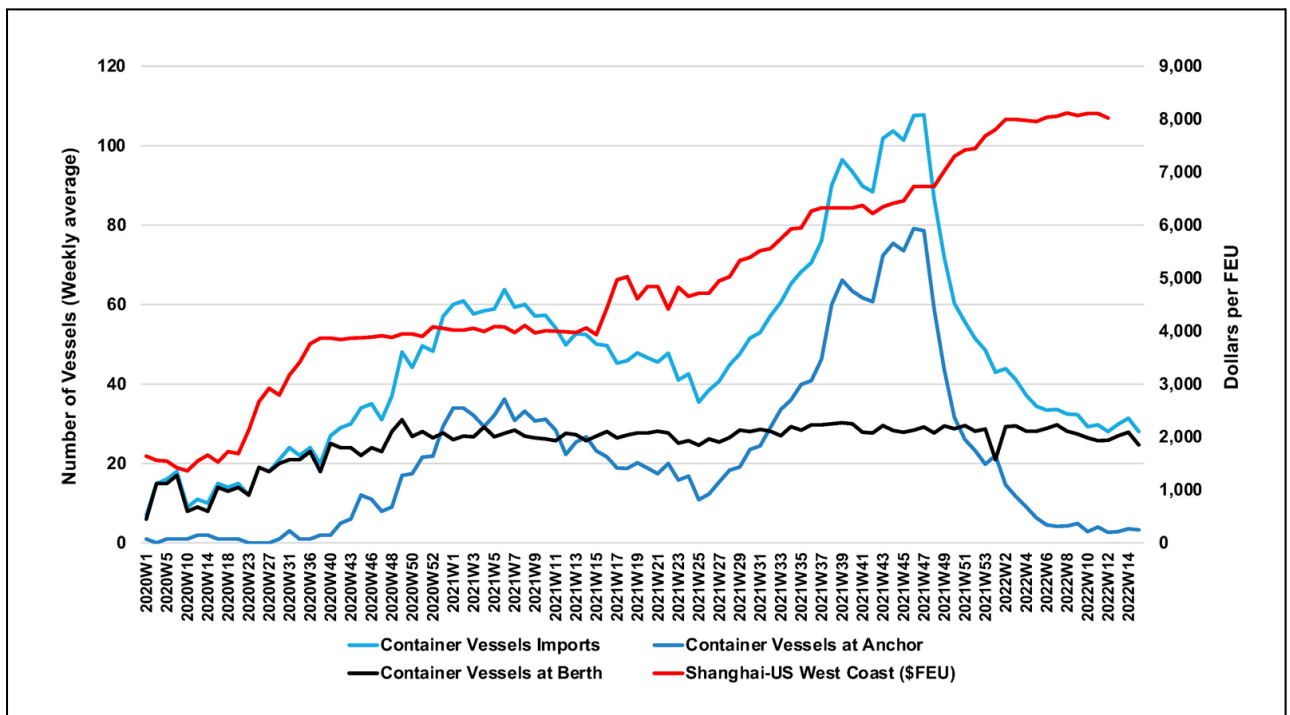


Figure 11. Containerships inside 25 Miles of Los Angeles/Long Beach (weekly average), 2020-2022

Data source: Marine Exchange of Southern California. Freight rates data based on Clarkson Research 2022.<sup>60</sup>

<sup>60</sup>Retrieved from: "Case Study 1: Ports of Los Angeles and Long Beach, United States | United Nations."

## 7.2. Regional Immediate Effects within China and the United States

### Effects on Chinese Manufacturing Centres

China's manufacturing hubs were severely impacted by the COVID-19 pandemic, especially in Guangdong Province, which is vital to the nation's exports of consumer products and electronics. The first quarter of 2020 experienced a considerable decrease in production due to lockdowns implemented to contain the virus. China's manufacturing dropped by 14.1% year-over-year, affecting important industries including textiles and automobiles.<sup>61</sup> Exports decreased as a result, delaying the global supply chain.

China quickly recovered in the second half of 2020, driven by strong demand for raw resources like iron ore, despite a 3.8% worldwide decline in maritime traffic.<sup>62</sup> Trade flows were stabilised by this recovery, especially when Chinese industries started operating again

As a result of the supply chain vulnerabilities caused by the pandemic, companies started to diversify their manufacturing centres and minimise their dependency on Guangdong. Businesses moved to Southeast Asia as a result of this decentralisation strategy in order to strengthen supply chain resilience against potential global disruptions

### Effects on Broader U.S. Supply Chains

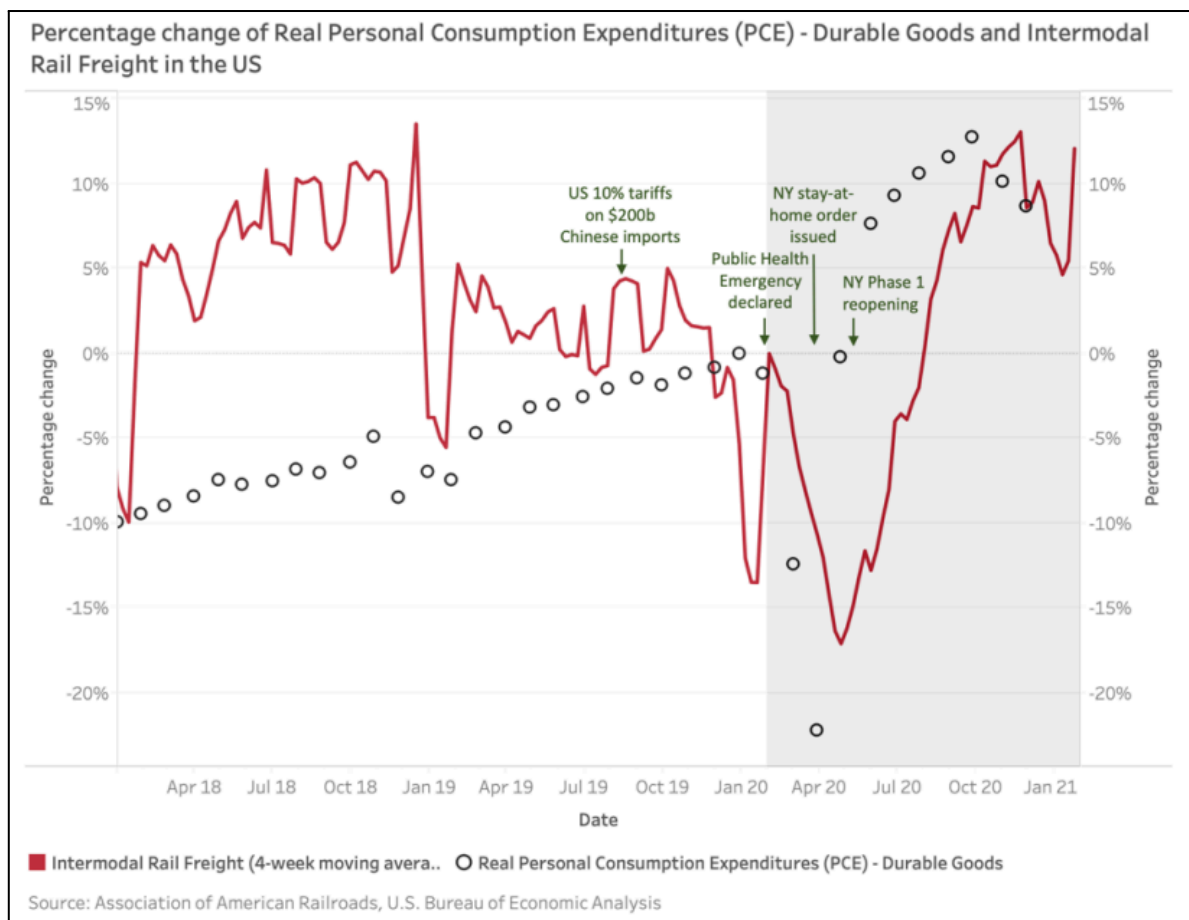
Although the pandemic resulted in extensively reported congestion and operating difficulties at West Coast ports such as Long Beach and Los Angeles, these problems had profound consequences that extended beyond the coast. Particularly in inland areas like the Midwest, the interruptions had an impact on the whole U.S. supply chain. Rail and trucking networks were very important in making sure goods continued to circulate across the country, which relieved pressure on busy shore ports. But the increase in freight movement revealed serious flaws in the Midwest's infrastructure, including antiquated rail networks and inadequate road capacity.

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<sup>61</sup> UNIDO Statistics, "World Manufacturing Production Statistics for Quarter I, 2020."

<sup>62</sup> Yunteam.com, "UNCTAD: 2020 Global Maritime Trade Atrophy 3.8%."

The connection can be seen in *Figure 13*, which shows the percentage change in intermodal rail freight (4-week moving average) and expenditure on durable goods during the pandemic. The pandemic forced many businesses to cease operations in early 2020, causing a substantial drop in sales. However, when consumer spending recovered, the demand for goods rebounded immediately. The increase in intermodal traffic by the summer of 2020 matches with the recovery in the consumption of durable goods, which has been pushed by the shift towards e-commerce and home improvements. Especially during this recovery, rail freight was crucial since trucking was having trouble finding workers and had capacity issues.



*Figure 13. Percentage change of Real Personal Consumption Expenditures (PCE) and Intermodal Rail Freight in the US. Data source: Association of American Railroads, U.S. Bureau of Economic Analysis.*<sup>63</sup>

<sup>63</sup> Retrieved from: Joseph L. Schofer et al., *The U.S. Railroads and COVID-19: Keeping Supply Chains Moving* (Northwestern University, 2021), [https://transportation.northwestern.edu/docs/2021/20210614\\_aar-report-final-d-june-2021.pdf](https://transportation.northwestern.edu/docs/2021/20210614_aar-report-final-d-june-2021.pdf).

The case studies and geographical analysis demonstrate the severe and diverse effects of COVID-19 on the global ocean freight forwarding industry, particularly along the China-United States trade route. The pandemic proved the importance of adaptation, digital transformation, and infrastructure investment in preventing disruptions. While big corporations like Maersk responded with strategy adjustments and technical innovations, ports such as Los Angeles and Long Beach proved the necessity of infrastructural preparation in managing supply chain adversities. The shipping business performed better than expected during the pandemic, but risks persist in the near future, which will be analysed in the next section of this project.

## 8. Future Prospects of China-U.S. Ocean Freight Forwarding

After COVID-19, the future of China-US ocean freight forwarding industry is likely to go through significant shifts, thanks to technological innovations, changing trade dynamics, and an increased demand for reliable supply chains. To prepare for future disruptions and maintain long-term growth, businesses must incorporate advanced supply chain management (SCM) strategies and take advantage of innovations that go beyond post-pandemic solutions.

### 8.1. Trends and Innovations

#### 8.1.1. Digitalization, Automation, and Blockchain Technology

The ongoing advancement on supply chain digitisation will play a significant role in changing ocean freight forwarding. Gartner predicts that by 2026, more than 75% of supply chain management application vendors will have AI-embedded solutions in their systems, concentrating on both immediate responses and predictive analytics to better predict disruptions such as port delays or spikes in demand. Furthermore, 50% of supply chain organisations are expected to invest in AI-enabled solutions, demonstrating AI's increasing significance in enhancing operational efficiency.<sup>64</sup>

In addition, automation technologies will expand over their existing applications. While big ports like Shanghai have already used automation to improve efficiency, future innovations will include completely autonomous ships, such as IBM's Mayflower Autonomous Ship<sup>65</sup>, as well as AI-powered end-to-end logistics systems that manage cargo without human involvement. These developments align with the Lean Supply Chain theory, which optimises operations by reducing waste, shortening inactive periods of time, and guaranteeing perfect

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<sup>64</sup> "The Important Role of AI in Supply Chain Management & Logistics - The Quantic Blog."

<sup>65</sup> Warwick, "How AI Automation Is Making a First-of-Its-Kind, Crewless Transoceanic Ship Possible - IBM Blog."

collaboration between supply chain stakeholders. Companies should expect major efficiency gains in critical areas such as freight handling and warehouse management.

Blockchain technology, which has already improved post-COVID paperwork procedures, is ready for wide adoption. In the future, blockchain systems are likely to be incorporated into global trade platforms. This will allow electronic contracts and real-time tracking of transactions internationally. This greater transparency will reduce fraud, improve compliance, and facilitate international trade, particularly when consistent global blockchain standards are established. By automating procedures and removing middlemen, blockchain will improve security in complicated international commercial operations.

### **8.1.2. Emergence of New Shipping Routes and Logistics Hubs**

The geopolitical factors and vulnerabilities shown by COVID-19 contributed to the creation of alternate maritime routes. However, Southeast Asia and Africa will no longer be seen as temporary alternatives to the China-US route. Instead, these places have the potential to become permanent logistical hubs, playing critical roles in influencing global trade.

Southeast Asia has developed to become an important player in international trade, thanks to easy-going regulations, a strategic geographic position, and an experienced population. Countries such as Malaysia, Indonesia, and Singapore are investing heavily in port infrastructure, while trade agreements such as ASEAN's Trade in Goods Agreement (ATIGA) have considerably improved global trade connections. Southeast Asia has become a vital global logistics hub, with easy access to major markets including the US, China, and the EU.<sup>66</sup>

Similarly, Africa is seeing an increase in infrastructure investment, transforming nations such as Kenya and Nigeria into major logistical centres.<sup>67</sup> These locations are receiving significant investments from both the public and private sectors, potentially establishing them as hubs for future maritime routes. To meet Africa's growing relevance in global logistics, the

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<sup>66</sup> "Southeast Asia Is Growing as a Global Trade Nexus – and Its Emerging Markets Have an Important Role."

<sup>67</sup> Maersk, "Transforming Africa's Logistics Landscape: Trends Shaping 2024."

continent is investing heavily and developing strategic plans to position itself as an important player in international commerce. Africa Global Logistics (AGL), which has invested over €1.54 billion in infrastructure,<sup>68</sup> is driving initiatives to modernise transport networks, increase ports, and improve local connectivity. This investment is transforming nations like Kenya, Nigeria, and Rwanda into logistical centres, boosting economic growth and strengthening Africa's global trade connections.

As new shipping routes are enforced due to changing geopolitical events, these regions will continue to invest in logistics infrastructure. Because of these changes, Southeast Asia and Africa are becoming important hubs for logistics that will support more global trade, especially in e-commerce and exporting goods.

## **8.2. Market Outlook**

### **8.2.1. Predicted Growth Rates and Market Trends**

The global ocean freight industry is expected to increase gradually, with the Supply Chain Management (SCM) market estimated to reach \$85.3 billion by 2033, increasing an 11.1% CAGR between 2022 and 2033.<sup>69</sup> This growth is driven by multiple factors, including increasing demand for China-US commerce, ongoing recovery from the pandemic, and faster adoption of digital platforms to improve efficiency and optimise operations.

In the future, sustainability will significantly influence market trends. As of 2023, about 50% of CEOs worldwide were integrating sustainability into their supply chain strategy. This trend is predicted to expand as environmental restrictions strengthen and customer demand for

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<sup>68</sup> *“Reshaping Africa’s Logistics Sector - CNBC Africa.”*

<sup>69</sup> *“Supply Chain Management Market Size, Share & Trends Analysis Report By Component (Solution, Services), By Deployment, By Enterprise Size, By Vertical, By Region, And Segment Forecasts, 2024 - 2030.”*

sustainability grows..<sup>70</sup> These initiatives will result in large investments in green shipping routes, smart ports, and energy-efficient ships. Innovative technologies are already being used by ports in Singapore and Los Angeles to decrease emissions and optimise operations.

This pro-sustainability trend will require businesses to not just adhere to environmentally friendly policies, but also to rethink their whole value chain. Companies may optimise every stage of logistics—from sourcing to delivery—by implementing Porter's Value Chain theory, with an emphasis on environmentally friendly approaches that also promote operational efficiency. This may be done by investing in solar-powered container ships and autonomous electric vehicles, among other examples

The combination of sustainability, digitalisation, and local infrastructure investment highlights the future orientation of global supply chains, especially on key routes such as China-United States. To remain competitive, businesses must not only use digital platforms and automated processes, but also commit to environmental goals that improve their global presence.

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<sup>70</sup> Cooney and Cooney, *“Learning from CEOs: Collaboration and Connectivity Are Keys to Navigating Sustainability.”*

## **8.3. Strategic Recommendations**

### **8.3.1. Improving the Flexibility and Resilience of the Supply Chain**

Businesses need to go past the reactive strategies used during the COVID-19 pandemic in order to create supply chains that are resilient and adaptable. The focus will be on prioritizing proactive strategies that anticipate disruptions and allow rapid responses.

#### **Apply the Theory of Constraints (TOC) and Agile/JIC Strategies**

Companies may detect and resolve supply chain bottlenecks including port traffic jams and customs processing delays by using the Theory of Constraints (TOC). Performance can be continuously monitored and weaknesses can be identified with real-time data analytics. Automation and process modification can be used to address these problems after they have been acknowledged, boosting productivity and decreasing delays.

In addition to TOC, companies should use a mix of Agile and Just-in-Case (JIC) techniques. Agile concepts facilitate quick adjustments to both short-term and long-term disruptions, and JIC techniques guarantee buffer stock maintenance across key locations, therefore reducing the impact of suppliers stopping production and geopolitical tensions. The establishment of logistics hubs in Southeast Asia and Africa can diversify supplier networks and mitigate reliance on single routes such as the China-US trade lane.

#### **Scenario Planning for Future Disruptions**

Scenario Planning is an important part of Supply Chain Risk Management (SCRM). It lets businesses practise handling problems like natural disasters, cyber risks, and political conflicts. Businesses may evaluate the effects of these interruptions and create backup plans, such as faster customs processes, pre-negotiated freight rates, and other shipping

routes, by using digital replications, or virtual models of supply chains. This will enable companies to continue operating even in the face of unforeseen difficulties.

### **8.3.2. Investing in Technology and Infrastructure**

Supply chain resilience and efficiency will be greatly impacted by technology. Automation, blockchain, and AI investments will increase transparency, accelerate processes, and allow for proactive management of disruptions.

#### **Centralising AI for Predictive Analytics and Automation**

Artificial intelligence (AI)-driven technologies will be crucial for supply chain optimisation at every level, from demand forecasting to maintenance prediction. Businesses may anticipate interruptions like labour shortages or port delays by implementing AI-based predictive analytics, which enables them to make adjustments in real time. AI can also automate repetitive jobs, which lowers mistake rates and ensures more efficient operations.

AI can be added to businesses' current supply chain management systems by partnering with technology companies. They will be able to gather data in real time from various processes and anticipate any problems before they become more serious as a result.

#### **Using Blockchain to Increase Documentation and Transparency**

Blockchain technology can automate customs procedures and speed international paperwork, reducing mistakes and delays. Smart contracts through blockchain may start automatic shipments and payments, increasing operational effectiveness.

## **Investing in Green Infrastructure**

Companies need to prioritise investing in green technology like low-emission vehicles, solar-powered logistics hubs, and energy-efficient vessels as government regulation on emissions intensifies. Businesses may minimise their environmental effect, lower expenses, and reduce fuel consumption by adopting AI-powered route optimisation.

Companies that invest in smart ports that utilise AI-powered cranes and automated guided vehicles (AGVs) to increase handling efficiency and decrease inactive periods might benefit from government incentives for green technology.

### **8.3.3. Fostering Collaboration and Strategic Partnerships**

For resilience to be built, cooperation throughout the system of supply chains is necessary. Transparency, resource sharing, and creativity will all be improved by strategic collaborations with logistical hubs, regional suppliers, and technology companies.

## **Enhancing Transparency with Blockchain**

Real-time data exchange amongst supply chain participants, including manufacturers, shipping companies, and customs officers, is made possible by blockchain systems. A seamless coordination and a decrease in misunderstanding allow stakeholders to make choices quickly and cut down on delays.

## **Forming Strategic Alliances for Risk Mitigation**

Companies should form alliances with regional logistics centres, especially in Africa and Southeast Asia, to diversify their supply chains and reduce the risk of trade route interruptions or political tensions. Businesses will have access to different sourcing alternatives through collaboration with local governments and suppliers, which will guarantee that they can move to other suppliers in the event that their primary routes are impacted.

By implementing these strategic recommendations, which are based on the JIC, Agile, Lean, and TOC frameworks, firms may create supply chains that are adaptable, strong, and sustainable. Businesses should position themselves for long-term success in the global market by investing in AI, blockchain, and green infrastructure, which will optimise processes, save costs, and establish systems that can resist future disruptions.

## **9. Conclusion**

In this conclusion, I will answer the primary questions asked at the beginning of the project—which intended to examine the trends in ocean freight forwarding between China and the United States before and following the Covid-19 pandemic. Examining the disruptions, technical developments, and strategic actions covered throughout the project will help me offer important insights on how these problems may be addressed. Every response captures the knowledge gained from the challenges and resolved issues originating along this important trade route.

### **9.1. Answers to Initial Questions**

**Q1: How did the COVID-19 pandemic worsen already-existing logistical challenges and reveal weak points in the ocean route between China and the United States?**

Especially in terms of port congestion, supply chain delays, and operational capacity inefficiency, the COVID-19 pandemic exposed significant flaws in the China-U.S. ocean route. Labour shortages and operational inefficiencies caused ports including Shanghai, Los Angeles, and Long Beach to see unprecedented traffic; ships waiting weeks to unload. Supply chain delays got worse because of declines in workforce availability, port closings, and manufacturing closures in China and the United States. These incidents made clear the requirement of more adaptability in managing demand spikes and improved port infrastructure to resist further disturbances.

**Q2: Before COVID-19, how were the dynamics of ocean freight forwarding between the United States and China altered by geopolitical concerns like the trade war and changing trade policies?**

Before the pandemic hit, geopolitical concerns—especially the U.S.-China trade war—had already impacted the ocean freight forwarding industry. By the end of 2019, tariffs imposed during the trade war had caused Chinese exports to the United States to drop by 16%. Businesses were forced to diversify their supply chains by moving manufacturing to Vietnam among other nations. As companies looked for other suppliers and ports, this shift in policy drastically changed freight routes and resulted in more complexity in logistics, therefore stressing operational efficiencies.

**Q3: How might technology innovations like automation, blockchain, and artificial intelligence enhance the resilience and operational effectiveness of the China-US trade route?**

Automation, blockchain, and artificial intelligence among other technological developments might significantly increase the operational effectiveness and resilience of the China-U.S. trade route. Advanced automation—including blockchain technology and automated guided vehicles—which allow operations to work without interruptions even during lockdowns—was embraced by ports like Shanghai. Systems driven by artificial intelligence allow businesses like Maersk to optimise route planning and predict interruptions. But inconsistent use of this technology throughout American ports, especially the lack of automation at important ports like Long Beach, helped to cause the congestion fall during the pandemic.

**Q4: Using the lessons learnt from the COVID-19 crisis, what strategic actions can ocean freight businesses take to improve supply chain resilience and flexibility against potential global disruptions?**

Ocean freight businesses have to implement a variety of strategic actions to improve supply chain resilience and flexibility. These include diversifying supply chains by lowering reliance on one nation or area, boosting investment in digital technology and automation, and building more robust contingency plans for port closures and labour shortages. Through systems like blockchain, companies can also concentrate on supply chain transparency and real-time data integration to reduce risks during further interruptions.

**Q5: How can the sustainability of international trade along the China-U.S. route be guaranteed and the impact of future interruptions to global trade minimised by supply chain diversification and flexible logistics systems?**

Reducing future global trade disruptions depends mostly on supply chain diversity and flexible logistics concepts. Companies can better control the hazards related to geopolitics and pandemics by spreading supply chains to several areas and depending less on one supplier. Supported by real-time data analysis and sophisticated tracking technologies, agile logistics provides quick reactions to changing market conditions, therefore guaranteeing smooth operations even during crises.

**Q6: Taking in consideration the unpredictability of the global economy, what are the critical elements that will determine the long-term viability of the ocean freight route between the United States and China, and how can businesses and policymakers meet these challenges?**

Several important elements will determine the future health of the U.S.-China ocean freight route: investments in port infrastructure, acceptance of green technology to satisfy new environmental rules, and ongoing technical innovation. Policymakers have to help stabilise trade policy and establish arrangements supporting investment in solid logistics networks. Companies also have to give environmental sustainability, cybersecurity, and risk management top priority if they are to guarantee long-term viability in a fast changing global commerce scenario.

## **9.2. Final Reflection**

When one considers all aspects of this project, it is evident that the China-U.S. ocean freight route is an essential connection of world trade that suffers great difficulties from both internal inefficiencies including geopolitical tensions and infrastructure constraints as well as from outside factors like the COVID-19 pandemic. Although the pandemic worsened many of the already-existing weaknesses, it also drove businesses to reassess their supply chain plans and accelerated the acceptance of technology developments.

The main lesson from this study is that, for ocean freight forwarding going forward, resilience, flexibility, and anticipation are not just benefits but also requirements. Ensuring the sustainability and efficiency of global trade routes within an ever more unpredictable environment will depend on the integration of technology, diversification of supply chains, and cooperative efforts between governments and the business sector. Companies that invest in these areas will be able to handle future problems and take advantage of opportunities that come up when the global trade system is eventually more flexible and durable.

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