UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

Master's degree project in Logistics and Transport Management

# Identifying the Underlying Factors Causing the Changes in the European Container Shipping Market in the Post-COVID-19 Era

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## ABSTRACT

The COVID-19 pandemic has disrupted global supply chains and container shipping markets in several ways, leading to changes in demand, supply, and price. Therefore, identifying and understanding the underlying factors that have contributed to these changes is crucial for stakeholders in the industry and policymakers seeking to mitigate the negative effects of the pandemic on global trade, particularly in Europe. This study has employed a mixed research approach, including a literature review, an empirical survey, and expert interviews, and utilized an exploratory factor analysis (EFA) to identify the key factors affecting the market. The study has found three underlying factors - ***supply chain disruption, changes in freight capacity and consolidation, and supply chain transformation*** – which have had a moderate-to-high impact on the demand and supply of container shipping markets. Supply chain transformation had the highest impact on demand, while supply chain disruption had the highest impact on supply and price. Changes in freight capacity and consolidation had a lower impact on demand, supply, and price. To overcome the challenges faced by the container shipping industry in Europe after the COVID-19 pandemic, companies can improve supply chain resilience, engage in collaborative planning and forecasting, implement advanced technologies like AI, and adopt sustainable supply chain practices. These solutions can mitigate supply chain disruptions, respond to changes in the market, improve operational efficiencies, reduce costs, and maintain social and environmental responsibilities.

**Key words:** Container shipping, freight market challenges, COVID-19, supply chain disruptions, freight capacity & consolidation, supply chain transformation, exploratory factor analysis

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Gothenburg, 03 May 2023

## LIST OF ABBREVIATIONS

AI – Artificial Intelligence

EU – European Union

EFA – Exploratory Factor Analysis

GDP – Gross Domestic Product

IAPH – The International Association of Ports and Harbors

KMO – Kaiser Mayer-Olkin

LOA – Length Overall

OECD – Organization for Economic Cooperation and Development

PCA – Principal Component Analysis

PPE – Personal Protective Equipment

RO-RO – Roll on Roll off

SPSS – Statistical Package for the Social Sciences

TEU – Twenty-foot Equivalent Units

UNCTAD – United Nations Conference on Trade and Development

USA – United States of America

USD – United States Dollar

WHO – World Health Organization

WTO – World Trade Organization

WPSP – World Port Sustainability Program

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# I/ INTRODUCTION

## 1.1. Research background

The COVID-19 pandemic has brought significant changes to the global economy, with many industries struggling to adjust to the new normal (Cullinane and Haralambides, 2021). This new normal that has emerged in the wake of the pandemic includes a range of measures designed to mitigate the spread of the virus. These include social distancing, wearing masks, frequent hand washing, and enhanced cleaning and disinfection protocols (Wang et al., 2020). According to Modgil et al. (2022), the pandemic has also accelerated the adoption of remote work and digital communication technologies. Many businesses have shifted to e-commerce and contactless payment systems, while schools and universities have moved to online learning platforms. It has also shown the importance of international cooperation and collaboration in addressing global health challenges.

As depicted in figure 1, there has been a sharp increase in labor shortages across many industries in the world during and after the pandemic. According to Causa et al. (2022), the main factors behind this increase were attributed to the changes in employee preferences, structural changes within the organization, and the employee refusal to accept low-pay or challenging work environments.

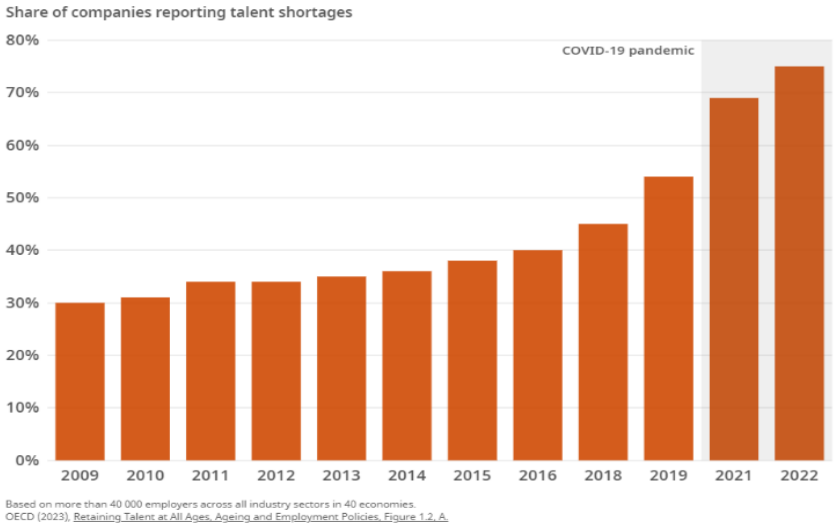


*Figure 1: Labor shortages before and after the pandemic (Source: OECD – 2023)*

The post-pandemic labor shortage has negatively impacted most industries (figure 2). Although the food and accommodation service sectors are mostly affected, it is worth mentioning that the transportation and storage sector also faces significant difficulties.

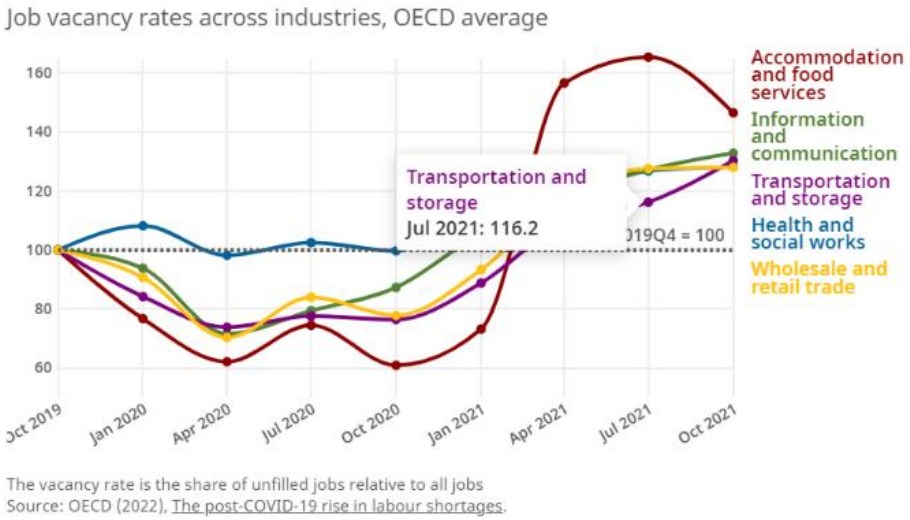


*Figure 2: Industries impacted by the labor shortages (Source: OECD - 2023)*

In addition, the COVID-19 pandemic has had a significant impact on international trade. According to the research of Wang et al. (2020), the measures taken to mitigate the spread of the virus, such as travel restrictions and lockdowns, have disrupted global supply chains and trade flows. The pandemic has led to a decline in demand for goods and services in many countries, decreasing exports and imports.

According to UNCTAD (2022), maritime trade volume declined by 4.1% in 2020, marking the first annual decline in global trade since 2009 (figure 3). This decline was particularly severe in the second quarter of 2020, when the volume of world merchandise trade fell by a record 17.3%.

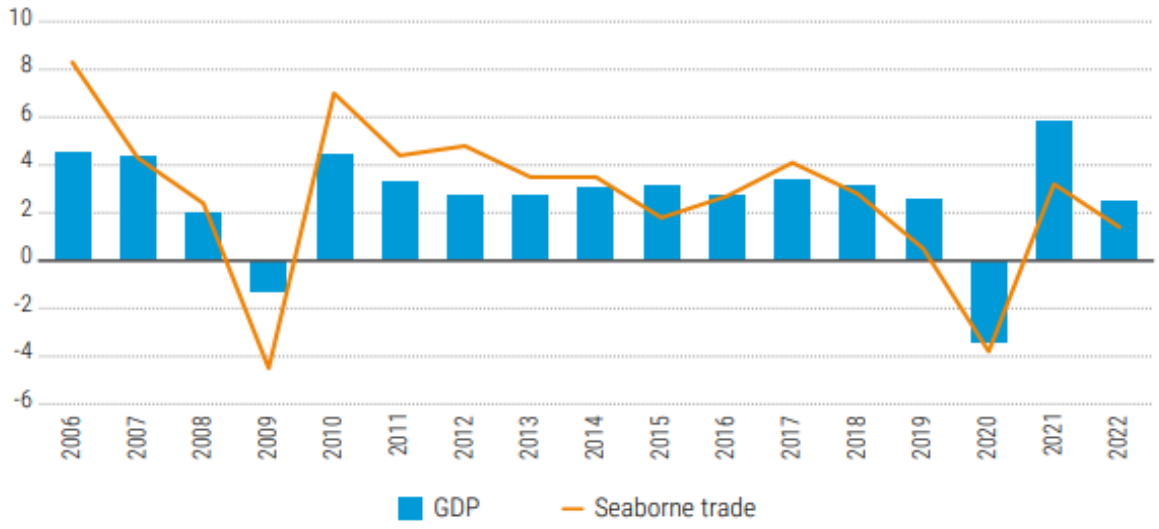


*Figure 3: International maritime trade and world GDP (Source: UNCTAD – 2022)*

In addition, the surge in demand, coupled with disruptions in supply chain operations and logistical constraints, resulted in a drastic rise in container freight rates. For instance, as depicted in figure 4, the Shanghai Containerized Freight Index reached up to five times their pre-pandemic levels, from 1,000 USD/container in Jan 2020 to 5,000 USD/container in Jan 2022 (UNCTAD, 2022). As container shipping costs peaked in the beginning of 2022, the prices of many consumer goods surged, impacting the purchasing power of consumers.

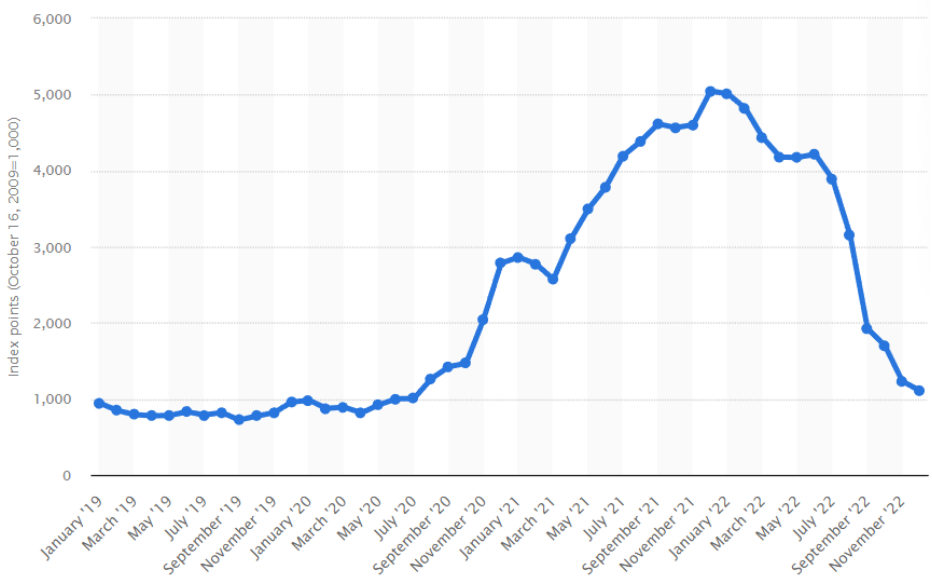


*Figure 4: Shanghai containerized freight rate index from pre-pandemic (Source: UNCTAD - 2022)*

Overall, the pandemic has led to a shortage of shipping containers, with the global container supply chain disrupted due to factors such as factory closures, reduced shipping capacity, and imbalanced trade flows (Ali et al., 2021). The shortage of shipping containers has resulted in increased shipping costs, delays in delivery, and a backlog of cargo at ports. These impacts have been significant and far-reaching, with long-term effects likely to persist even after the pandemic has subsided.

## 1.2. Problem description

### 1.2.1. Research gap

Previous literature on the COVID-19 pandemic focused on its impact on human health and behavior, environmental and transportation factors. However, there has been limited research on the effects on maritime transportation in the post COVID-19 era, with a focus on the European sea freight container shipping market. This research gap is significant because the European market is a critical player in the global container shipping industry, accounting for approximately 20% of global container throughput (UNCTAD, 2021). The supply chain includes multiple stakeholders, such as freight forwarders, shipping lines, port operators, and logistics service providers. The pandemic has disrupted the supply chain in several ways, such as causing a reduction in the number of port calls, reducing ship sizes, causing congestion at ports, and increasing shipping costs. However, the extent of these disruptions and their impact on the European sea freight container shipping market remains unclear, especially during the post-pandemic period.

### 1.2.2. Research problem

The research problem to be addressed in this study is to understand the underlying factors that impact the sea-freight container shipping market in Europe after the COVID-19 pandemic, with a particular focus on the changes in demand, supply, and pricing. The research argument is that COVID-19 has had significant impacts on the container shipping market, and understanding these factors is crucial for stakeholders in the industry as well as policymakers seeking to mitigate the negative effects of the pandemic on global trade.

### 1.3. Research objectives and questions

The aim of this study is to understand the factors that have influenced the sea-freight container shipping market in Europe after the pandemic. It is also expected to provide recommendations for the stakeholders in the container shipping industry to overcome the challenges faced during the period.

The following research questions are expected to be answered during this study.

**RQ 1 –** What factors have contributed to the changes in demand for container shipping services in Europe after the COVID-19 pandemic?

**RQ 2 -** What factors have contributed to the changes in supply of container shipping services in Europe after the COVID-19 pandemic?

**RQ 3 -** What factors have contributed to the changes in price of container shipping services in Europe after the COVID-19 pandemic?

**RQ 4 -** What are the potential solutions to the challenges faced by the container shipping industry in Europe after the COVID-19 pandemic?

The relationship between the research questions and the objectives of this study can be summarized as shown in figure 5.

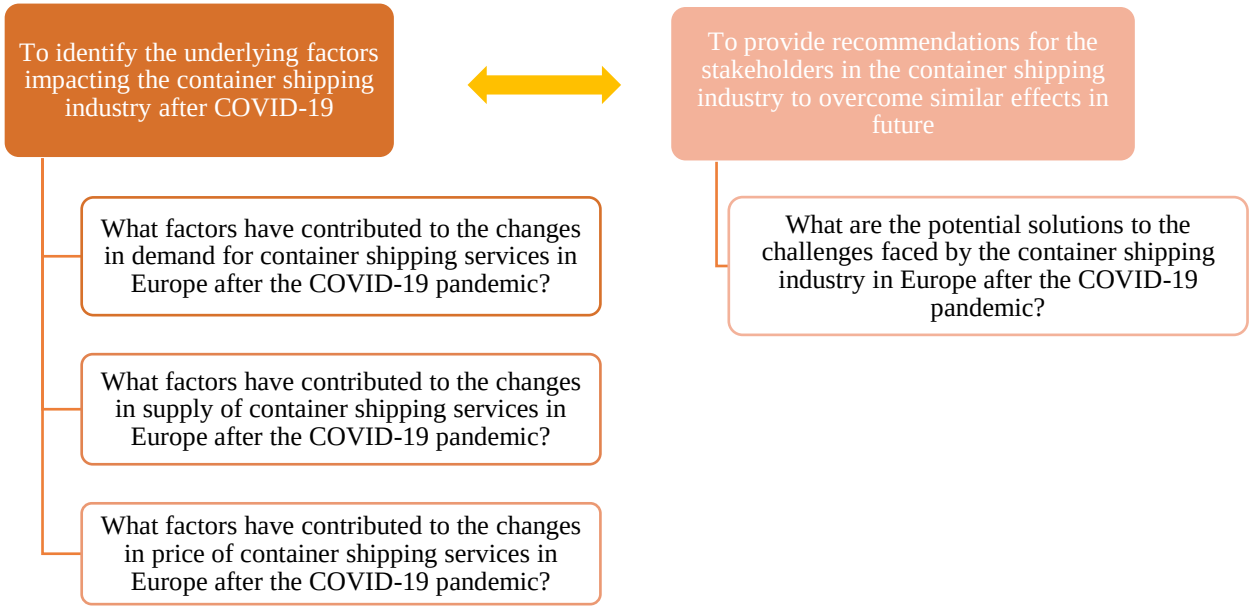


*Figure 5: The link between research objectives and research questions*

### 1.4. Research scope and delimitations

The purpose of this study is to examine the changes in the container shipping market of Europe during the post-pandemic period. Therefore, the study will only focus on the shipping of goods and exclude passenger transportation. It also excludes other forms of sea freight transportation, such as dry bulk, liquid bulk, break-bulk and RO-RO shipping, and will focus only on container shipping. To meet the time, cost, and other resource limitations, the study will concentrate on the European container shipping market, that includes both exports and imports of containers to and from the European Union. The lack of publications on the post-pandemic era also led to the decision to focus on the effects created on the container shipping market after the pandemic.

The study is based on secondary data gathered from the articles published after 2009 to ensure an enhanced validity and reliability of findings. Due to the use of carefully selected terminology in the search criteria and the use of a limited number of online research databases, the study might not capture all publications under the same domain. Furthermore, those publications published in languages other than English will not be included in this study to avoid potential errors of translating.

### 1.5. Importance of the study

There are several reasons which make it important to analyze the changes in the European container shipping market after the COVID-19 pandemic. In the global economy, maritime trade plays a critical role, and Europe has one of the largest container shipping markets in the world. The COVID-19 pandemic has had a significant impact on global trade and gaining an understanding of the changes in the container shipping market would create the opportunity to understand the economic impact of the pandemic.

Most supply chains have been heavily disrupted due to the pandemic, causing shortages and delays in the markets. Due to the derived nature of demand, the container shipping industry has been severely affected by the disruptions in global trade routes and changes in consumer demand. In that case, this type of study could also be useful for the organizations involved in the container shipping trade on shaping their strategies to adapt to a new normal.

# II/ LITERATURE REVIEW

*This purpose of this chapter is to provide a comprehensive review of the relevant literature to establish a solid foundation for achieving the objectives outlined in this thesis. The chapter is divided into six sections. Section 2.1 provides an overview of the context of global trade and its relationship to container shipping. Section 2.2 provides a snapshot of the main stakeholders participating in the container shipping industry. Section 2.3 highlights the impact of the COVID-19 pandemic on the European economy and the response of governments to the crisis. Section 2.4 describes the impacts of the pandemic on global supply chains, and section 2.5 provides an overview of the impact of COVID-19 on the European container shipping market. Finally, section 2.6 introduces the theoretical framework that will serve as the fundamental basis for model development.*

## 2.1. International trade and the container shipping market in global context

Global trade and container shipping have been increasingly crucial aspects in the global economy which connects businesses and consumers across continents. The integration of national economies into a vast interconnected global economic system, known as globalization, has resulted in significant growth in international business and global trade (Sharma et al., 2020). According to the WTO (2019), the global trade was valued at approximately $25.3 trillion in 2018. This amount was comprised $19.48 trillion (77%) from merchandise trade and $5.77 trillion (23%) from commercial services. During the same year, the nominal global GDP was estimated at $86 trillion, and it increased to $88 trillion in 2019.

The growth in global trade has led to an increase in container shipping, which, in terms of value has become the dominant mode of transport for international trade. Containerization has revolutionized the shipping industry, enabling goods to be transported more efficiently and cost-effectively (Rothengatter et al., 2021). The container shipping market has grown significantly over the past few decades, with global container throughput increasing from 102 million TEUs in 1990 to 800 million TEUs in 2019 (UNCTAD, 2022).

Although the COVID-19 pandemic harmed container trade volume, which declined by 1.3% in 2020, the containerized trade market has shown significant resilience in 2021, rebounding to 165 million TEUs, as shown in figure 6. This impressive recovery was fuelled by a combination of factors, including improved global economic conditions, pent-up demand released after the pandemic subsided, restocking of inventories, and continued spending on consumer goods, especially through e-commerce channels (UNCTAD, 2022).

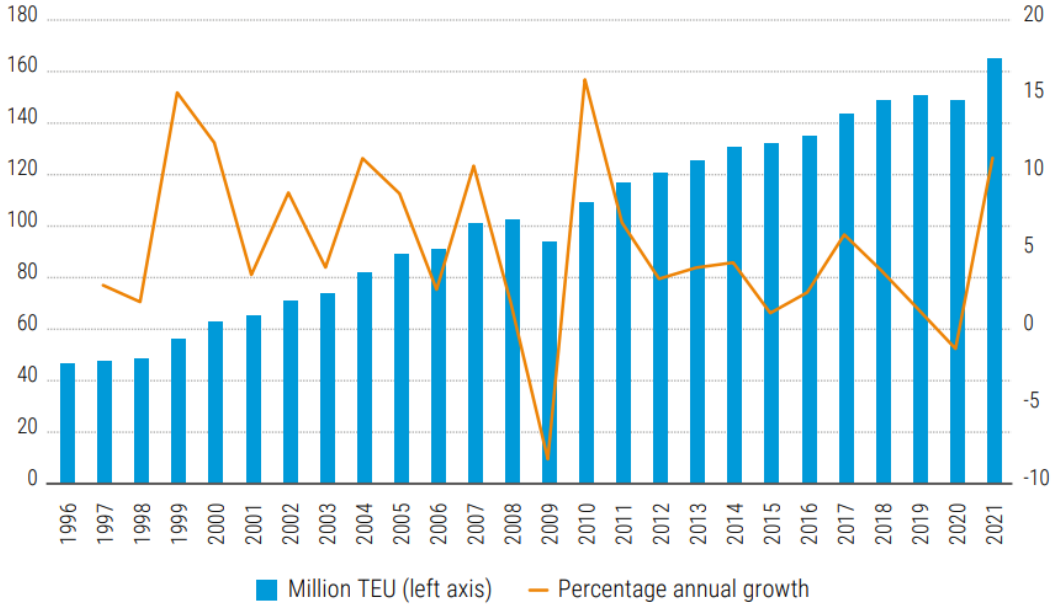


*Figure 6: Global containerized trade from 1996-2021 (UNCTAD, 2022)*

### 2.2. Stakeholders in container shipping industry

The global container shipping industry has five key stakeholders who the greatest influence over its operations (figure 7). A shipper who is also known as the "consignor," can be a person, business, or entity that ships and most often supplies the goods (LaGore, 2020). On the other hand, the recipient of the goods or the entity which would receive the ultimate ownership of the goods can be introduced as the consignee (LaGore, 2020). The demand for transport is derived from the demand for goods when a shipper and consignee initiate a commercial transaction. The freight forwarders are recognized as the third-party logistics providers who specialized in moving goods from one place to another and acting as an intermediary between the shipper and the carrier (Yildiz, 2023). In general, forwarders provide crucial services such as cargo consolidation, local transportation, storage of goods, customs clearance etc.

The shipper contacts a freight forwarder when the goods are ready to ship, and the forwarding agent helps to ensure that there is enough space on the ships/containers for the goods. For a container to be brought into a port, a suitable transport service must be used and, prior to loading the goods onto a ship, the shipper must declare the goods to customs and pay any applicable taxes. As soon as the goods have cleared from customs, the port/terminal operator will assist with handling the containers inside the port premises and loading them onto the designated vessel. Finally, the shipping line transports the container to its destination and issues the bill of lading.

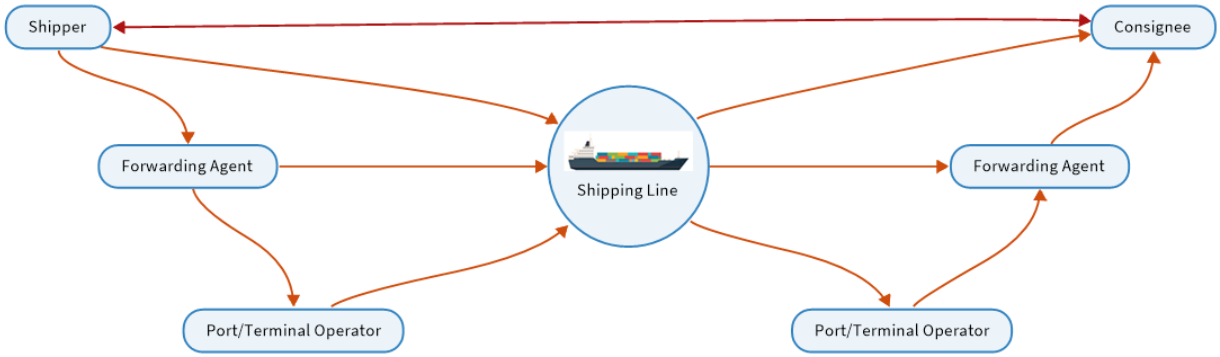


*Figure 7: Stakeholders in container shipping industry*

### 2.3. The COVID-19 situation in Europe and the disrupted responses

COVID-19 is an illness caused by a novel coronavirus (SARS-CoV-2), which was first identified in Wuhan, China in late December 2019. The virus rapidly spread to other parts of China and soon reached Thailand, Japan, and South Korea by January 20, 2020 (Sohrabi et al., 2020). During the outbreak, the Chinese authorities altered the case definition multiple times, leading to confusion about the number of cases and the virus's reach. Consequently, several European countries had to change their testing strategies to focus only on symptomatic or severe cases (Johnson et al., 2020). France reported the first European case on January 24, 2020, with Germany and Sweden following suit. By the end of February, Italy experienced a sharp rise in COVID-19 cases concentrated in the northern regions of the country. By March, all EU Member States had confirmed cases (Pullano et al., 2020). The European Council and other EU institutions closely monitored the situation and implemented relevant measures, including the adoption of EU legislation and coordination with Member States to ensure a consistent response. On March 11, 2020, the WHO declared COVID-

19 a global pandemic, and the EU supported the worldwide response by producing daily reports, guidelines, and data registration (Lescure et al., 2020). The development of the global emergence of COVID-19 is described in figure 8.

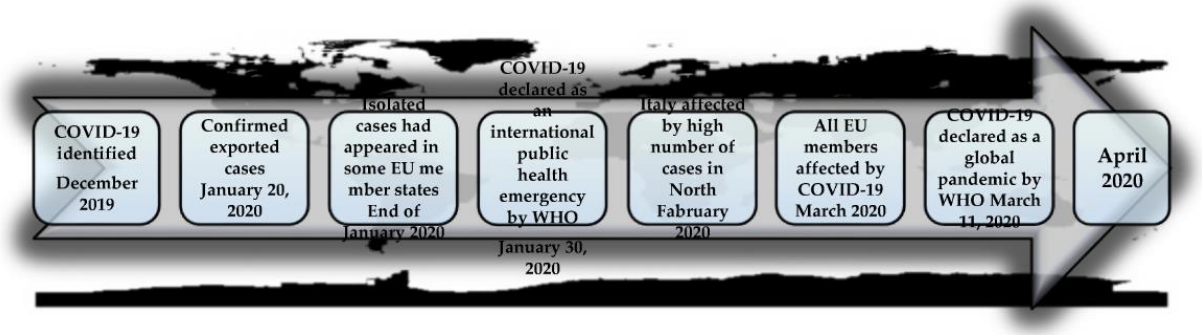


*Figure 8: Global emergence of COVID-19 (Source: Goniewicz et al., 2020)*

The EU prioritized several key areas in response to the COVID-19 pandemic, as shown in Figure 9. These priorities were agreed upon by EU leaders during video conferences held on 17 March and 26 March 2020, and include public health, travel and transportation, research and innovation, economy, crisis management and solidarity, and education. According to Article 3 of the Council Implementing Decision (2018), a crisis is defined as a situation of such wide-ranging impact or political significance that it requires timely policy coordination and response at the union political level. These priorities were based on prior discussions that began on 10 March 2020, involving the European Central Bank President, the President of the Euro-group, and the High Representative. Members of the European Council, who agreed to collaborate in the previously identified major areas to combat the pandemic (European Council, 2020). The meeting also confirmed the need for restricted border movements to be implemented and enforced, to reduce the spread of the virus. The purchase of Personal Protective Equipment (PPE) needed to support the fight against the pandemic was implemented through the civil protection framework, which is financed by EU funds and coordinated by the European Commission (European Council, 2020). Additionally, a coordinated and transparent process was initiated to share and support any developments in research concerning the novel public health threat among all the supporting Advisory Groups on COVID-19 (Johnson et al., 2020).

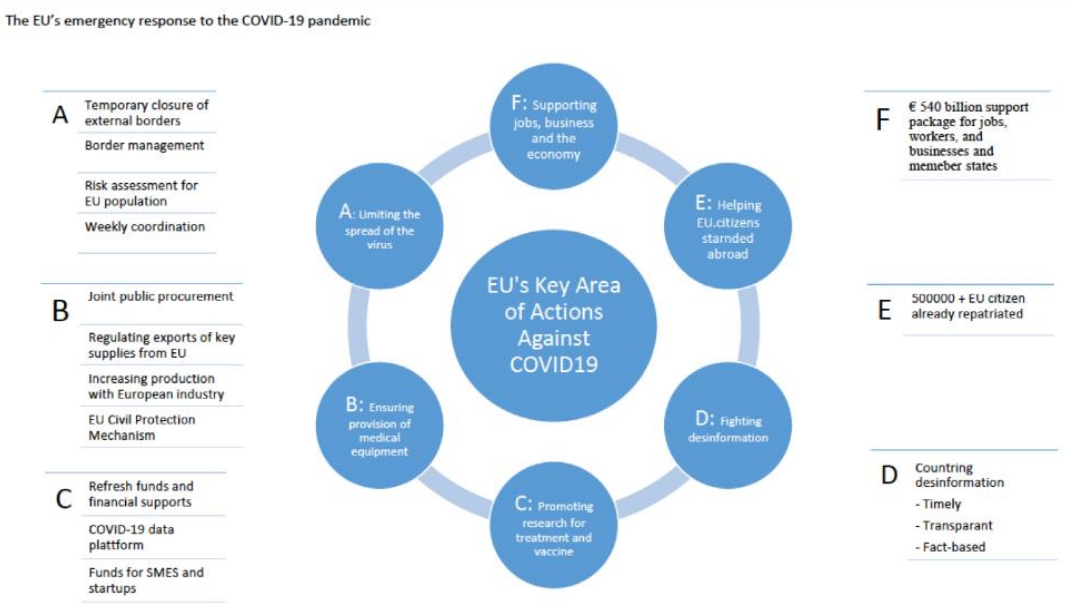


*Figure 9: The EU's emergency response to the COVID-19 pandemic (Source: Goniewicz et al., 2020)*

It was evident that the global pandemic has created a massive economic slowdown throughout the world during 2020 and 2021. As highlighted by The World Bank (2022), the COVID-19 pandemic is reported as the largest global economic crisis reported during this century. The effects of the pandemic have evolved in several sequential waves (Notteboom et al., 2021). Many global health authorities and local governments-imposed lockdown policies to prevent the spread of the virus during the first wave of the pandemic in early 2020. In response, numerous travel restrictions were introduced, which led to several changes in people's behavior and trade patterns.

### 2.4. Global container shipping market during and after the pandemic

While some studies have investigated cruise shipping, port, and shipping operations, research has shown that the pandemic has significantly reduced maritime freight transportation to prevent the spread of the virus (Zheng et al., 2020). According to Figure 10, global container volumes reached their lowest point compared to levels 8 years previous. The COVID-19 pandemic has also affected human activity in the sea, with seaport restrictions and changes in utilization patterns impacting fisheries, passenger ferries, and cruise vessels that rely on the movement of people and goods (Xu et al., 2021). Recent studies of Hülya and Eda (2021) have examined the effects of the pandemic on maritime freight transportation, with a focus on container shipping operations, as well as the movement of cruise vessels and its impact on the spread of the virus.

Ito et al. (2020) have explored individual behaviors in COVID-19 situations and the need to reorganize transport policies, while also examining the effects of the pandemic on shipping-related issues, such as congestion at ports and a decline in maritime traffic. The pandemic has negatively affected numerous industries, including oil, tourism, aviation, and healthcare, leading to an economic slowdown and market instability. While the short-term outlook for maritime business appears bleak, UNCTAD (2020), expected a return to optimistic growth in 2021, if global output recovers. Furthermore, the pandemic has highlighted the role of maritime digitalization and increased cybersecurity risks in global trading activities. The International Association of Ports and Harbors (IAPH) and World Port Sustainability Program (WPSP) have been conducting seaport studies to monitor the impact of COVID-19 on global seaports and developments compared to previous times.

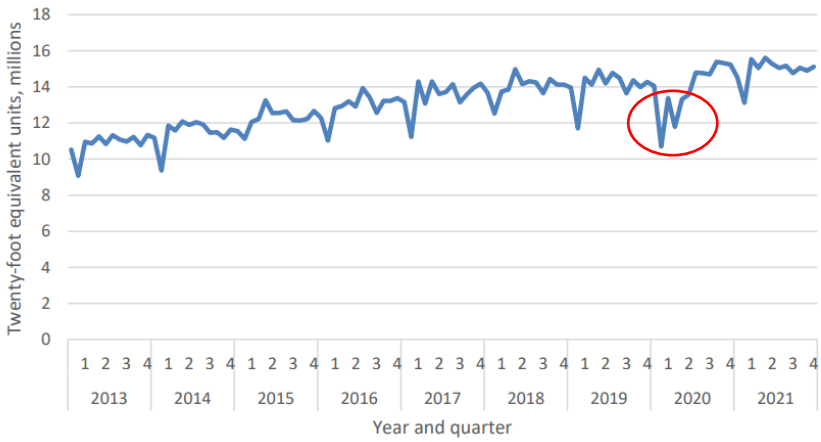


*Figure 10: Global container volumes transported per quarter 2013-21 (Source: Based on Container Trade Statistics n.d.)*

Containerized goods are often transported by standard liner shipping services which operate with a weekly schedule and call on several ports (Zhang et al., 2022). As highlighted by Zhang et al., (2022), liner ships are known for frequent deviations from their published schedules, caused by the operational challenges and uncertainties at ports. It was evident that there have been quite a lot of instances reported throughout the world where the port operations have been disrupted due to lockdowns and the reduced number of employees reporting to work. As a result, a significant drop was noticed in the schedule reliability in the global linear shipping sector during the first half of 2021 and 2022 (DHL Global, 2020).

As depicted in figure 11, the schedule reliability has dropped by 30% to 40% in both years. However, there was a rapid recovery reported during the second half of 2022.

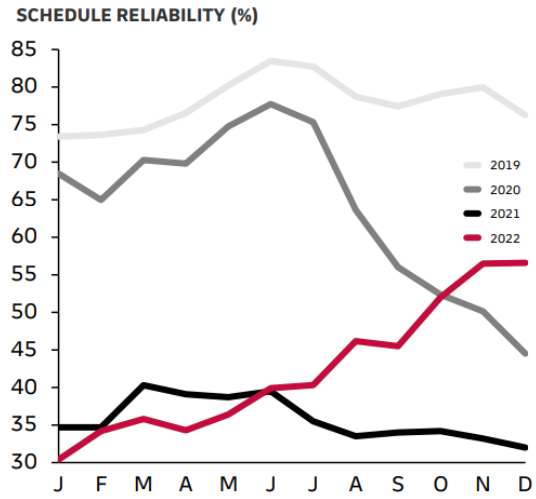


*Figure 11: Global liner shipping schedule reliability (Source: DHL Global, 2020)*

### 2.5. European container shipping market during and after the pandemic

Similar to the global container shipping market, the European container shipping market has also experienced significant changes following the COVID-19 pandemic. A significant disruption has been caused by the lockdowns and restrictions imposed by different countries, which led to a decrease in global trade and port activities (OECD, 2022). Due to the decline in demand for goods, fewer container ships traveled to and from Europe, which resulted in longer delivery times and a scarcity of containers (Yamen, 2022).

As highlighted by UNCTAD (2022), several challenges were faced by container shipping companies, including a shortage of crew due to quarantine measures, increased operational costs, and declining revenue. However, shipping companies have adopted multiple strategies to begin their recovery process after the pandemic. For instance, the adoption of modern technology and digital solutions could be seen as one of the major trends in the shipping industry after the pandemic (Raza et al., 2023). Less use of paper-based documents, shifting towards cloud-based technologies, and the application of predictive analytics in business operations are some of the key developments identified (Raza et al., 2023).

In recent studies, it has been noted that the European container shipping industry is slowly recovering and eventually will return to pre-pandemic levels. As proposed by UNCTAD (2022), It is critical for the industry to invest in modern technologies, automation, and digitalization to increase efficiency, reduce costs, and improve supply chain visibility. Moreover, the industry players would require diversifying their operations and exploring new trade routes to mitigate the risks associated with global supply chain disruptions (UNCTAD, 2022).

### 2.6. Theoretical framework

The market characteristics of the container shipping market are influenced by a variety of factors. These variables can be analyzed within a theoretical framework as that considers the interplay between different elements of the market. These variables have emerged because of the COVID-19 pandemic. However, it is likely that some of these factors will continue to impact the container shipping market beyond the pandemic.

The first variable that can impact the container shipping market is the increase in the number of blank sailings. These occur when shipping companies cancel scheduled voyages due to low demand or supply chain disruptions, especially during COVID-19 period (Merk et al., 2022). As of October 2020, the total number of blank sailings for the year due to COVID-19 had reached an astonishing figure of 515; as a result, shipping capacity was reduced 20-30% from the main trade lanes (Cullinane and Haralambides, 2021).

When looking at figure 12 showing ship utilization rates, it is understood that the market supply was greater than the demand during the pandemic. The underutilization of ships has led to significant revenue losses for the shipping lines and resulted in various remedies such as the reduction of ship sizes (International Transport Forum, 2020).

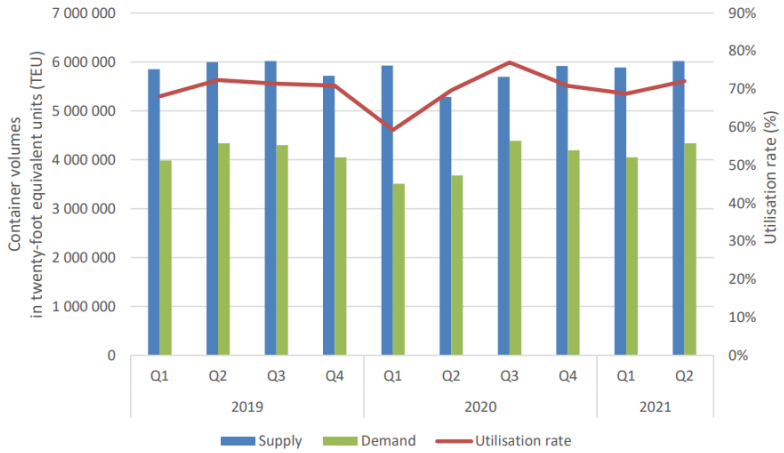


*Figure 12: Ship utilization rate, East Asia-Europe, 2019-21 (Source: MDS Transmodal n.d)*

Another key variable is the reduction in the number of port calls or cancelled port calls. According to Notteboom et al., (2021), there was a 3.6% decline in container vessel calls at ports worldwide during the first 30 weeks (about 7 months) in 2020 when compared to the same period in 2019, which negatively impacted port operations and shipping capacity.

Containers are considered as one of the most critical pieces of equipment that facilitate the transportation of many kinds of cargo in the shipping industry. According to UNCTAD (2021), the volume of containerized cargo in 2019 has accounted for approximately 69% of total sea borne trade. In other words, this means that a significant proportion of goods traded globally rely on the availability of containers for their transportation. It has also been noted that there was a shortage of containers in the global market during the pandemic which resulted in an even greater imbalance of global trade, decreased workforce levels, and various types of restrictions imposed by the local authorities (Toygar et al., 2022).

Labor shortage is another variable that should be taken into consideration. The container shipping industry has traditionally been viewed as a labor-intensive industry which requires a large and highly skilled workforce to operate and manage ships, ports, logistics networks etc. It was noteworthy that; the size of the workforce significantly declined during the COVID-19 pandemic due to the rising number of infections reported among the employees working in the sector and various regulations imposed by the local governments. As highlighted by Dierker et al. (2022), the

port congestion witnessed during the pandemic was heavily influenced by the unavailability of staff for port operations such as handling the trucking equipment.

Increased overhead costs were another challenge identified during the pandemic. These include administrative expenses, facility and equipment maintenance costs, and various other non-operational expenses. As explained by LaRocca (2021), containerized maritime freight shipping costs increased significantly during the period November 2020 to February 2021. The increase in operating costs would eventually lead to a decrease in profits and the companies must pay attention to controlling their costs to achieve the expected levels of profits (Hertati et al., 2022). Therefore, a lower profit margin could be one of the key challenges leading to changes in the container shipping market.

A noteworthy change has occurred in relation to the general transport lead times for sea freight as a consequence of the lack of containers and reduced workforce. As highlighted by Merk et al., (2022), port waiting times and turnarounds times, especially for the ports in the USA, have increased rapidly from the beginning of 2020. Due to this lack of supply in the global market, the regular transport lead times have been heavily influenced and vice versa.

Container shipping markets are highly impacted by the decisions made by shippers and consignees since demand is derived. In response to the COVID-19 pandemic, many global production companies have revised their location strategies by adopting near shoring approaches (van Hassel et al., 2021). When the supply sources are in close proximity to the manufacturing facilities, the risk of having various supply chain disruptions is lowered and the demand for longer transportation is reduced. Therefore, the localization of the supply chain is a variable that should be analyzed.

The adoption of technology and automation is also a crucial factor. To reduce the high dependency on labor, many players connected to container shipping industry have started adopting automation and other technologies into their businesses. As highlighted by McKinsey & Company (2020), both consumers and businesses have dramatically shifted towards online channels during the pandemic. When consumers are increasingly turning to online shopping, the need for having a physical store becomes less important and, in most cases, those traditional customer touch points

would be completely closed or operated at reduced capacity. On the other hand, many organizations have adopted digital collaborations with their business partners and enabled remote working possibilities for their employees. These dynamics in the global market have opened many avenues for the container shipping industry in the post COVID-19 era.

Finally, modal shifts in the mode of transportation used for shipping goods could also have a significant impact on the container shipping market. According to Brett (2022), during the COVID-19 pandemic, the air cargo industry witnessed a substantial boost as businesses increasingly favored air transportation over ocean shipping. However, leading forwarders have recently indicated that this trend began to reverse in 2022. Shippers are increasingly opting to convert airfreight back to ocean freight, primarily driven by their desire to reduce supply chain costs.

Based on the above findings from previous studies, the following theoretical framework could be developed as depicted in figure 13.

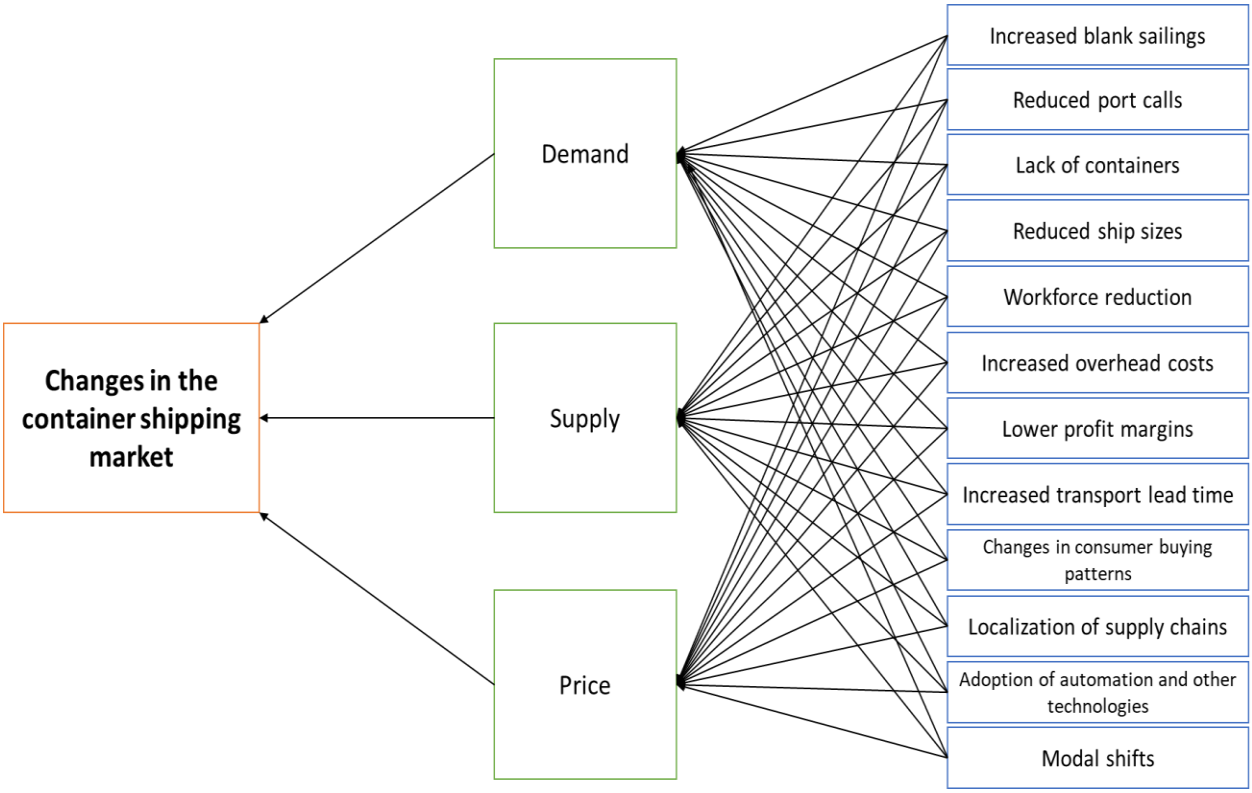


*Figure 13: Theoretical framework*

# III/ METHODOLOGY

*To gather both qualitative and quantitative data, this study employed a mixed approach utilizing three key data-gathering methods: a comprehensive literature review, an empirical survey, and expert interviews. In this chapter, the research design is presented in section 3.1, while section 3.2 explains the process for selecting the population and sample for the study. The data collection method is introduced in section 3.3, and section 3.4 outlines how the questionnaires and interview questions were developed.*

## 3.1. Research design

A mixed research approach is used for this study, combining both quantitative and qualitative techniques as depicted in figure 14. A literature review implemented in a systematic manner is used to gather the secondary data for the study, and a structured online survey and expert interviews are used for gathering primary data. The aim of the literature review is to understand the existing knowledge in the selected domain and identify the gaps which can be explored during this study. Through expert interviews, the findings of the literature review are further strengthened, aiding the study's inclusion of new knowledge. A few examples of industry experts would be management-level professionals in shipping/forwarding companies, independent logistics consultants, and other researchers who work in the same area of expertise. An online structured survey is used to collect widespread opinions from various industry stakeholders. The data gathered from the online survey are analyzed by applying an exploratory factor analysis that is conducted by Statistical Package for the Social Sciences (SPSS).

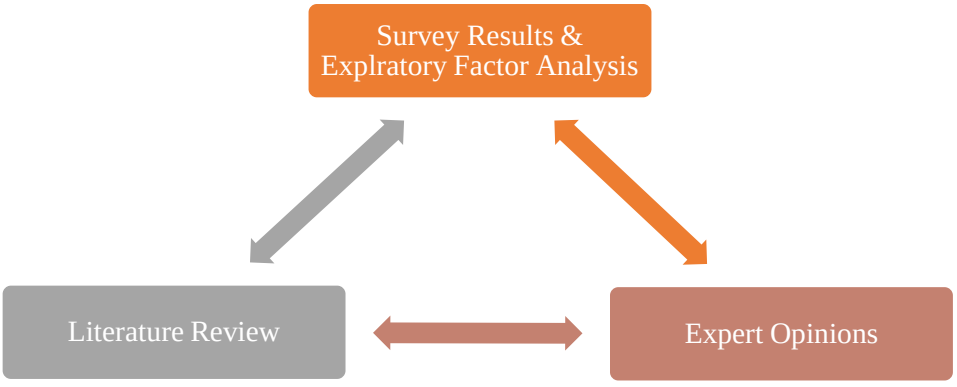


*Figure 14: Triangulation of data*

### 3.2. Selection of population and sample

#### 3.2.1. Population

The population for this study encompasses all the companies involved in the container shipping industry in Europe, and the table 1 highlights some of the key players in the sector.

| No | Stakeholder | Example Companies |
|---|---|---|
| 1 | Shipping Lines | Kuehne + Nagel (AG & Co.) KG, COSCO Shipping Lines, Maersk, etc. |
| 2 | Forwarding Agent | DHL Supply Chain & Global Forwarding, DSV, CEVA, etc. |
| 3 | Shipper/ Exporter | H&M, HEINEKEN, SANOFI AVENTIS, Ford, Volvo |
| 4 | Consignee/ Importer | Samsung, Saica Pack, Graphic Packaging |
| 5 | Port/Terminal Operator | Rhenus Logistics, TTS Operators |

*Table 1: Stakeholder groups*

#### 3.2.2. Sample

To enhance the validity and feasibility of the study, it is targeted to derive a sample of 150 employees who currently work in selected companies operating within the container shipping market in Europe. The companies were chosen based on specific characteristics such as operational capacity, sales revenue, and number of employees, which were essential indicators of the relevance and importance of the companies in the industry. It is expected to use this purposive sampling method when selecting respondents for the survey, allowing equal chance for respondents to be selected from the large population. The sampling frame of 150 employees consists of two sources:

- Network contacts: This includes a list of all the employees who are personally known or connected to the researchers, such as colleagues, friends, or acquaintances who are involved in the container shipping market in Europe.
- LinkedIn: The researchers sent out messages to a selected group of employees who meet certain criteria, such as job title, industry, and location.

Furthermore, the researchers expected to conduct semi-structured interviews with two industry professionals to delve more deeply into the variables tested in this study.

### 3.3. Data collection

#### 3.3.1. Primary data sources

To ensure the accuracy and comprehensiveness of the research, the primary data for this study was gathered through a structured online questionnaire, which was distributed to a carefully selected sample of 150 employees currently working in the container shipping market in Europe. The main objective of the questionnaires is to obtain information from the participants about their experience and opinions with the changing demand, supply, and price of the container shipping market after the COVID-19 pandemic. Specifically, the study aimed to collect data on how the pandemic had affected the industry and how it had led to changes in these aspects. Additionally, the questionnaire sought to uncover the challenges that remained in the market after the pandemic period.

To ensure that the questionnaire findings were valid and reliable, the researchers also conducted semi-structured interviews with senior management representatives from the selected companies. These interviews provided additional insights into the impact of the pandemic on the container shipping market and helped to validate the responses received from the questionnaire. Overall, the study utilized a multi-pronged approach to gather primary data and ensure that the findings were robust and accurate. By combining the questionnaire with expert interviews, the research provided a comprehensive and detailed picture of the container shipping market in Europe following the COVID-19 pandemic.

#### 3.3.2. Secondary data sources

The secondary data sources for this study comprised previous research publications that explored the container shipping market in Europe, with a focus on the impacts of COVID-19 in the post-pandemic era. 53 research articles were screened for their relevance and applicability to the current study. These articles provided valuable insights into the industry, which were used to supplement and support the primary data obtained through the questionnaire and expert interviews. By drawing on a range of sources, the study aimed to provide a comprehensive and nuanced understanding of the container shipping market in Europe after the pandemic.

### 3.4. Questionnaire

#### 3.4.1. Overview

In developing the questionnaire survey for this study, the researchers drew upon the literature reviewed during the research process. However, the researchers also made several additions to the questionnaire to improve its scope and ensure that it was tailored to each key player in the industry.

The questionnaire survey was composed of 9 compulsory questions that focused on three principal areas: changes in demand, changes in supply, and price fluctuations, as well as open-ended questions related to challenges encountered during the post-COVID-19 period. During the trial runs, respondents completed the questionnaire within 15 to 25 minutes.

The finalized questionnaire, shown in Appendix-II, was carefully designed with relevant justifications provided for each question. By using existing questions and tailored additions, the survey aimed to provide a comprehensive and insightful assessment of the container shipping market in Europe after the pandemic.

#### 3.4.2. Structure of the questionnaire

The initial question of the survey ensures that the respondent is relevant to the research topic. Only those involved in the container shipping market in Europe can proceed to the subsequent questions. This step ensures that only relevant stakeholders contribute to the research findings.

The next section of the survey comprises the focus of the questionnaire. The initial question prompts the respondent to select their main industry, representing the five stakeholders as depicted in the stakeholder mapping. The subsequent questions investigate their perception of how the demand, supply, and price of the container shipping market are affected by a list of 12 observed variables. These variables include factors such as supply chain disruption, freight capacity, consolidation, and digitalization. The questions utilize a Likert-scale format, allowing respondents to indicate the level of impact each variable has on the container shipping market. Following these questions are open-ended questions, enabling respondents to input other factors not included in the list of 12 variables. The final two questions in this section are also open-ended, inquiring about the

challenges the company has faced after the COVID-19 pandemic and viable solutions based on the respondent's experience.

The concluding section of the survey is designed to collect the demographic characteristics of the respondents, such as their work experience, work position, and the number of employees working in their functional area. The survey also provides the option for respondents to include their email addresses, allowing researchers to follow up with them if needed. It is important to note that answering this section is optional and left to the discretion of the respondents.

### 3.4.3. Implementation of the survey and interviews

The development of the questionnaire for this survey will be done using Google Forms. To reach the sample number required, the survey will be distributed through a variety of electronic platforms, including email and social networking platforms, such as LinkedIn and, WhatsApp. It is important to note that participation in the survey is entirely voluntary. There will be no inducements or incentives used to persuade individuals to take part. All responses from the participants will be collected anonymously, and confidentiality will be maintained throughout the survey process.

In addition to the online survey, the research team will also conduct interviews with a select group of participants. These individuals were selected based on their relevance to the research topic and their willingness to participate. Prior to the interview session, the research team shared the relevant questions to be discussed with each participant to ensure they are fully informed and prepared for the discussion.

### 3.4.4. Error control

To ensure that the participants provide all the necessary information required for the study, various techniques were implemented to minimize any inconsistencies in their answers. To achieve this, the questions were made compulsory and presented in a variety of formats including multiple-choice, Likert scale, and short text. By presenting the questions in these formats, participants could easily select their responses from a given list, reducing the likelihood of incomplete or inconsistent answers. To further ensure data accuracy, the respondents' email addresses were recorded in the

questionnaire. This allowed the research team to filter out any repeated responses from the database, ensuring that the data collected was unique and reliable.

To facilitate the expert interviews, it was decided to utilize both Zoom and Microsoft Teams software, which allowed for the entire interview session to be recorded. This recording will provide the research team with better accessibility to the discussion for reference purposes in later stages of the project. Before recording, the team would obtain informed consent from the interviewees by explaining the recording's purpose, ensuring confidentiality, and providing an opportunity for participants to ask questions and clarify any concerns. It is important to note that without the interviewees' consent, the interviews would not be recorded.

### 3.5. Exploratory factor analysis

As stated by Fabrigar and Wegener (2011), actual data collected for a study would rarely produce clear correlation patterns and mostly include various deviations. Therefore, it could be challenging for the researchers to fully interpret those patterns without adopting a systematic data analysis method. The factor analysis is a statistical procedure designed to determine the number of distinct constructs that need to be identified in order to account for the pattern of correlations among a set of variables (Fabrigar and Wegener, 2011). An exploratory factor analysis or an unrestricted factor analysis could be performed when the researchers are having limited knowledge about the underlying structure of correlations (Fabrigar and Wegener, 2011).

To recognize the most significant factors concerning demand, supply, and price, EFA was utilized for this study and the relevant steps involved in the EFA process are summarized in the figure 15.


*Figure 15: EFA process*

### 3.5.1. KMO and Bartlett’s test

The initial examinations utilized the Kaiser Mayer-Olkin (KMO) and Bartlett's Test. According to Shrestha (2021), the KMO statistic is a Measure of Sampling Adequacy, both overall and for each variable. The KMO statistic provides a measure of the degree to which the partial correlations between variables in the factor analysis are insignificant compared to their original (zero-order) correlations. If both the KMO value is over 0.5 and the significance level for Bartlett's test is below 0.05, it suggests that the data is suitable for factor analysis, and that there is evidence of substantial correlation among the variables (Kant and Adula, 2022).

# IV/ ANALYSIS OF AND RESULT I: THE SURVEY AND INTERVIEWS

*In Chapter 4, a broad analysis is conducted on both quantitative and qualitative data gathered from the selected sample. The section begins with data screening in section 4.1, where the study's high response rate of 43% is highlighted. The analysis then moves on to section 4.2, which provides an in-depth examination of demographic factors to offer a better understanding of the backgrounds of respondents. Lastly, section 4.3 presents the findings from open-ended questions and expert interviews, providing insights into the qualitative data gathered in the study.*

## 4.1. Data screening

The research involved the development of a questionnaire through Google Forms, which was subsequently distributed via email and other electronic media channels (such as WhatsApp and LinkedIn Message) to 150 executives from five distinct selected actors involved in the container shipping market in Europe. The survey yielded a total of 70 responses, of which 64 were deemed valid, resulting in a response rate of 43%. The anonymity of the respondents was strictly preserved, and measures were taken to ensure the privacy and protection of their personal information. Despite the lower-than-anticipated number of responses, the research team decided to proceed with the data analysis due to the limitations of the research time frame. In summary, the response rates for the study can be delineated in table 2.

| **Description** | **Total** | **Shipping Lines** | **Freight Forwarders** | **Exporters** | **Importers** | **Terminal/ Port operators** |
|---|---|---|---|---|---|---|
| Expected number of responses | **150** | 30 | 30 | 30 | 30 | 30 |
| Actual number or responses | **64** | 16 | 12 | 12 | 14 | 10 |
| **Response Rate** | **43%** | **53%** | **40%** | **40%** | **47%** | **33%** |

*Table 2: Response rates*

To ensure the dependability and validity of the outcomes, several steps were implemented to screen the data obtained from the survey and interviews. Specifically, duplicated responses provided by the participants were removed from the dataset before starting the analysis in SPSS. Furthermore, the responses were systematically arranged using numerical and textual formatting to eliminate any discrepancies in the data. Additionally, the data collected from the expert interviews were recorded in a structured fashion, adhering to a standardized set of questions. These measures were taken to improve the accuracy and reliability of the data and, by extension, the credibility of the research results.

For convenience of reference, the variables that have an impact on demand, supply, and price are coded in accordance with table 3 provided below:

| **No** | **Variables** | **Impact on demand (D)** | **Impact on supply (S)** | **Impact on price (P)** |
|---|---|---|---|---|
| 1 | Increased blank sailings | D1 | S1 | P1 |
| 2 | Reduced ship sizes | D2 | S2 | P2 |
| 3 | Reduction in number of port calls | D3 | S3 | P3 |
| 4 | The lack of containers | D4 | S4 | P4 |
| 5 | Workforce reduction | D5 | S5 | P5 |
| 6 | Increased variable costs | D6 | S6 | P6 |
| 7 | Lower profit margins | D7 | S7 | P7 |
| 8 | Increased transportation lead time | D8 | S8 | P8 |
| 9 | Changes in the consumer buying patterns | D9 | S9 | P9 |
| 10 | Localization of the supply chains | D10 | S10 | P10 |
| 11 | The adoption of automation and other technologies | D11 | S11 | P11 |
| 12 | The changes in mode selection | D12 | S12 | P12 |

*Table 3: Variables coding*

### 4.2. Analysis of demographics

To gain a better understanding of background of respondents, the survey contained questions regarding demographics such as industry, company size, work experience, and role in the company. However, it was decided to include only one compulsory question at the beginning of the survey to facilitate direct access to the main questions (i.e., Likert scale). All other demographic questions followed towards the end of the survey and the participants could voluntarily answer them.

As shown in figure 16, an almost equal representation of the five different stakeholder groups was captured during the survey, which helped in the avoidance of bias in the results. However, there was a slightly higher number of participants captured from the shipping line sector, one of the main players in the container shipping market.

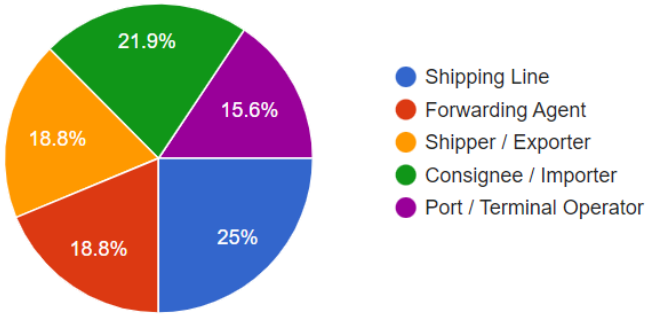


*Figure 16: Stakeholder representation in the sample*

As defined by OECD (2017), organizations with less than 50 employees are considered small-scale enterprises, whereas those with over 250 employees are seen as larger companies. During the survey, the majority of respondents represented large scale companies as shown in figure 17. By having a higher representation of respondents from large-scale enterprises, greater reliability and lower variability are expected in the survey results.

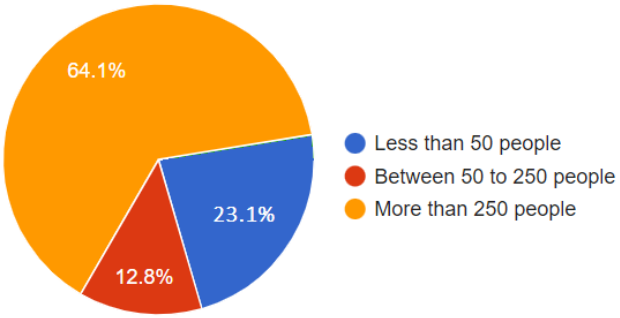


*Figure 17: Company size*

It was significant to note that most respondent had work experience of more than 1 year which implies that they have gone through the changes that happened in the container shipping market especially during early 2022 (figure 18). Since répondents could answer the survey questions easily on the basis of their own experiences, this helps to improve the reliability of the data used within the study.

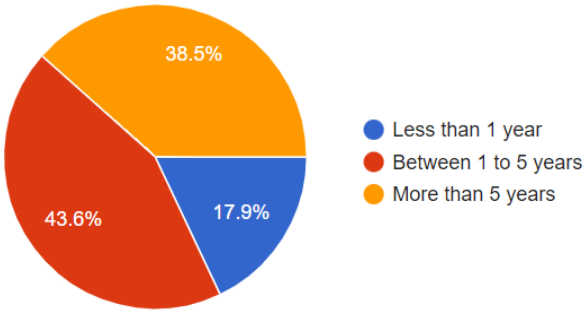


*Figure 18: Level of work experience*

The survey involved an equal number of respondents from both operational and managerial levels (figure 19). These two levels represent the front-line staff responsible for executing the decisions made by the top management in their respective organizations. Therefore, both operational and managerial staff would encounter the most industry-specific challenges when it comes to implementation. As the majority of respondents were from the front-line staff, this would contribute to enhancing the validity and reliability of the survey results.

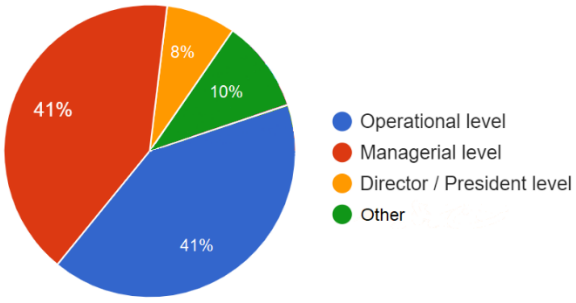


*Figure 19: Role in the company*

### 4.3. Qualitative data analysis

This study collected qualitative data from two main sources: the responses to open-ended survey questions and semi structured interviews with a few industry professionals. The relevant qualitative data will be summarized and analyzed in the following sections.

#### 4.3.1. Analysis of open-ended survey questions

During the survey there were several questions which kept open-ended for respondents to answer. It was decided to keep them non-compulsory to gain a higher involvement from respondents for the Likert scale questions. The first three open-ended questions in the survey were intended to explore whether there are any other variables that might have an impact on the demand, supply, and price aspects of the container shipping market. There were 7 to 9 responses received for each question, and the factors highlighted can be summarized as follows.

*Additional variables that could impact the demand of container shipping services*

- Freight rate
- Intensity of the pandemic and the country's reaction
- New provisions in the law

*Additional variables that could impact the supply of container shipping services*

- Shortage of raw materials in the goods market
- Bankruptcy of shipping lines
- Lockdown activities in larger ports
- Increased shipping crimes

- New provisions in the law

*Additional variables that could impact the pricing of container shipping services*

- The excess supply compared to demand
- High inflation rate
- Increased fuel prices
- Reduced demand for global trade

Many responses (20 out of 64) were received for the remaining two open-ended questions focused on the challenges companies faced during the post-COVID-19 period and how they dealt with them. To make the analysis more efficient, the responses were categorized into seven sections as follows.

*Supply chain disruptions*

- Shortage of raw materials
- Difficulty of finding new shippers/consignees
- Lack of communication from suppliers
- Supplier capacity issues

*Operational inefficiencies*

- Port congestions causing delays the arrival date at destination ports
- The shortage of containers
- Longer transportation time from origin to destination due to the skipping of ports

*Low profitability*

- Reduced demand for exported goods, impacting the revenues and cashflows of companies
- Intense competition, where some companies may offer attractive deals by not requiring deposits to gain new customers, can negatively affect the profit.

*High inflation*

- The ongoing war in Ukraine and general inflation have also contributed to higher inflation rates

- Higher costs of transportation and freight have further increased inflation in the shipping industry
- The global economic situation also plays a role in high inflation rates, as economic downturns can impact supply and demand dynamics in the shipping industry

*Lack of resources & new working arrangements*

- Restructuring of personnel allocations
- Lack of infrastructure and system-related investments
- Workforce reduction which impacts operational capacity
- The need to have work flexibility schemes allowing employees to work from home or hybrid choice between working from home and the office

*New regulations / laws*

- New laws and protocols introduced by governments
- Higher emphasis on establishing green logistics practices which involves higher costs

*Changes in market structures*

- A highly competitive market, with many shipping lines and freight forwarders looking to expand their scope of operation and market share through mergers and acquisitions
- As competition among freight forwarders intensifies, profit margins have become increasingly low, making it challenging for businesses to maintain profitability

The following strategies were shared by the respondents during the survey as how to overcome the above-mentioned challenges:

*Improve supply chain resilience*

- Dynamic planning of transportation modes
- Review the safety stocks regularly to overcome short term supply disruptions
- Localized sourcing to enable cost savings, uninterrupted supply, and better sustainability

*Strengthen supplier relationships*

- Prioritization of orders & closer follow ups with suppliers
- Improve service quality to gain more new customers
- Retain existing customers by providing solutions for their supply chain pain points
- Develop good relationships with the shipping lines to gain better availability and prices

*Implement Artificial Intelligence and other advanced technologies in the business processes*

- Automation and restructuring of working shifts
- Digitalization to enhance the service experience of customers
- Modern technologies and automation tools emerge to support virtual working

*Adopt better sustainable supply chain practices*

- Shift towards a flat organization structure by reducing the number of hierarchical levels which allows streamlined decision-making processes
- Investing in sustainable logistics and aiming for sustainable development to save costs in the long term and protect the environment
- Implementing agile supply chain strategies to minimize transport distances and reduce emissions

These challenges and potential solutions are summarized in the table 4 below:

| **No** | **Challenges** | **Potential solutions** |
|---|---|---|
| 1 | Supply chain disruptions | Improve supply chain resilience & strengthen the supplier relationships |
| 2 | Operational inefficiencies | Implement Artificial Intelligence and other advanced technologies in the business processes |
| 3 | Low profitability | Adopt better sustainable supply chain practices |
| 4 | High inflation | Improve supply chain resilience |
| 5 | Lack of resources & new working arrangements | Implement Artificial Intelligence and other advanced technologies in the business processes |

| | | |
|---|---|---|
| 6 | New regulations / laws | Adopt better sustainable supply chain practices |
| 7 | Changes in market structures | Improve supply chain resilience |

*Table 4: Summary of challenges and potential solutions*

### 4.3.2. Expert interview data

The researchers conducted two semi-structured interviews to authenticate the survey findings and gain more insights into market dynamics. Both interviews were conducted using the same set of questions with slight customization towards the industry represented by each interviewee.

***Interviewee 1***

The first interview was conducted with a seasoned professional from one of the largest fourth-party logistics providers in Europe. The choice of interviewee was based entirely on his industry experience and involvement in the container shipping market. During the session, he pointed out that the most pressing issue during the pandemic was the tight capacity in the container shipping market. The high demand for pandemic-related products led to a scarcity of container supply, which caused significant disruption to the industry. However, this situation has improved after the COVID-19 pandemic, and the container shipping market is now being defined by price, with more competition and lower prices for customers. In addition to the issue of tight capacity, the expert also emphasized the challenges of cost that have emerged during and even after the pandemic. With the unexpected economic shocks caused by COVID-19 and other global events, such as the war in Ukraine, companies are now focusing more on reducing operational costs and finding ways to save money. This has significantly impacted on the demand for exported goods, which has affected the container shipping market. Considering the forwarder companies, these challenges have created critical issues that need to be addressed. To remain competitive and meet the changing demands of customers, forwarder companies must focus on reducing costs and adopting more sustainable operations. This can involve implementing modern technologies, streamlining processes, and reducing waste, among other measures. By doing so, forwarder companies can ensure that they are well-positioned to meet the evolving needs of the container shipping market and the wider global economy.

***Interviewee 2***

An expert from port operations with over 10 years of experience was selected for the second interview. The selection of the interviewee was purely based on his professional and academic background connected to maritime shipping, mostly from the perspective of port operations. As explained by the interviewee, the COVID-19 pandemic has led to various challenges in the shipping industry. Supply chain disruptions have resulted in delayed deliveries, particularly in the European ports where operations have been slow due to a reduced workforce and congestion. The shortage of containers in Asia has been severe due to the delay in the return of empty containers by USA and European consignees. This has resulted in the workforce reduction during and after the pandemic. However, the shipping lines have opted for ships of about 300 LOA, instead of larger ones to avoid the underuse of ships. However, the change of ship sizes was heavily dependent on the type of ship charter and has only been noticed on some routes. The interviewee also explained that port handling charges, and terminal fees have remained the same during the pandemic due to pressure from many other stakeholders involved in container shipping. Large-scale manufacturers in Asia have also had production stoppages due to low volumes ordered. The interviewee also stressed that the shoring has become a more popular choice among many European customers. However, it is just a temporary change in the market because it would take more time to become a permanent change. According to the interviewee, the rise of e-commerce after the pandemic has not negatively affected the volume of cargo shipped by sea, as customers still prefer the cost-effective option of ocean freight. Furthermore, the shipping lines are still able to secure their customer base through additional service offerings, mergers, and acquisitions with other stakeholders. In port operations, various automation features such as auto store, expert decking, prime route, and digital twin are being used to increase efficiency and better utilization of vessel and port space. As explained by the interviewee, the European ports are heavily relying on digital twin technology which provides the ability of simulating port operations in advance and avoid unnecessary costs.

# V/ ANALYSIS AND RESULTS II: EXPLORATORY FACTOR ANALYSIS

*The purpose of this chapter is to derive the underlying factors concerned in this study using Exploratory Factor Analysis. The section starts by applying the KMO & Bartlett's test to validate the data for the exploratory factor analysis, followed by explaining the descriptive statistics. The chapter then moves on to the use of correlation analysis to examine the relationships or associations between observed variables. Finally, the results of the analysis are presented and explained in detail.*

## 5.1. Applying the KMO and Bartlett's tests

Based on the results of the KMO and Bartlett's tests displayed in tables 5, 6 and 7, the sample adequacy level is close to one (KMO > 0.5) and the significance level for Bartlett's test is lower than 0.001, indicating that the data collected for this study is suitable for conducting a meaningful factor analysis.

**KMO and Bartlett's Test**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .749 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 272.323 |
| | df | 66 |
| | Sig. | <.001 |

*Table 5: KMO & Bartlett's test - demand*

**KMO and Bartlett's Test**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .779 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 344.877 |
| | df | 66 |
| | Sig. | <.001 |

*Table 6: KMO & Bartlett's test - supply*

**KMO and Bartlett's Test**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .855 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 324.511 |
| | df | 66 |
| | Sig. | <.001 |

*Table 7: KMO & Bartlett's test – price*

## 5.2. Descriptive statistics

Descriptive statistics involve describing the characteristics of a given sample in both numerical and graphical forms (Fisher and Marshall, 2009). With a five-point Likert scale, the respondents were asked to rank the relative effects of 12 factors on demand, supply and price during the survey conducted in this study. Given that the data represent ordinal level measurements, it is meaningful to use certain descriptive statistics such as median, mode and standard deviation to explain the frequency distribution. However, the numerical values assigned to ordinal categories might not fully explain the impact, as it only provides a hierarchy and not an absolute measurement of the impact level. The effective use of descriptive statistics would create the possibility of generalizing the sample result to the population.

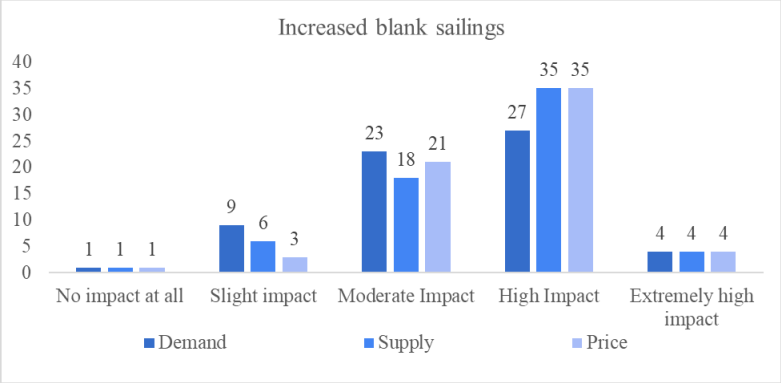


*Figure 20: The impact of increased blank sailings*

As shown in figure 20, a higher number of respondents have stated that the increased blank sailings have a greater impact on all three market aspects. However, when looking at the mode parameter of the results it can be concluded that the highest impact of increased blank sailings is on supply and price aspects. For instance, when the shipping lines cancel certain voyages, it would impact directly on the level of supply and eventually on the price.

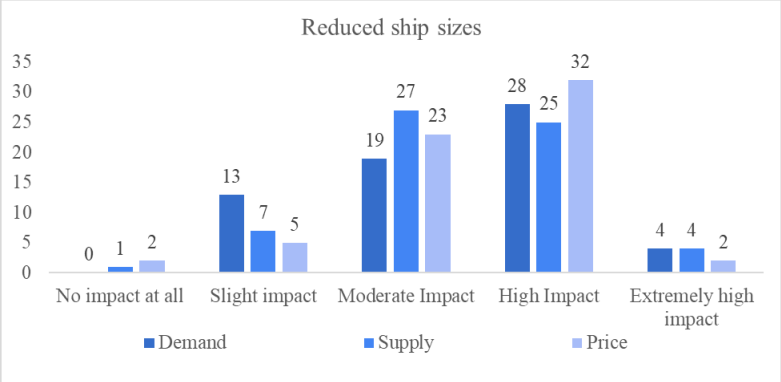


*Figure 21: The impact of reduced ship sizes*

A higher number of participants have ranked the reduced ship size as having a moderate impact on the supply and a higher impact on the demand and price (figure 21). The reduction of the ship size is purely a decision made by the ship's operator based on certain market characteristics and the operating costs. Therefore, this outcome does not fully explain the real situation in the market where the ship size is heavily impacting the supply. Therefore, this will be investigated further in the subsequent steps of the data analysis.

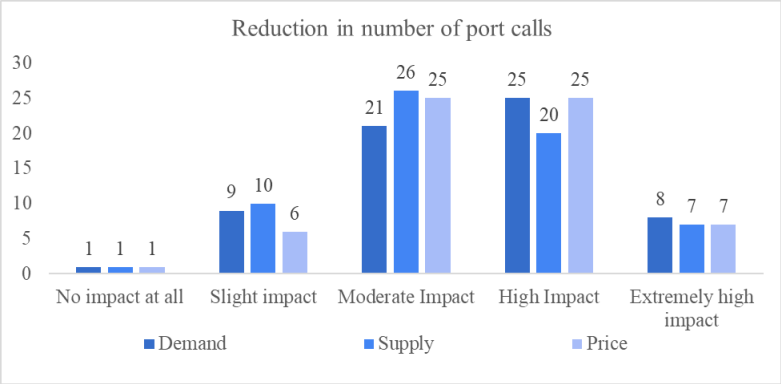


*Figure 22: The impact of reduction in number of port calls*

Overall, a higher number of respondents have claimed that the reduction in the number of port calls is having a moderate impact on the supply in the market (figure 22). In addition, most respondents have highlighted that it can have a higher impact on demand and price. When the ships are not calling in to all the ports they used to, this would cause a lack of supply in the market which can lead to a high impact on the demand and pricing.

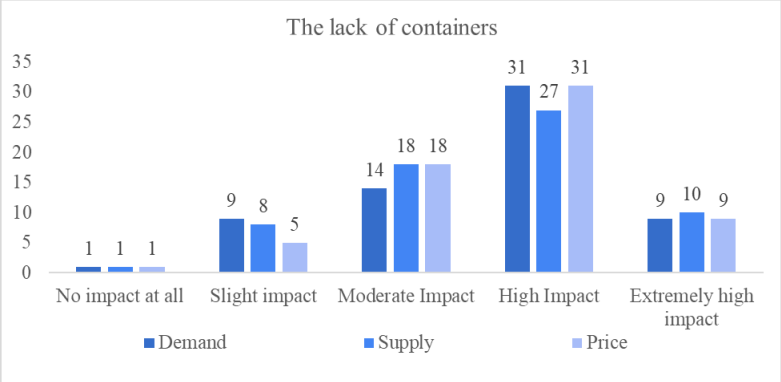


*Figure 23: The impact of container shortage*

There was a significantly higher number of responses received indicating that the lack of containers could have a higher impact on demand, supply, and price (figure 23). However, as highlighted by many respondents, this would have a greater impact on demand and price aspects. This result is quite in line with the general market situation as when there is a shortage of containers in the market, this would result in a lower supply in the market and eventually could lead to an increase in demand and prices.

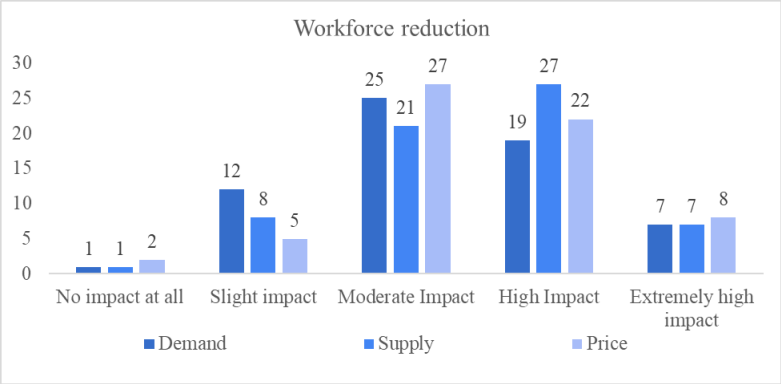


*Figure 24: The Impact of workforce reduction*

During the expert interviews, it was understood that the reduction in the workforce has led to many supply chain disruptions during and after COVID-19 as most of the consignees could not return the empty containers on time to shipping lines. As shown in figure 24, a higher number of respondents to the survey have also claimed that workforce reductions could create a greater impact on supply and a moderate impact on price. Furthermore, it is essential to highlight the

impact it creates on the demand aspect, as lack of supply could lead to an increase in demand for containers.

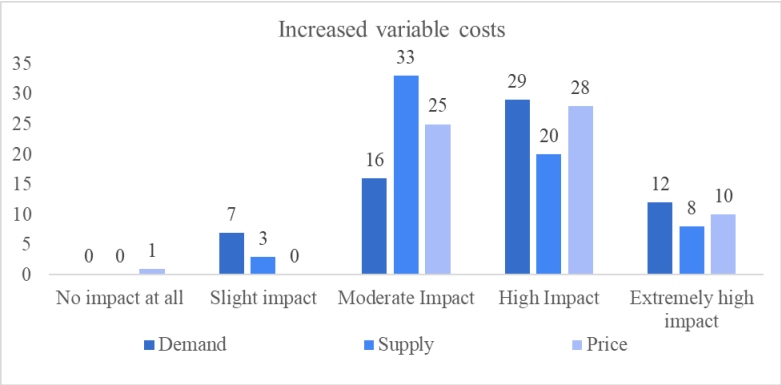


*Figure 25: The Impact of increased variable costs*

It was noticed that there were many organizations which experienced an increase of overheads during and after the pandemic. According to the results of the survey (figure 25), the highest number of respondents have indicated that the increased variable costs could have a moderate impact on the supply and a higher impact on demand and price. In general, the pricing levels would start increasing when the overhead costs increase and subsequently this could have a higher impact on demand.

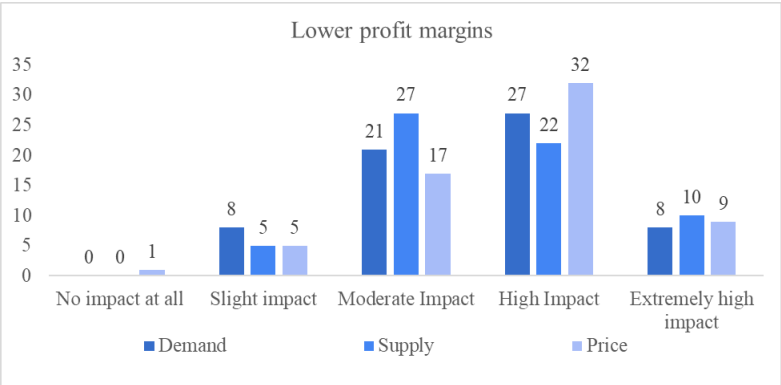


*Figure 26: The impact of lower profit margins*

The container shipping market is considered as an oligopolistic market as the large-scale container operators have established different consortiums to maintain capacity and pricing. However, with the spread of COVID-19, many service providers had to limit their services due to increases in

costs and the lower availability of resources. The lesser availability of services has led to increasing prices in the market and parties involved in the container trade have had to lower their profit margins to be competitive in the new market. As depicted in figure 26, the highest number of respondents to the survey have highlighted that the lower profit margins could generate a significant impact on pricing and demand. However, most respondents have also remarked that there is a moderate impact on the level of supply from the lower profit margins.

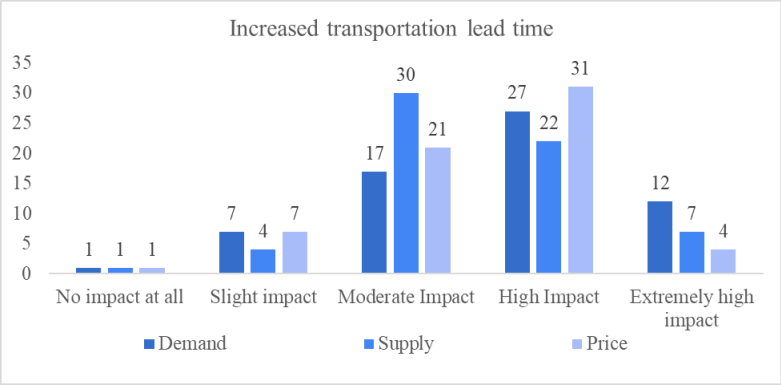


*Figure 27: The impact of increased transportation lead time*

It was noticed that the transportation lead time was longer than usual during the post-COVID-19 era. This has led to numerous disruptions in the container shipping markets as there was a less supply of containers/ships. As many respondents noted in the survey (figure 27), there is a higher impact on pricing and demand, whereas only a moderate impact on supply, from the increase in transportation lead time. This result explains the general market structure that prices increase when there is a short supply.

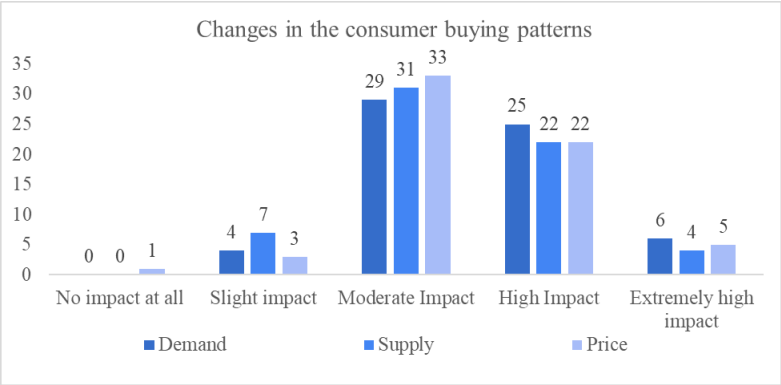


*Figure 28: The impact of changes in consumer buying patterns*

The outbreak of COVID-19 has led to various changes in consumer buying behavior, including the increased number of online purchases. Since container shipping is having a derived demand from the actual demand for goods in the market, those changes in consumer buying patterns can influence container shipping demand. During the survey, it was noted that most respondents have highlighted a moderate impact on demand, supply, and price from the change in consumer buying patterns (figure 28). Furthermore, this result is in line with the reflections received during the expert interviews, where the shift from physical shopping to online shopping does not create a significant impact on container shipping.

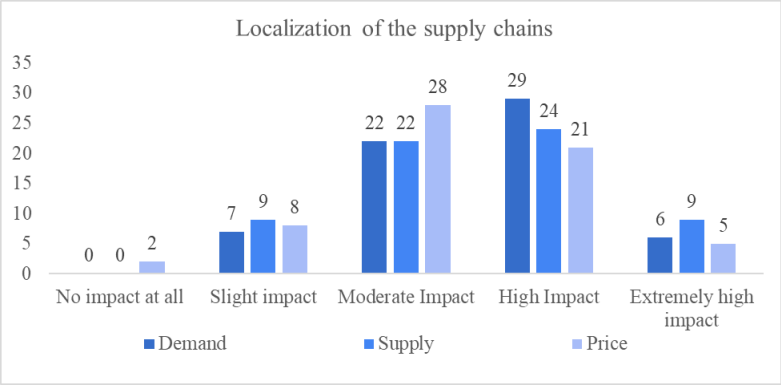


*Figure 29: The impact of localization of the supply chains*

It was understood that most businesses have started increasingly adopting local supply sources into their raw material sourcing models to avoid the negative supply implications they faced from the global pandemic. As depicted in figure 29, the majority of respondents to the survey claimed that the localization of supply chains could create a high impact on container shipping demand and supply, as there could be less demand for container shipping services whilst having an excess supply in the market. It was also noticed that a considerable number of respondents to the survey feel that there is a moderate impact of this variable on pricing.

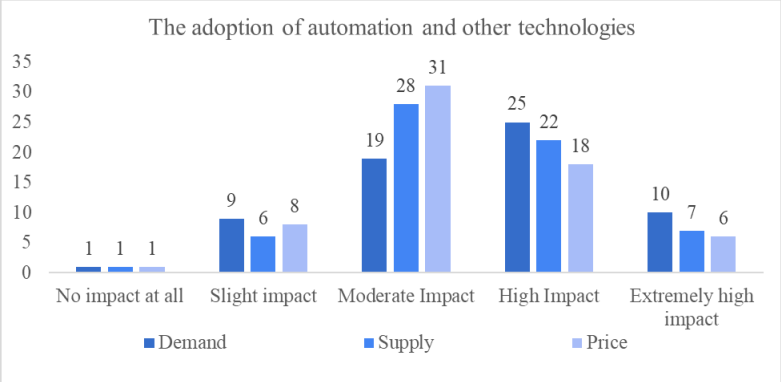


*Figure 30: The impact of adopting automation and other technologies*

With the evolution of industry 4.0, many organizations have started using several automations and other advanced technologies in their businesses. For instance, with the use of additive manufacturing organizations can produce certain raw materials in-house without having to purchase them from an external source. During the survey, it was highlighted by many respondents that the adoption of automation could have a higher impact on container shipping demand, as the demand for trading in goods becomes lower (figure 30). Furthermore, the majority of respondents claimed that the adoption of automation could lead to a moderate increase of price and supply as when the container shipping companies themselves start investing in modern technologies it would involve higher costs.

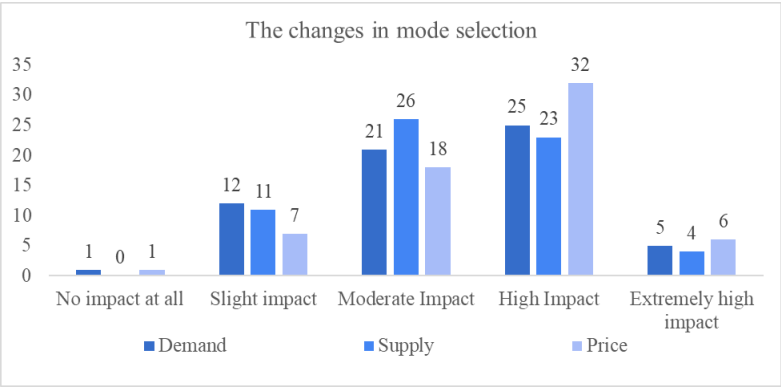


*Figure 31: The impact of changes in mode selection*

Due to the increased transport lead time during the pandemic, most shippers have started to use faster transport solutions such as air freight. May respondents to the survey suggested that, there is a high impact on pricing and the demand for container shipping services as the freight volume

shifted to alternative modes of transport (figure 31). However, it was noticed that the majority of respondents also claimed that the change in mode selection has a moderate effect on the supply of container shipping services.

### 5.3. Correlation analysis

Correlation analysis refers to the examination of the relationships or association between two or more variables (Gogtay, 2017). This analysis is based on the assumption that there exists a linear relationship between the variables. As suggested by Gogtay (2017), the outcome of a correlation analysis is represented by a correlation coefficient, which can take values between -1 and +1. A correlation coefficient of +1 indicates a perfect positive linear relationship between the two variables being studied, whereas a correlation coefficient of -1 suggests a perfect negative linear relationship (Gogtay, 2017). A correlation coefficient of zero implies that there is no linear relationship between the two variables being examined.

Upon examining the correlation between the variables that influence demand, as illustrated in table 8, it was observed that the majority of the correlation coefficients were below 0.5, indicating a weak or moderate association among them. Notably, the highest positive correlation of 0.655 was found between the reduction in ship sizes and the decrease in the number of port calls. This implies that the decrease in ship sizes during the COVID-19 pandemic was often accompanied by a reduction in the number of port calls, which collectively contributed to the changes in demand in the container shipping market during and after the COVID-19 pandemic. It is also interesting to note a higher correlation between the localization of supply chains and the adoption of automation, with a value of 0.617. This is likely due to the fact that automation can support and facilitate the localization of supply chains, by enabling more efficient and cost-effective production processes that can be carried out in closer proximity to the final consumers. In turn, the localization of supply chains can also drive the adoption of automation, as it may require companies to restructure their operations and implement new technologies to effectively manage and optimize production processes in a decentralized and geographically dispersed network. Furthermore, the combination of automation and localized supply chains can have a significant impact on demand patterns, as it can enable companies to respond more quickly and effectively to changing market conditions and

customer preferences. As a result, shifts in consumer demand can lead to changes in the demand for container shipping services.

**Correlation Matrix[a]**

| | | D1 – Increased blank salings | D2 – Reduced ship sizes | D3 – Reduction in number of port calls | D4 – The lack of containers | D5 – Workforce reduction | D6 – Increased variable costs | D7 – Lower profit margins | D8 – Increased transportation lead time | D9 – Changes in the consumer buying patterns | D10 – Localization of the supply chains | D11 – The adoption of automation and other technologies | D12 – The changes in mode selection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Correlation | D1 – Increased blank salings | 1.000 | .468 | .405 | .245 | .094 | .015 | .250 | .272 | .380 | .456 | .231 | .181 |
| | D2 – Reduced ship sizes | .468 | 1.000 | .655 | .309 | .249 | .170 | .278 | .392 | .194 | .194 | .107 | .301 |
| | D3 – Reduction in number of port calls | .405 | .655 | 1.000 | .462 | .249 | .289 | .379 | .478 | .146 | .290 | .329 | .348 |
| | D4 – The lack of containers | .245 | .309 | .462 | 1.000 | .431 | .327 | .309 | .433 | .053 | .261 | .235 | .189 |
| | D5 – Workforce reduction | .094 | .249 | .249 | .431 | 1.000 | .580 | .355 | .493 | .247 | .120 | .271 | .409 |
| | D6 – Increased variable costs | .015 | .170 | .289 | .327 | .580 | 1.000 | .442 | .308 | .240 | .229 | .336 | .379 |
| | D7 – Lower profit margins | .250 | .278 | .379 | .309 | .355 | .442 | 1.000 | .379 | .047 | .277 | .250 | .344 |
| | D8 – Increased transportation lead time | .272 | .392 | .478 | .433 | .493 | .308 | .379 | 1.000 | .291 | .276 | .299 | .235 |
| | D9 – Changes in the consumer buying patterns | .380 | .194 | .146 | .053 | .247 | .240 | .047 | .291 | 1.000 | .527 | .355 | .027 |
| | D10 – Localization of the supply chains | .456 | .194 | .290 | .261 | .120 | .229 | .277 | .276 | .527 | 1.000 | .617 | .228 |
| | D11 – The adoption of automation and other technologies | .231 | .107 | .329 | .235 | .271 | .336 | .250 | .299 | .355 | .617 | 1.000 | .366 |
| | D12 – The changes in mode selection | .181 | .301 | .348 | .189 | .409 | .379 | .344 | .235 | .027 | .228 | .366 | 1.000 |

*Table 8: Correlation matrix of variables impacting to demand*

A similar correlation pattern was also identified for variables that impact supply. As depicted in table 9, most correlation coefficients between these variables were below 0.5, indicating either a weak or moderate relationship among them. In detail, the highest positive correlation of 0.698 was found between the reduction in ship sizes and the decrease in the number of port calls, indicating that these variables were often linked together for the supply side. Therefore, it can be suggested that the reduction in ship sizes was often accompanied by a decrease in the number of port calls for the supply side; consequently, impacting the supply of container shipping market. In addition, a higher correlation was observed between decreased ship sizes and increased blank sailings during the COVID-19 pandemic. This suggests that the reduction in ship sizes and the increase in blank sailings were often interrelated, and both contributed to the changes in global supply chains during and after the pandemic

**Correlation Matrix[a]**

| | | S1 – Increased blank salings | S2 – Reduced ship sizes | S3 – Reduction in number of port calls | S4 – The lack of containers | S5 – Workforce reduction | S6 – Increased variable costs | S7 – Lower profit margins | S8 – Increased transportation lead time | S9 – Changes in the consumer buying patterns | S10 – Localization of the supply chains | S11 – The adoption of automation and other technologies | S12 – The changes in mode selection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Correlation | S1 – Increased blank salings | 1.000 | .610 | .565 | .301 | .494 | .199 | .109 | .387 | .291 | .321 | .261 | .282 |
| | S2 – Reduced ship sizes | .610 | 1.000 | .698 | .465 | .516 | .337 | .251 | .408 | .412 | .415 | .408 | .219 |
| | S3 – Reduction in number of port calls | .565 | .698 | 1.000 | .451 | .382 | .476 | .427 | .566 | .248 | .294 | .400 | .248 |
| | S4 – The lack of containers | .301 | .465 | .451 | 1.000 | .513 | .127 | .187 | .271 | .037 | .145 | .130 | .148 |
| | S5 – Workforce reduction | .494 | .516 | .382 | .513 | 1.000 | .405 | .289 | .386 | .500 | .424 | .290 | .342 |
| | S6 – Increased variable costs | .199 | .337 | .476 | .127 | .405 | 1.000 | .527 | .503 | .405 | .585 | .530 | .262 |
| | S7 – Lower profit margins | .109 | .251 | .427 | .187 | .289 | .527 | 1.000 | .372 | .408 | .532 | .403 | .413 |
| | S8 – Increased transportation lead time | .387 | .408 | .566 | .271 | .386 | .503 | .372 | 1.000 | .304 | .220 | .412 | .220 |
| | S9 – Changes in the consumer buying patterns | .291 | .412 | .248 | .037 | .500 | .405 | .408 | .304 | 1.000 | .507 | .428 | .345 |
| | S10 – Localization of the supply chains | .321 | .415 | .294 | .145 | .424 | .585 | .532 | .220 | .507 | 1.000 | .573 | .455 |
| | S11 – The adoption of automation and other technologies | .261 | .408 | .400 | .130 | .290 | .530 | .403 | .412 | .428 | .573 | 1.000 | .224 |
| | S12 – The changes in mode selection | .282 | .219 | .248 | .148 | .342 | .262 | .413 | .220 | .345 | .455 | .224 | 1.000 |

*Table 9: Correlation matrix of variables impacting to supply*

Correlation Matrix[a]

| | | P1 – Increased blank salings | P2 – Reduced ship sizes | P3 – Reduction in number of port calls | P4 – The lack of containers | P5 – Workforce reduction | P6 – Increased variable costs | P7 – Lower profit margins | P8 – Increased transportation lead time | P9 – Changes in the consumer buying patterns | P10 – Localization of the supply chains | P11 – The adoption of automation and other technologies | P12 – The changes in mode selection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Correlation | P1 – Increased blank salings | 1.000 | .624 | .621 | .388 | .224 | .368 | .278 | .360 | .492 | .345 | .295 | .394 |
| | P2 – Reduced ship sizes | .624 | 1.000 | .625 | .474 | .502 | .363 | .287 | .476 | .470 | .346 | .372 | .364 |
| | P3 – Reduction in number of port calls | .621 | .625 | 1.000 | .470 | .412 | .526 | .316 | .380 | .469 | .479 | .445 | .377 |
| | P4 – The lack of containers | .388 | .474 | .470 | 1.000 | .430 | .502 | .368 | .332 | .311 | .291 | .413 | .561 |
| | P5 – Workforce reduction | .224 | .502 | .412 | .430 | 1.000 | .353 | .324 | .358 | .439 | .369 | .433 | .456 |
| | P6 – Increased variable costs | .368 | .363 | .526 | .502 | .353 | 1.000 | .510 | .277 | .277 | .410 | .432 | .274 |
| | P7 – Lower profit margins | .278 | .287 | .316 | .368 | .324 | .510 | 1.000 | .366 | .279 | .447 | .408 | .198 |
| | P8 – Increased transportation lead time | .360 | .476 | .380 | .332 | .358 | .277 | .366 | 1.000 | .550 | .507 | .494 | .318 |
| | P9 – Changes in the consumer buying patterns | .492 | .470 | .469 | .311 | .439 | .277 | .279 | .550 | 1.000 | .546 | .462 | .359 |
| | P10 – Localization of the supply chains | .345 | .346 | .479 | .291 | .369 | .410 | .447 | .507 | .546 | 1.000 | .546 | .335 |
| | P11 – The adoption of automation and other technologies | .295 | .372 | .445 | .413 | .433 | .432 | .408 | .494 | .462 | .546 | 1.000 | .503 |
| | P12 – The changes in mode selection | .394 | .364 | .377 | .561 | .456 | .274 | .198 | .318 | .359 | .335 | .503 | 1.000 |

*Table 10: Correlation matrix of variables impacting to price*

Upon reviewing the correlation matrix of variables that impact price as shown in table 10, it was observed that most of the correlation coefficients were below 0.5, like the patterns observed for supply and demand. Specifically, the reduction in the number of port calls and the decrease in ship sizes yield the highest correlation of 0.624. Furthermore, the second highest correlation was found between reduced ship sizes and increased blank sailings. This implies that increased blank sailing and reduced ship sizes were often associated during the COVID-19 pandemic and both had an impact on the changes in prices during and after the pandemic.

### 5.4. Total variance and scree plot diagram

Principal component analysis (PCA) is a well-known statistical technique which can be used for data compression and to reduce the dimensionality of data. As proposed by Shlens (2014), PCA extracts orthogonal vectors (or principal components) that are orthogonal to each other from highly dimensional data. The principal components are ranked according to the level of variance they represent. For instance, the first principal component captures the direction of maximum variance in the data, and each subsequent principal component captures the direction of maximum variance that is orthogonal to the previously extracted principal components (Shlens, 2014).

The first output of the exploratory factor analysis is called the total variance explained and it summarizes the eigenvalues of each component. SPSS calculates the "Total Variance Explained" matrix using an eigenvalue decomposition method to extract principal components and calculate the amount of variance explained by each component. In general, it is considered that the components with higher eigenvalues (greater than or equal to 1) are likely to represent the actual

underlying factors for a scenario (Gie and Pearce, 2013). Accordingly, this output could be used to recognize the factors which needs to be retained and evaluated in the next steps.

**Total Variance Explained**

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 4.370 | 36.417 | 36.417 | 4.370 | 36.417 | 36.417 |
| 2 | 1.576 | 13.132 | 49.550 | 1.576 | 13.132 | 49.550 |
| 3 | 1.375 | 11.455 | 61.005 | 1.375 | 11.455 | 61.005 |
| 4 | .947 | 7.890 | 68.895 | | | |
| 5 | .785 | 6.540 | 75.435 | | | |
| 6 | .693 | 5.774 | 81.209 | | | |
| 7 | .572 | 4.767 | 85.976 | | | |
| 8 | .553 | 4.606 | 90.581 | | | |
| 9 | .336 | 2.801 | 93.382 | | | |
| 10 | .313 | 2.609 | 95.991 | | | |
| 11 | .268 | 2.229 | 98.220 | | | |
| 12 | .214 | 1.780 | 100.000 | | | |

Extraction Method: Principal Component Analysis.

*Table 11: Total variance explained - demand*

As illustrated in table 11, the first 3 components show eigenvalues greater than or equal to 1 and they are considered as high-quality scores or “string factors” which represent the actual traits. The remaining components are called “scree” or weak factors which are not assumed to represent the real characteristics (figure 32).

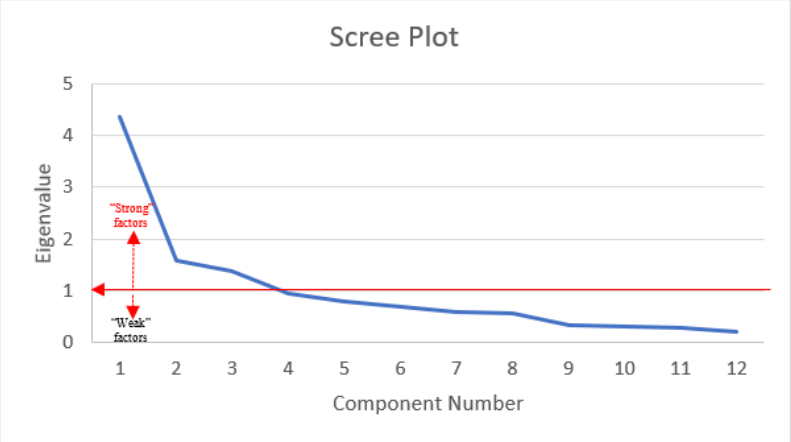


*Figure 32: Scree plot – demand*

Similar to the demand aspect, the following variance tables 12 & 13, and figures 33 and 34 were produced for the supply and price aspects. It was also noticed that the first three components have the highest eigenvalues.

**Total Variance Explained**

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 5.119 | 42.655 | 42.655 | 5.119 | 42.655 | 42.655 |
| 2 | 1.605 | 13.379 | 56.034 | 1.605 | 13.379 | 56.034 |
| 3 | 1.032 | 8.597 | 64.630 | 1.032 | 8.597 | 64.630 |
| 4 | .867 | 7.228 | 71.858 | | | |
| 5 | .737 | 6.140 | 77.998 | | | |
| 6 | .666 | 5.547 | 83.545 | | | |
| 7 | .521 | 4.343 | 87.888 | | | |
| 8 | .468 | 3.902 | 91.790 | | | |
| 9 | .351 | 2.927 | 94.717 | | | |
| 10 | .270 | 2.246 | 96.963 | | | |
| 11 | .218 | 1.814 | 98.777 | | | |
| 12 | .147 | 1.223 | 100.000 | | | |

Extraction Method: Principal Component Analysis.

*Table 12: Total variance explained - supply*

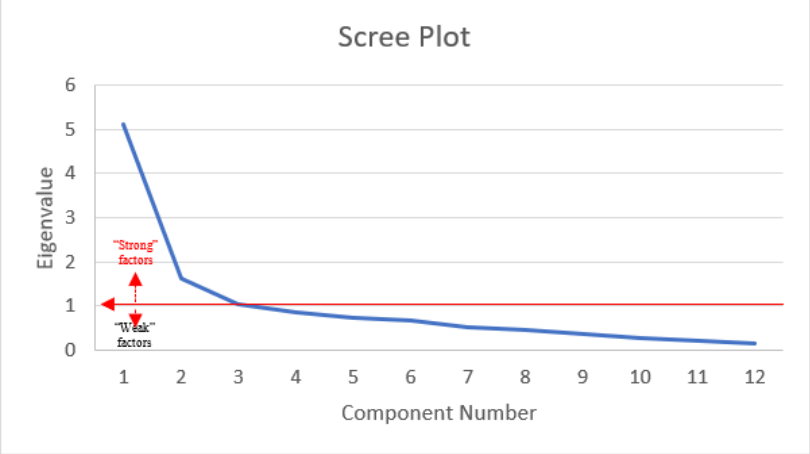


*Figure 33: Scree plot – supply*

**Total Variance Explained**

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 5.521 | 46.011 | 46.011 | 5.521 | 46.011 | 46.011 |
| 2 | 1.097 | 9.140 | 55.150 | 1.097 | 9.140 | 55.150 |
| 3 | 1.041 | 8.675 | 63.826 | 1.041 | 8.675 | 63.826 |
| 4 | .959 | 7.993 | 71.819 | | | |
| 5 | .671 | 5.593 | 77.413 | | | |
| 6 | .585 | 4.871 | 82.283 | | | |
| 7 | .482 | 4.014 | 86.297 | | | |
| 8 | .436 | 3.634 | 89.932 | | | |
| 9 | .385 | 3.211 | 93.143 | | | |
| 10 | .329 | 2.740 | 95.882 | | | |
| 11 | .282 | 2.350 | 98.232 | | | |
| 12 | .212 | 1.768 | 100.000 | | | |

Extraction Method: Principal Component Analysis.

*Table 13: Total variance explained - price*

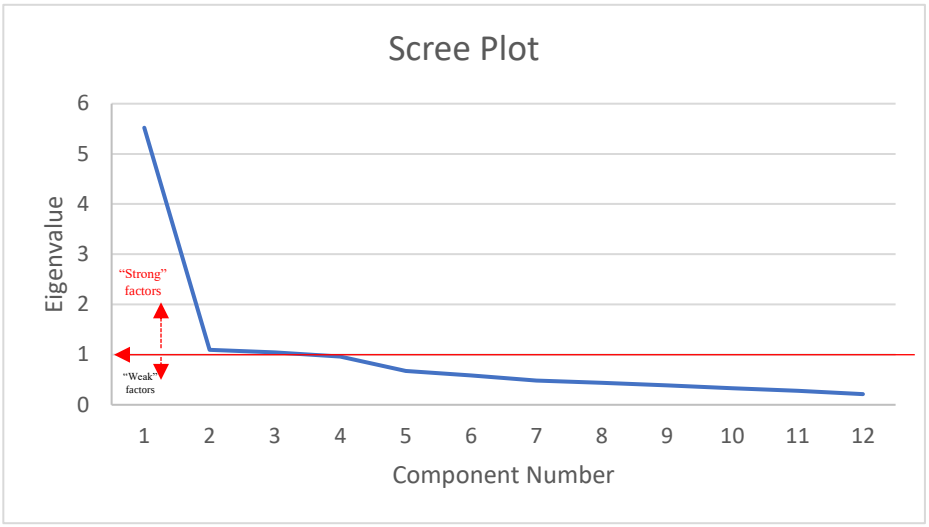


*Figure 34: Scree plot – price*

## 5.5. Communalities

**Communalities**

| | Initial | Extraction |
|---|---|---|
| D1 – Increased blank salings | 1.000 | .685 |
| D2 – Reduced ship sizes | 1.000 | .734 |
| D3 – Reduction in number of port calls | 1.000 | .720 |
| D4 – The lack of containers | 1.000 | .447 |
| D5 – Workforce reduction | 1.000 | .666 |
| D6 – Increased variable costs | 1.000 | .693 |
| D7 – Lower profit margins | 1.000 | .442 |
| D8 – Increased transportation lead time | 1.000 | .497 |
| D9 – Changes in the consumer buying patterns | 1.000 | .628 |
| D10 – Localization of the supply chains | 1.000 | .774 |
| D11 – The adoption of automation and other technologies | 1.000 | .641 |
| D12 – The changes in mode selection | 1.000 | .393 |

Extraction Method: Principal Component Analysis.

**Communalities**

| | Initial | Extraction |
|---|---|---|
| S1 – Increased blank salings | 1.000 | .624 |
| S2 – Reduced ship sizes | 1.000 | .714 |
| S3 – Reduction in number of port calls | 1.000 | .784 |
| S4 – The lack of containers | 1.000 | .553 |
| S5 – Workforce reduction | 1.000 | .676 |
| S6 – Increased variable costs | 1.000 | .722 |
| S7 – Lower profit margins | 1.000 | .583 |
| S8 – Increased transportation lead time | 1.000 | .635 |
| S9 – Changes in the consumer buying patterns | 1.000 | .588 |
| S10 – Localization of the supply chains | 1.000 | .724 |
| S11 – The adoption of automation and other technologies | 1.000 | .593 |
| S12 – The changes in mode selection | 1.000 | .560 |

Extraction Method: Principal Component Analysis.

**Communalities**

| | Initial | Extraction |
|---|---|---|
| P1 – Increased blank salings | 1.000 | .695 |
| P2 – Reduced ship sizes | 1.000 | .718 |
| P3 – Reduction in number of port calls | 1.000 | .661 |
| P4 – The lack of containers | 1.000 | .707 |
| P5 – Workforce reduction | 1.000 | .432 |
| P6 – Increased variable costs | 1.000 | .659 |
| P7 – Lower profit margins | 1.000 | .630 |
| P8 – Increased transportation lead time | 1.000 | .656 |
| P9 – Changes in the consumer buying patterns | 1.000 | .723 |
| P10 – Localization of the supply chains | 1.000 | .700 |
| P11 – The adoption of automation and other technologies | 1.000 | .617 |
| P12 – The changes in mode selection | 1.000 | .460 |

Extraction Method: Principal Component Analysis.

*Table 14: Comparison of Communalities*

As suggested by Gie and Pearce (2013), the variables with r-squared values less than 0.20 could be omitted from the analysis since they do not significantly contribute to measuring the underlying factors. It was noticed from table 14 that all the variables considered in this study were having r-squared values greater than 0.20 and it was decided to proceed with further analysis including all the variables.

## 5.6. Unrotated component matrix

At this point in the analysis, it was determined that the 12 variables would measure three underlying factors. However, it is essential to understand the relationship between those factors and the variables to decide which variables can be used to measure each factor. A component matrix is also known as a factor loading matrix as it contains Pearson correlations between items and components. Essentially, the factor loadings measure how much variables contribute to factors and whenever there are high factor loading scores, they indicate that the variables better account for the factors (Gie and Pearce, 2013).

**Component Matrix[a]**

| | Component | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| D1 – Increased blank salings | .539 | .514 | -.361 |
| D2 – Reduced ship sizes | .606 | .039 | -.604 |
| D3 – Reduction in number of port calls | .716 | -.024 | -.454 |
| D4 – The lack of containers | .602 | -.236 | -.169 |
| D5 – Workforce reduction | .628 | -.450 | .263 |
| D6 – Increased variable costs | .599 | -.397 | .419 |
| D7 – Lower profit margins | .605 | -.276 | .000 |
| D8 – Increased transportation lead time | .688 | -.111 | -.103 |
| D9 – Changes in the consumer buying patterns | .455 | .571 | .310 |
| D10 – Localization of the supply chains | .605 | .574 | .282 |
| D11 – The adoption of automation and other technologies | .603 | .276 | .448 |
| D12 – The changes in mode selection | .554 | -.272 | .110 |

Extraction Method: Principal Component Analysis.
a. 3 components extracted.

**Component Matrix[a]**

| | Component | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| S1 – Increased blank salings | .620 | .450 | .193 |
| S2 – Reduced ship sizes | .746 | .395 | .024 |
| S3 – Reduction in number of port calls | .747 | .350 | -.321 |
| S4 – The lack of containers | .462 | .577 | .083 |
| S5 – Workforce reduction | .707 | .214 | .360 |
| S6 – Increased variable costs | .701 | -.348 | -.330 |
| S7 – Lower profit margins | .628 | -.415 | -.126 |
| S8 – Increased transportation lead time | .652 | .122 | -.442 |
| S9 – Changes in the consumer buying patterns | .631 | -.320 | .295 |
| S10 – Localization of the supply chains | .707 | -.427 | .203 |
| S11 – The adoption of automation and other technologies | .659 | -.301 | -.261 |
| S12 – The changes in mode selection | .512 | -.246 | .487 |

Extraction Method: Principal Component Analysis.
a. 3 components extracted.

**Component Matrix[a]**

| | Component | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| P1 – Increased blank salings | .668 | -.490 | -.094 |
| P2 – Reduced ship sizes | .735 | -.417 | -.066 |
| P3 – Reduction in number of port calls | .763 | -.276 | .042 |
| P4 – The lack of containers | .679 | -.122 | .480 |
| P5 – Workforce reduction | .650 | .037 | .094 |
| P6 – Increased variable costs | .646 | .204 | .447 |
| P7 – Lower profit margins | .574 | .504 | .217 |
| P8 – Increased transportation lead time | .667 | .168 | -.428 |
| P9 – Changes in the consumer buying patterns | .701 | -.030 | -.480 |
| P10 – Localization of the supply chains | .693 | .370 | -.289 |
| P11 – The adoption of automation and other technologies | .715 | .323 | -.037 |
| P12 – The changes in mode selection | .629 | -.154 | .204 |

Extraction Method: Principal Component Analysis.
a. 3 components extracted.

*Table 15: Comparison of unrotated component matrixes*

Whenever variables have more than one factor loading, the interpretation of the relationship might become complex, and these circumstances are known as cross loadings. Complex variables which are having cross loadings could be retained or dropped from the study based on the nature of that variable or the difficulty of interpretation (Gie and Pearce, 2013). To make the result more interpretable, it was decided to use varimax rotation and redistribute the factor loadings.

## 5.7. Rotated component matrix

**Rotated Component Matrix[a]**

| | Component 1 | 2 | 3 |
|---|---|---|---|
| D6 – Increased variable costs | .811 | | .181 |
| D5 – Workforce reduction | .807 | | |
| D12 – The changes in mode selection | .586 | .196 | .109 |
| D7 – Lower profit margins | .581 | .314 | |
| D8 – Increased transportation lead time | .491 | .467 | .195 |
| D4 – The lack of containers | .491 | .453 | |
| D2 – Reduced ship sizes | .153 | .842 | |
| D3 – Reduction in number of port calls | .323 | .777 | .109 |
| D1 – Increased blank salings | -.110 | .671 | .472 |
| D10 – Localization of the supply chains | .133 | .200 | .846 |
| D9 – Changes in the consumer buying patterns | | | .786 |
| D11 – The adoption of automation and other technologies | .387 | | .700 |

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

**Rotated Component Matrix[a]**

| | Component 1 | 2 | 3 |
|---|---|---|---|
| S2 – Reduced ship sizes | .762 | .298 | .213 |
| S1 – Increased blank salings | .748 | | .242 |
| S4 – The lack of containers | .743 | | |
| S3 – Reduction in number of port calls | .690 | .554 | |
| S5 – Workforce reduction | .629 | .108 | .519 |
| S6 – Increased variable costs | .105 | .791 | .292 |
| S11 – The adoption of automation and other technologies | .124 | .700 | .296 |
| S8 – Increased transportation lead time | .439 | .664 | |
| S7 – Lower profit margins | | .629 | .431 |
| S12 – The changes in mode selection | .159 | | .728 |
| S10 – Localization of the supply chains | .101 | .455 | .712 |
| S9 – Changes in the consumer buying patterns | .150 | .304 | .688 |

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 8 iterations.

**Rotated Component Matrix[a]**

| | Component 1 | 2 | 3 |
|---|---|---|---|
| P1 – Increased blank salings | .796 | .236 | |
| P2 – Reduced ship sizes | .782 | .284 | .160 |
| P3 – Reduction in number of port calls | .693 | .283 | .316 |
| P12 – The changes in mode selection | .519 | .143 | .413 |
| P10 – Localization of the supply chains | .135 | .751 | .344 |
| P8 – Increased transportation lead time | .272 | .750 | .140 |
| P9 – Changes in the consumer buying patterns | .446 | .723 | |
| P11 – The adoption of automation and other technologies | .193 | .564 | .511 |
| P6 – Increased variable costs | .257 | .131 | .759 |
| P7 – Lower profit margins | | .381 | .696 |
| P4 – The lack of containers | .534 | | .650 |
| P5 – Workforce reduction | .380 | .314 | .435 |

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 12 iterations.

*Table 16: Comparison of rotated component matrixes*

The following results as shown in table 16 were obtained with the use of varimax rotation and three-color codes were used to highlight the connection of each variable to each component based on their correlation values. For instance, the correlation value of each variable was checked against the components and grouped together based on the highest correlation value. The variables connected to component one is marked in red whilst components 2 & 3 are followed by yellow and blue, respectively.

Based on the results of the above comparison, the following tables were produced by relating the measures towards the demand, supply, and price. As summarized in table 10, the observed variables D4, D5, D6, D7, D8 & D12 are connected to component 1. It was decided to use a meaningful term such as “supply chain disruption” because most variables connected to component 1 represent several types of disruptions in the container shipping market. Accordingly, component 2 was also renamed as “changes in freight capacity & consolidation” as the variables D2, D3 & D1 represent the level of capacity and consolidation ability in the container shipping market. The variables D9, D10 & D11 listed under component 3 were more connected to various supply chain transformations such as digitalization and near-shoring. Therefore, component 3 was termed as “supply chain transformations”. The authors have decided to use the same terms when renaming the components connected to supply and price to maintain consistency.

| No | Demand-related underlying factor | Observed variables |
|---|---|---|
| 1 | DF1 - Supply chain disruptions | D6 - Increased variable costs<br>D5 - Workforce reduction<br>D12 - The changes in mode selection<br>D7 - Lower profit margins<br>D8 - Increased transportation lead time<br>D4 - The lack of containers |
| 2 | DF2 - Changes in freight capacity & consolidation | D2 - Reduced ship sizes<br>D3 - Reduction in number of port calls<br>D1 - Increased blank sailings |
| 3 | DF3 - Supply Chain Transformations | D10 - Localization of the supply chains<br>D9 - Changes in the consumer buying patterns<br>D11 - The adoption of automation and other technologies |

*Table 17: Summary of underlying factors connected to demand*

| No | Supply-related underlying factor | Observed variables |
|---|---|---|
| 1 | SF1 - Changes in freight capacity & consolidation | S2 – Reduced ship sizes<br>S1 – Increased blank sailings<br>S4 – The lack of containers<br>S3 – Reduction in number of port calls<br>S5 – Workforce reduction |
| 2 | SF2 - Supply chain disruptions | S6 – Increased variable cost<br>S11 – The adoption of automation and other technologies<br>S8 – Increased transportation lead time<br>S7 – Lower profit margins |
| 3 | SF3 - Supply Chain Transformations | S12 – The changes in mode selection<br>S10 – Localization of the supply chains<br>S9 – Changes in the consumer buying patterns |

*Table 18: Summary of underlying factors connected to supply*

| No | Price-related underlying factor | Observed variables |
|---|---|---|
| 1 | PF1 - Changes in freight capacity & consolidation | P1 – Increased blank sailings<br>P2 – Reduced ship sizes<br>P3 – Reduction in number of port calls<br>P12 – The changes in mode selection |
| 2 | PF2 - Supply Chain Transformations | P10 – Localization of the supply chains<br>P8 – Increase transportation lead time<br>P9 – Changes in the consumer buying patterns<br>P11 –The adoption of automation and other technologies |
| 3 | PF3 - Supply chain disruptions | P6 – Increased variable costs<br>P7 – Lower profit margins<br>P4 – The lack of containers<br>P5 – Workforce reduction |

*Table 19: Summary of underlying factors connected to price*

### 5.8. EFA results

Through the process of grouping the observed variables, a summary of the survey of the impacts on the changes in the container shipping market in Europe can be presented as follows:

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| DF1-Supply chain disruptions | 64 | 2 | 5 | 3.523 | .642 |
| DF2-Changes in freight capacity consolidation | 64 | 1 | 5 | 3.401 | .735 |
| / Chain Transformations | 64 | 2 | 5 | 3.526 | .695 |
| Valid N (listwise) | 64 | | | | |

*Table 20: Descriptive statistics - demand factors*

Upon analyzing the data presented in table 20, it can be concluded that all three factors examined in this study have a moderate-to-high impact on the demand for container shipping markets in Europe following the COVID-19 pandemic. Notably, the survey results indicate that there is a slight difference in the degree of impact between the three factors.

The factor that received the highest score, as reported by most respondents, was supply chain transformation. The adoption of modern technologies, the localization of supply chains, and the implementation of artificial intelligence were identified as potential drivers of changes in the demand for exported goods. Consequently, these changes could lead to a shift in the demand for container shipping services. This finding is consistent with the growing trend of digitalization and automation in the logistics industry, which has the potential to transform supply chain operations and drive efficiencies.

The second factor that was found to impact the change in demand for container shipping markets in Europe was supply chain disruption. This factor received a score of 3.5 out of 5, indicating that respondents recognize the negative effects that disruptions in the supply chain, such as increased costs, lower profit margins, or a lack of containers, can have on the demand for container shipping services. This highlights the importance of supply chain resilience and the need for effective risk management strategies to mitigate the impact of disruptions.

Finally, the changes in freight capacity and consolidation were identified as the third factor impacting the change in demand for container shipping markets. While this factor was found to have a significant impact on the demand for container shipping services, it was rated lower than the other two factors. Changes in freight capacity and consolidation, such as increased blank sailings or a reduction in the number of port calls, can directly impact the availability and cost of container shipping services. However, it is important to note that the impact of these changes may be mitigated by the adoption of alternative transport modes or the use of alternative shipping routes.

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| SF1-Changes in freight capacity consolidation | 64 | 1 | 5 | 3.466 | .686 |
| SF2-Supply chain disruptions | 64 | 2 | 5 | 3.500 | .641 |
| SF3-Supply Chain Transformations | 64 | 2 | 5 | 3.396 | .661 |
| Valid N (listwise) | 64 | | | | |

*Table 21 Descriptive statistics – supply factors*

In general, the three influencing factors examined in this study could significantly impact the container shipping market supply after the COVID-19 pandemic (table 21).

Supply chain disruption was found to have the greatest impact on the supply side, with a score of 3.5 out of 5. This suggests that any disruption in supply chain operations, such as increased variable costs or longer transport lead time, can have a notable impact on the supply of container shipping markets. Previous studies have also emphasized the importance of supply chain disruption on the performance of global supply chains, where it can lead to significant financial losses and negatively affect customer satisfaction (Parast et al., 2021).

The second factor, changes in freight and consolidation, received a rating of 3.46. It is evident that these changes, such as increased blank sailings, reduction in the number of port calls, or changes in ship sizes, can directly impact the supply of container shipping markets. However, it is essential to note that these changes, which occurred during the COVID-19 pandemic, had only a moderate impact on the supply of container markets. It is important to recognize that the COVID-19 pandemic has significantly disrupted global supply chains and container shipping markets, and these changes may not occur under normal circumstances.

The final factor, supply chain transformation, which includes the adoption of modern technologies or logistics strategies, was also found to affect the supply of container shipping markets. Respondents believed that some changes in the supply chain, such as localization, the advance of technology, and artificial intelligence, could lead to increased efficiency or decreased demand for container shipping services, which can have an impact on the supply of containers.

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| PF1-Changes in freight capacity consolidation | 64 | 1 | 5 | 3.512 | .652 |
| PF2-Supply Chain Transformations | 64 | 1 | 5 | 3.375 | .676 |
| PF3-Supply chain disruptions | 64 | 1 | 5 | 3.625 | .647 |
| Valid N (listwise) | 64 | | | | |

*Table 22: Descriptive statistics – price factors*

The price of container shipping markets is a critical aspect of the industry and understanding the factors that impact it is crucial. From table 22, all three factors examined have a moderate-to-high impact on the change in the price of container shipping market in Europe after the COVID-19 pandemic.

Specifically, supply chain disruption was found to have the highest impact, with a score of 3.6 out of 5. Respondents indicated that increased variable costs and lower profits were the key factors affecting the price of container shipping markets in the wake of supply chain disruptions. The second factor, changes in freight capacity and consolidation, was also found to impact the change in price. It is understandable that increased blank sailings, a reduction in ship size, or a decrease in the number of port calls could have a significant impact on the supply of container shipping markets, which would impact the price of container shipping services. The final factor identified as impacting the change in container shipping markets' price was supply chain transformation. As the industry evolves, the adoption of modern technologies or logistics strategies may lead to increased efficiency or decreased demand for container shipping services, both of which could impact the price of container shipping services.

# VI/ CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

*The aim of this chapter is to present the research findings that provide answers to the four research questions. Additionally, this chapter will discuss the limitations encountered during the study and reveal potential future research directions. The insights gained from this chapter will be beneficial for scholars interested in further exploring this research domain.*

## 6.1. Summary of the research findings

The COVID-19 pandemic has caused significant disruptions to global supply chains and container shipping markets, resulting in many changes in demand, supply, and price. In response to these changes after the COVID-19 era, numerous factors have emerged as potential influencers of the container shipping market. In this study, three key factors, namely supply chain disruption, changes in freight capacity and consolidation, and supply chain transformation, were examined to evaluate their impact on the container shipping markets in Europe after the COVID-19 pandemic.

***RQ 1 – What factors have contributed to the changes in demand for container shipping services in Europe after the COVID-19 pandemic?***

The study found that all three factors examined had a moderate-to-high impact on the demand for container shipping services in Europe following the COVID-19 pandemic. Supply chain transformation received the highest score and was identified as a potential driver of changes in the demand for exported goods due to the adoption of modern technologies, the localization of supply chains, and the implementation of artificial intelligence. Supply chain disruption received the second highest score, indicating that disruptions such as increased costs or a lack of containers can have negative effects on the demand for container shipping services. Finally, changes in freight capacity and consolidation were identified as the third factor impacting the change in demand but rated lower than the other two factors. Changes in freight capacity and consolidation can directly impact the availability and cost of container shipping services, but the impact may be mitigated by the adoption of alternative transport modes or the use of alternative shipping routes.

***RQ 2 - What factors have contributed to the changes in supply of container shipping services in Europe after the COVID-19 pandemic?***

Regarding the change of supply, the three factors also have potential impacts on the container shipping markets after the COVID-19 pandemic. The results showed that supply chain disruption had the highest impact on the supply side, with any disruption in supply chain operations having a significant effect on the supply of container shipping markets. The second factor was changes in freight capacity and consolidation, which can directly impact the supply of container shipping markets, although these changes may not occur under normal circumstances. Lastly, the study found that supply chain transformation, including the adoption of modern technologies and logistics strategies, could impact the supply of container shipping markets by leading to increased efficiency or decreased demand for container shipping services.

***RQ 3 - What factors have contributed to the changes in price of container shipping services in Europe after the COVID-19 pandemic?***

Lastly, the findings suggest that all three factors examined - supply chain disruption, changes in freight capacity and consolidation, and supply chain transformation - have a moderate-to-high impact on the change in price. Supply chain disruption was identified as the factor with the highest impact on price, as increased variable costs and lower profits were reported to be the key factors affecting the price of container shipping markets. Changes in freight capacity and consolidation were also found to have an impact on price, with reductions in ship size, blank sailings, or a decrease in port calls affecting the supply of container shipping markets, and therefore the price of container shipping services. Finally, the study found that supply chain transformation, such as the adoption of modern technologies or logistics strategies, could lead to increased efficiency or decreased demand for container shipping services, both of which could impact the price of container shipping services.

***RQ 4 - What are the potential solutions for the challenges faced by the container shipping industry in Europe after the COVID-19 pandemic?***

The container shipping industry has faced several challenges, including supply chain disruptions, operational inefficiencies, low profitability, high inflation, lack of resources, new working arrangements, new regulations and laws, and changes in market structures. To overcome these challenges, companies in the European container shipping market can implement several solutions. Firstly, improving supply chain resilience is a key strategy for mitigating supply chain disruptions, responding to changes in the market, and mitigating the impact of high inflation. Companies can invest in supply chain technology, such as blockchain, to monitor and respond to disruptions more effectively. Secondly, companies can engage in collaborative planning, forecasting, and replenishment practices to strengthen supplier relationships and diversify supplier networks. Additionally, implementing Artificial Intelligence and other advanced technologies is another way to address several challenges in the container shipping market. These technologies can improve operational efficiencies, reduce costs, and solve the lack of resources and new working arrangements. For example, AI can automate processes, reducing the need for manual labor, and allowing companies to respond more effectively to changing market conditions. Lastly, adopting better sustainable supply chain practices can help overcome low profitability and meet regulatory requirements. By reducing waste, improving efficiency, and investing in sustainable energy sources, companies can reduce costs and maintain their social and environmental responsibilities.

## 6.2. Research limitations

There were several limitations observed during this study that should be acknowledged. Firstly, the sample size used in this study was relatively small, consisting of only 64 participants. As a result, the findings might not be representative of the larger population and cannot be generalized to other settings. In addition, most of the participants for the survey were selected from large scale organizations in the sector which might also limit the generalizability of the findings. Secondly, the use of a Likert scale for data collection may limit the depth of the responses and may not capture the full range of respondent experiences. Therefore, further collection of data might be required for an in-depth analysis of the responses. Thirdly, the time frame of the study was relatively short, with data collected over a period of only three weeks. This limited time frame might have restricted the ability to capture changes in respondent experiences over a longer period.

Fourthly, the effects of random events occurred during the post-pandemic era, such as the Suez Canal obstruction and the war between Ukraine and Russia, were excluded during this study as they are not within the chosen research scope. Lastly, the expert interviews were conducted with only two professionals from the industry, and this limited the amount of qualitative data considered for the study. Therefore, the results of the study could have been different if there were more respondents used for the expert interviews.

Despite having these limitations, this study provides valuable insights into the experiences of respondents and offers a basis for further research in this area. Future research should aim to address these limitations by using larger sample sizes, alternative data collection methods, longer study periods, and different research designs to provide more robust and generalizable findings.

### 6.3. Future research directions

The findings of the study highlight the importance of several solutions to mitigate the impact of the key underlying factors impacting the changes in European container shipping markets. Further research is required to assess the long-term impact of these solutions on the container shipping markets. In addition, this study has been carried out with the focus on the changes in the European container shipping market where a significant movement of maritime freight is observed. However, the findings of this study could be further strengthened if a similar study could be conducted in the Asian container shipping market as the European market is highly connected to Asian freight flows. Future studies could use alternative data collection methods to gain a deeper understanding of respondent experiences. For example, a larger number of interviews or focus group discussions could be conducted to supplement the survey data. Apart from that, the effects of the Suez Canal blockage and the Ukraine-Russia conflict on the container shipping market of Europe could also be studied in future research. Lastly, further research could be conducted involving additional stakeholders in the industry, such as government policy makers and regulators to extend the validity of this study.

### 6.4. Concluding remarks

The COVID-19 pandemic has caused significant disruptions to global supply chains and container shipping markets, resulting in changes in demand, supply, and price. Therefore, identifying and

understanding the underlying factors that have contributed to these changes is crucial for stakeholders in the industry and policymakers seeking to mitigate the negative effects of the pandemic on global trade.

The research utilized a mixed approach to gather both qualitative and quantitative data, which involved three key data-gathering methods: a literature review, an empirical survey, and expert interviews. The aim was to gather comprehensive information on the factors affecting the container shipping markets in Europe after the COVID-19 pandemic. After the data was gathered, an exploratory factor analysis was conducted to identify the underlying factors that were most important. This approach allowed the researchers to identify three key factors, namely supply chain disruption, changes in freight capacity and consolidation, and supply chain transformation. The study found that all three factors had a moderate-to-high impact on the demand for container shipping markets in Europe. The highest impact was associated with supply chain transformation, followed by supply chain disruption and changes in freight capacity and consolidation. The study also revealed that the three factors could potentially impact the supply of container shipping markets after the pandemic. Supply chain disruption had the highest impact, followed by changes in freight capacity and consolidation, and supply chain transformation. Moreover, the study found that all three factors examined had a moderate-to-high impact on the change in price. Supply chain disruption had the highest impact on price, followed by changes in freight capacity and consolidation, and supply chain transformation.

To overcome challenges faced by the container shipping industry in Europe after the COVID-19 pandemic, companies can improve supply chain resilience, engage in collaborative planning and forecasting practices, implement advanced technologies such as AI, and adopt better sustainable supply chain practices. By taking these measures, companies can mitigate supply chain disruptions, respond to changes in the market, reduce costs, improve efficiency, and maintain their social and environmental responsibilities.

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## APPENDIX-I – INTERVIEW QUESTIONS

| No | Question | Justification |
|---|---|---|
| 1 | Please give a brief introduction about the company (number of staff, key customers, types of operations etc.) | Company data is used for the purpose of categorization and compare against the survey's results |
| 2 | What were the key challenges faced by your company in the post COVID-19 era? | The challenges during post-COVID-19 era explained by the interviewees are discussed as qualitative data |
| 3 | What changes have you made in your company's business model after COVID-19 compared to the era before? | The changes during post-COVID-19 era explained by the interviewees are discussed as qualitative data |
| 4 | What do you think in general about the demand of container shipping market after COVID-19?<br>- Higher number of blank sailings<br>- Reduction in ship size<br>- Reduction in number of port calls<br>- The lack of containers<br>- Workforce reduction<br>- Overhead costs increase<br>- Lower profit margins<br>- Increased transportation lead-time<br>- Change in consumer buying patterns<br>- Localization of supply chains<br>- The use of automation & other technologies<br>- The modal shifts<br>- The ship turnaround time | The focus questions discuss the qualitative analysis of 12 observed variables used in a survey, and their comparison with the survey's results. |

| | | |
|---|---|---|
| 5 | What do you think in general about the supply of container shipping market after COVID-19?<br>- Higher number of blank sailings<br>- Reduction in ship size<br>- Reduction in number of port calls<br>- The lack of containers<br>- Workforce reduction<br>- Overhead costs increase<br>- Lower profit margins<br>- Increased transportation lead-time<br>- Change in consumer buying patterns<br>- Localization of supply chains<br>- The use of automation & other technologies<br>- The modal shifts<br>- The ship turnaround time | The focus questions discuss the qualitative analysis of 12 observed variables used in a survey, and their comparison with the survey's results. |
| 6 | What do you think in general about the prices of container shipping market after COVID-19?<br>- Higher number of blank sailings<br>- Reduction in ship size<br>- Reduction in number of port calls<br>- The lack of containers<br>- Workforce reduction<br>- Overhead costs increase<br>- Lower profit margins<br>- Increased transportation lead-time<br>- Change in consumer buying patterns<br>- Localization of supply chains<br>- The use of automation & other technologies<br>- The modal shifts<br>- The ship turnaround time | The focus questions discuss the qualitative analysis of 12 observed variables used in a survey, and their comparison with the survey's results. |

**APPENDIX-II – QUESTIONNAIRE**

# The Changes in the European Container Shipping Market in the Post COVID-19 Era

Hello!

We are Ryan and Dinuka, two master students from Gothenburg University, currently working on our thesis regarding the impact of COVID-19 on the container shipping market. We would like to invite you to participate in our survey, which aims to gather valuable data that will contribute to our research and ultimately enhance the understanding of this topic.

Your participation in this survey is highly appreciated and will help us to gain insights from industry professionals and other stakeholders about the impact of COVID-19 on the container shipping market in Europe. The survey will only take a few moments to complete, and your responses will be kept confidential.

If you have any questions or concerns, please do not hesitate to contact us via email at gusdoquu@student.gu.se and gusbethpe@student.gu.se

Thank you in advance for your time and effort. Your participation is essential for the success of our study.

We wish you have a very good day!

Ryan and Dinuka.

* Indicates required question

1. Are you involved in any business related to container shipping in Europe? *

*Mark only one oval.*

- ◯ Yes *Skip to question 2*
- ◯ No

*Skip to question 2*

2. Please select your role in the container shipping industry *

*Mark only one oval.*

- ◯ Shipping Line
- ◯ Forwarding Agent
- ◯ Shipper / Exporter
- ◯ Consignee / Importer
- ◯ Port / Terminal Operator

3. How much do you think the **Demand** of container shipping market is impacted by the following factors **after** the COVID-19? *

*Mark only one oval per row.*

| | No impact at all | Slight impact | Moderate Impact | High Impact | Extremely high impact |
|---|---|---|---|---|---|
| **Increased blank salings** | | | | | |
| **Reduced ship sizes** | | | | | |
| **Reduction in number of port calls** | | | | | |
| **The lack of containers** | | | | | |
| **Workforce reduction** | | | | | |
| **Increased variable costs (i.e. terminal fees, energy costs, container charges, raw material costs etc)** | | | | | |
| **Lower profit margins** | | | | | |
| **Increased transportation lead time** | | | | | |
| **Changes in the consumer** buying patterns | | | | | |

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| sea to air) | | | | | |

4. Do you think that any other factor (which we have not mentioned above) that might have affected the container shipping market **demand** **after** COVID-19 pandemic ?

5. How much do you think the **Supply** of container shipping market is impacted by the following factors **after** the COVID-19? *

*Mark only one oval per row.*

| | No impact at all | Slight impact | Moderate Impact | High Impact | Extremely high impact |
|---|---|---|---|---|---|
| **Increased blank salings** | | | | | |
| **Reduced ship sizes** | | | | | |
| **Reduction in number of port calls** | | | | | |
| **The lack of containers** | | | | | |
| **Workforce reduction** | | | | | |
| **Increased variable costs (i.e. terminal fees, energy costs, container charges, raw material costs etc)** | | | | | |
| **Lower profit margins** | | | | | |
| **Increased transportation lead time** | | | | | |
| **Changes in the consumer** buying | | | | | |

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| sea to air) | | | | | |

6. Do you think that any other factor (which we have not mentioned above) that might have affected the container shipping market **supply after** COVID-19 pandemic ?

7. How much do you think the **Price** of container shipping market is impacted by the following factors **after** the COVID-19? *

*Mark only one oval per row.*

| | No impact at all | Slight impact | Moderate Impact | High Impact | Extremely high impact |
|---|---|---|---|---|---|
| **Increased blank salings** | | | | | |
| **Reduced ship sizes** | | | | | |
| **Reduction in number of port calls** | | | | | |
| **The lack of containers** | | | | | |
| **Workforce reduction** | | | | | |
| **Increased variable costs (i.e. terminal fees, energy costs, container charges, raw material costs etc)** | | | | | |
| **Lower profit margins** | | | | | |
| **Increased transportation lead time** | | | | | |
| **Changes in the consumer** buying | | | | | |

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| sea to air) | | | | | |

8. Do you think that any other factor (which we have not mentioned above) that might have affected the container shipping market **price** **after** COVID-19 pandemic ?

9. What are the other challenges faced by your company **after** COVID-19 pandemic?

10. What are the solutions taken by your company for those challenges faced **after** COVID-19 pandemic?

11. Would you like to spend 1 minute more to answer few general questions? *

*Mark only one oval.*

- ◯ Yes *Skip to question 12*
- ◯ No

General Questions

12. How long you have been working in the current company? *

*Mark only one oval.*

- ◯ Less than 1 year
- ◯ Between 1 to 5 years
- ◯ More than 5 years

13. What is your position/role in the current company? *

*Mark only one oval.*

- ◯ Operational level
- ◯ Managerial level
- ◯ Director / President level
- ◯ Other: _____

14. How many employees working in your company at the moment? *

*Mark only one oval.*

- ◯ Less than 50 people
- ◯ Between 50 to 250 people
- ◯ More than 250 people

15. We would like to get in touch with you in case if we need further information. Would you like to share your email address with us?

_____