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ARTICLE

Understanding the impact of global challenges on container shipping: a qualitative study in the COVID-19 era

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Abstract

Global challenges in container shipping can cause periodic disruptions and result in volumetric losses in supply chain operations, which can restrict commercial mobility. Throughout history, major disruptions have been the most significant drivers of change and progress. Therefore, it is crucial to determine the impact of these challenges to develop solutions. The aim of this study is to determine the impact of global challenges that have occurred in the COVID-19 era on container shipping. Qualitative research methods were used to form a study group of twenty-seven industry representatives. The challenges were conceptualized into four main themes. The results of the study showed that the strategic decision areas prioritized include prolongation of the transport time, port congestion, increased shipping cost, and global scale impact. This study allows the impact of global challenges on container shipping to be conceptualized and to identify criteria for decision-making methods.

Keywords COVID-19 · Container shipping · Supply chain · Qualitative methods · Content analysis

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1 Introduction

Challenges that are defined as regional crises such as conflicts or epidemics, and then spread throughout the world, can cause deterioration in processes such as raw material supply, transportation, and storage. Moreover, these challenges lead to inefficient use of companies' capacity, increased transportation costs, uncertainty in the supply chain, and decreased customer satisfaction (Toygar and Yıldırım 2021). Therefore, every crisis in the past has led to the emergence of weaknesses in all systems, thus creating new strategies (Notteboom et al. 2021). Although there have been challenges that deeply affect global trade throughout history, one of the largest losses in global trade volumes took place during the COVID-19 pandemic (Ivanov 2021). COVID-19 emerged as a high-level acute respiratory syndrome in December 2019 in Wuhan city in the Hubei state of China (Singhal 2020). It was declared by the World Health Organization to be a global pandemic on March 11, 2020, and has had negative impacts on many areas. In the early stages of the pandemic, there was a slowdown in production activities, port,services and trade, leading to a decline in exports and imports (Notteboom 2020). According to the World Trade Organization (WTO), there was a 6.2% loss in exports and a 5.3% loss in imports in the first quarter of 2020 and a 21% loss in value in both exports and imports in the second quarter (WTO 2020a, b). Overall, the pandemic caused a decrease of approximately 9% in international trade in 2020, posing a threat to the sustainability of global value chains (UNCTAD 2021).

Containerization has been crucial to the global movement of goods and has enabled large-scale international trade since its inception in the maritime industry (Stahlbock and Voß 2008). Thanks to the container, the loading and unloading costs of previous eras have been rapidly reduced (Levinson 2016). In addition to revolutionizing the functioning of international trade, the container has also increased the volume of global transport (Notteboom and Rodrigue 2008). Before the year 2000, global container trade generated a volume of less than 60 million twenty-foot equivalent units (TEUs), while in 2021, it reached a transport volume of 165 million TEUs (UNCTAD 2022). However, COVID-19 has also caused significant challenges to container shipping, which is one of the most important modes of transport for seaborne trade and ensures the safe transport of cargo during shipping (Van Tatenhove 2021). Between 2000 and 2009, global containerized volumes increased steadily each year until the first 6 months of the financial crisis in 2009, when volumes fell by around 16% (Kalgora and Christian 2016). Excluding this sharp decline, containerized volumes grew rapidly between 2000 and 2019. However, the challenges caused by COVID-19 have reduced container shipping volumes to their lowest levels since the 2009 crisis to date (Notteboom et al. 2021). During the COVID-19 pandemic, supply chain disruptions put pressure on production and distribution centers (Sahoo 2022). In particular, the imbalance between supply and demand for empty containers and the closure of ports due to the pandemic led to disruptions in global supply chain linkages (Jeong and Kim 2023). COVID-19 has also led to global container positioning

challenges and a container shortage, resulting in a significant increase in container shipping costs compared to previous years. China plays a significant role in shaping the position of containers in world trade. In other words, China has the largest share of container shipping and seven of the world's ten largest container ports are located in China (Koyuncu et al. 2021). The volume loss in global merchandise trade and the interruption of production in China due to COVID-19 in the first months of 2020 reduced the demand for container shipping in Chinese ports. Consequently, in addition to the volume loss in the China's external trade, several major challenges have emerged, such as global containment practices (Deb et al. 2020; Depellegrin et al. 2020; Millefiori et al. 2020), operational constraints in port operating areas (Doumbia-Henry 2020), global container shortage and increased freight rates (Toygar et al. 2022), increased blank sailing announcements, and sharp declines in the number of ports of call (Humphreys et al. 2020; Michail and Melas 2020; Notteboom and Haralambides 2020).

Global challenges in container shipping can periodically lead to similar disruptions, causing volume losses in supply chain operations and restricting commercial mobility. The disruption of supply chains that began with the COVID-19 pandemic, coupled with the conflict between Russia and Ukraine, has manifested itself in the form of high-cost increases in essential logistics services such as transportation and storage (Toygar and Yildirim 2023). The conflict has significantly reduced commercial activity in the Black Sea. Containers waiting to be loaded onto ships for Ukrainian ports have had to be kept in the ports. This situation has led to an increase in demurrage charges for storage in ports and the exceeding of the container's free usage time (UTİKAD 2023). In addition, ships with ports in Russia and Ukraine in their schedules have had to change their arrival routes and determine alternative destination ports in different countries (Hapag-Lloyd 2020). This mandatory rescheduling in scheduling has led to unplanned port calls at ports already congested with cargo and ships, causing traffic congestion in the port hinterland and customs procedures, and prolonged storage of goods in depots. These adverse developments may serve as an indicator that events such as the COVID-19 pandemic and the Russia-Ukraine conflict may have a similar impact on container shipping.

Effectively analyzing and learning from past crises is essential for developing strategies and agile transport methods to withstand crises. Major challenges such as pandemics can act as primary drivers for change, and understanding the impact of the challenges that arise during these processes is crucial to developing solutions. The pandemic has exposed weaknesses in the system and highlighted the need for change. In particular, the outbreak and the restrictions imposed during this period have challenged the container shipping industry and highlighted the need for corrective action by parties and policymakers (Merk et al. 2022; Notteboom and Rodrigue 2023). To achieve real change, it is essential to understand the origins of the situation and identify ways to systematically address these challenges (Erol 2023). Therefore, it is essential to examine in depth the impact of global developments on container shipping, to create sectoral strategies and development plans, and to develop corrective measures. In other words, when examining the impact of COVID-19 on container shipping, it is of great importance to define the challenges created by the environment of uncertainty. Previous studies have made significant

periodic inferences about certain aspects of maritime trade in determining the impact of COVID-19 on container shipping. However, it may not be appropriate to make definitive inferences, especially as periodic effects are likely to change in the future, leading to different results. Therefore, evaluating the impact of COVID-19 over the entire pandemic, from beginning to end, may provide more comprehensive results. The impact of the COVID-19 pandemic on the container shipping industry has been highly variable. Throughout this period, parties in the industry have had to deal with challenges that have arisen at various stages of the shipping process. Identifying these maritime challenges and developing solutions is essential to the sustainability and efficiency of the sector.

Container shipping involves many parties in the transport chain in the movement of containers between export and import factories. To cover the research topic comprehensively, key industry parties participated in the study. This is because the emergence of challenges related to the container shipping sector can impact not only ship and port operators but also other parties in the industry. Container shipping is a broad sector characterized by the complex interaction of a number of different parties, such as container terminal operators, container shipping operators, freight forwarders, and beneficial cargo owners. Each group in the sector has specialized expertise and different perspectives. The qualitative research conducted as part of the content analysis provides an opportunity to explore in depth the challenges posed by the COVID-19 to the sector through the experiences and perceptions of the parties involved. By collaborating with the sector representatives who have an in-depth understanding of the challenges, the research gains the ability to conduct a current and detailed investigation. This collaboration provides a perspective based on container shipping experience. It also allows a thorough examination of the industry's experiences and challenges from different perspectives. Participants have clearly expressed their views on the challenges facing the industry. This approach has increased the reliability of the study.

The pandemic led to border closures and economic fluctuations that disrupted national and international logistics activities (UTİKAD 2023). In addition, supply chain disruptions had a significant impact on global trade. In this context, it is widely recognized that global trade has been under the influence of the COVID-19 pandemic for the past three years (TÜRKLİM 2023). Recently, a highly mutated variant of COVID-19, known as Pirola (BA.2.86), has been detected in different countries on different continents (Callaway 2023; Rigby and Steenhuysen 2023). In this context, this study, which aims to thoroughly investigate the impact of the ongoing COVID-19 pandemic on container shipping uncertainties, remains highly relevant and critical to the functioning of the industry.

2 Conceptual framework

Global challenges to the container shipping industry are disrupting the supply chains of thousands of beneficial cargo owners. For example, in March 2021, a container ship blockade in the Suez Canal resulted in the canal being closed to shipping for a week. This challenge restricted commercial mobility and caused a deterioration in

global supply chain connectivity. However, the challenges faced by container shipping began to emerge much earlier. The rapid growth in demand for container shipping has had a significant impact on ship capacity. In 1956, the Ideal-X, considered to be the first container ship, had a length of 33 ft and a capacity of 58 containers (approximately 96 TEU when adjusted to 20 ft dimensions). Today, however, there are container ships that are 250 times larger than the Ideal-X, with a capacity of 24,000 TEU (Salleh et al. 2021). On the one hand, the high carrying capacity of ships suppresses freight rates, but on the other hand, it reduces the ability of shipping operators to provide reliable service (Fusillo and Haralambides 2020). The rapid increase in ship capacity is reflected in all supply chain links as high costs and fluctuations in freight rates, leading to an increase in financial and demand uncertainty as a risk factor in container shipping (Notteboom 2012; Russell et al. 2020). All these challenges require container shipping operators to develop management strategies. If these strategies are inadequate, the assets of container shipping operators may be reduced or completely lost (Choi et al. 2018). Therefore, in the process of developing solutions methods, decisions may be taken, such as omitting, blank sailing, slowing down or idling ships, or shift to different service lines (Humphreys et al. 2020; Notteboom et al. 2021). These decisions are frequently taken during the COVID-19 era. In particular, when the observed fluctuations in freight rates due to low sulfur bunker fuel regulations were combined with the negative effects of COVID-19 from 2020 onwards, the uncertainty in container shipping activities increased significantly (Russell et al. 2020).

In times of major crises and downturns, container shipping may experience temporary disruptions and volume losses. Recently, despite various developments affecting global trade, the COVID-19 pandemic has surpassed all others (Merk et al. 2022). The pandemic, which started in China and spread globally, has had a major impact on container shipping. The COVID-19 pandemic has caused container positioning challenges and container shortages worldwide, resulting in a significant increase in container shipping costs and freight rates compared to previous years. Despite being a new concept, many studies have been published in a short period of time examining the impact of COVID-19 on container shipping. Toygar et al. (2022) examined the challenges that led to empty container shortages during the COVID-19 era and evaluated potential solutions. The results showed that the main challenge causing the shortage was the increase in the cost of container shipping. COVID-19 also tested the crisis resilience of container terminals. The unpredictable course of COVID-19 and the possibility of a new shock effect have led many global service providers to develop various precautionary strategies, forming the basis of port congestion (Gu and Liu 2023). Ayaz et al. (2022) investigated the identification and prioritization of management strategies for ports to reduce the impact of COVID-19. Using data from the major container ports in Nigeria, Nwokedi et al. (2021) concluded that COVID-19 has led to an increase in container shipping costs. Mandatory 14-day quarantine practices for ships entering ports, security checks, and delays in container handling in port have resulted in significant time losses in container shipping (Yazir et al. 2020). When these time losses are combined with other mandatory containment measures caused by COVID-19, it triggers period-based high-volume losses in container shipping activity, similar to volume losses

in world trade. According to UNCTADStat (2021) data, the number of ship calls at container ports increased by 4.52% in the first half of 2019 compared to the previous year, but decreased by 3.19% in 2020 compared to the previous year. Similarly, Depellegrin et al. (2020), found that the mobility of commercial ships due to COVID-19 decreased by 69% in the Veneto Region compared to the same period in 2017.

Container ship schedule compliance and reliable arrival and departure times are highly important factors (Agarwal and Ergun 2008). However, the reliability of ship schedules has decreased by double digits since June 2020, reaching 34.9% in January 2021, the lowest since 2011 (Sea-intelligence 2021). COVID-19 has caused an increase in the blank sailing of container ships and a sharp decrease in the number of ports of call, making schedules unreliable (Humphreys et al. 2020). Therefore, some studies examine changes in the number of ports of call, especially using real-time positions and operation times of ships obtained from AIS data. For example, in their study, Millefiori et al. (2020) compared global ship mobility between 2016 and 2020, evaluating data from more than 50,000 ships. As a result, they found that there has been a steady increase in ship mobility since 2016, and they also highlighted a significant decrease in global shipping activity since 2020, when COVID-19 began to spread. Similarly, Depellegrin et al. (2020) studied ship activities between 2017 and 2020, and Zhu et al. (2020) investigated ship operation processes and container handling volume. Moreover, delays caused by COVID-19 in global container shipping have created challenges in meeting export demands from China. This situation, which has global implications on import–export balances and was studied by (Cerdeiro et al. 2020). Using AIS data, their study aimed to determine the impact of COVID-19 on Chinese exports and found that the pandemic had significantly disrupted Chinese production and exports. The studies conducted during the pandemic reveal that the challenges caused by the pandemic varied periodically. The present study has been carried out to provide a comprehensive examination of the difficulties encountered during this process. Additionally, the inclusion in the study group of the four fundamental parties that make up the container shipping building block allows the challenges to be examined from all dimensions.

3 Methodology

In this study, which was conducted using a qualitative method, an evaluation was made based on data collected from various parties in the container shipping industry. The reason for using a qualitative method for this study was that such methods can be useful when quantitative methods are unable to adequately describe and interpret a case (Marshall and Rossman 2014). This method aims to identify participants' feelings, thoughts, and attitudes regarding the subject, making the challenges examined in the research more visible (Taylor and Bogdan 1984). It also includes the process of identifying unforeseen themes and dimensions, which is done through four steps: coding the data, identifying themes, organizing and defining the data according to main and sub-themes, and finally interpreting the results (Miles and Huberman 1994). Although this method can be used using with different approaches, in this study, a thematic approach was preferred after the coding process

to explore the code relationships of the themes (Oliveira et al. 2013). The main reason for this choice is to code the interview records obtained from the participants thematically, under themes, and to explore the challenges emerging in the industry. Although there are various software available for creating themes, categories, and codes, the MAXQDA software was preferred for this study. This software allows for the combination of qualitative and quantitative data (Kuckartz 2010). It also allows for the categorization of participants' statements and their arrangement under main themes. It also allows for the categorization of participants' statements and their arrangement under main themes and is used to clarify ideas using maps and visuals and to understand the relationships between themes (Kuckartz and Rädiker 2019). To assess the impact of challenges from a multidimensional and diverse perspective, a study group was formed with participants involved in various processes related to the delivery of containers from the export factory to the import factory.

3.1 Study group and data collection

In a negative situation affecting container shipping, it is highly likely that many sectors will be adversely affected due to the diverse composition of the sector. To understand the impact of global challenges on container shipping, our aim is to provide access to information through institutions and representatives that are key players in the sector and have activities that are critical to its functioning. Therefore, we deliberately selected container shipping parties and their representatives as our primary data source and formed a study group from these individuals.

The process of identifying the themes to be explored in the study involved a carefully planned and executed procedure. Firstly, a literature review and an examination of industry sources was conducted to create the themes to be used for content analysis. This phase considered existing studies related to the container shipping sector, as well as recent industry reports. The examinations conducted in this step have contributed to the creation of a theme pool. This pool formed the basis of the interviews held with the study group. Secondly, prior to the interviews, this theme pool was shared with the experts, and their opinions and contributions were considered, leading to necessary adjustments. This step is critical to the reliability of the research and the appropriateness of its themes. The purpose, content, and scope of the interviews were introduced to industry experts through office visits, online conferences, and telephone calls to ensure that the study group understood the general framework of the study. In-depth semi-structured interviews were conducted with participants who met the necessary eligibility criteria until theoretical saturation was reached (Charmaz 2006).

Prior to commencing interviews with participants, permission was obtained from the University's Science and Engineering Ethics Committee. Due to the COVID-19 measures adopted by many companies in the industry, such as remote/online/home working principles and restrictions, it was not possible to create a face-to-face interview environment. Therefore, a significant part of the data collection process was conducted using online communication tools. The interview process took place between 5 March and 25 April 2022. The interview durations

were between 20 and 35 min. Care was taken to create an environment that could reflect the emotions and thoughts of the sector representatives during the interview process. Interviews with participants who were uncomfortable in their surroundings were conducted in several separate sessions. After each interview, the themes in the pool were shared with the experts, and necessary revisions were made based on their opinions. In this way, the themes that made up the challenges examined in the study were evaluated using many different methods. The experts' industry experience and knowledge greatly enriched the themes. Throughout the interview process, these themes were thoroughly evaluated by the industry experts, enabling a better understanding of the challenges. This approach allowed the research results to be rich and detailed. Descriptive characteristics of the 27 participants included in the study are presented in Table 1.

Table 1 Semi-structured interview participants

Participant	Sector	Position	Experience
Participant 1	Container shipping operator	Account manager	6 years
Participant 2	Container shipping operator	Account manager	9 years
Participant 3	Beneficial cargo owner	Export specialist	6 years
Participant 4	Freight forwarder	Business development manager	8 years
Participant 5	Container terminal operator	Senior trade manager	17 years
Participant 6	Container terminal operator	Ship operation specialist	7 years
Participant 7	Beneficial cargo owner	Foreign trade specialist	6 years
Participant 8	Beneficial cargo owner	Export sales specialist	3 years
Participant 9	Beneficial cargo owner	Export manager	12 years
Participant 10	Container terminal operator	Project and business development specialist	9 years
Participant 11	Container shipping operator	Field sales specialist	6 years
Participant 12	Beneficial cargo owner	Export deputy manager	3 years
Participant 13	Container terminal operator	Ship operation specialist	6 years
Participant 14	Container terminal operator	Container yard planner	8 years
Participant 15	Freight forwarder	Business owner	9 years
Participant 16	Freight forwarder	Anatolian customer representative	6 years
Participant 17	Container shipping operator	Account manager	9 years
Participant 18	Container terminal operator	Container yard planner	9 years
Participant 19	Freight forwarder	Regional director	23 years
Participant 20	Freight forwarder	Sales and marketing manager	9 years
Participant 21	Container shipping operator	Digital sales manager	11 years
Participant 22	Freight forwarder	Marmara regional manager	16 years
Participant 23	Freight forwarder	Pricing team leader	9 years
Participant 24	Freight forwarder	Operation deputy manager	9 years
Participant 25	Beneficial cargo owner	Export sales specialist	6 years
Participant 26	Container shipping operator	Senior transshipment coordinator	6 years
Participant 27	Container shipping operator	Operation manager	13 years

3.2 Validity and reliability

The value of a scientific study depends on the credibility of the results obtained (LeCompte and Goetz 1982). Lincoln and Guba 1985 emphasized that validity and reliability in qualitative studies should be trustworthy. To ensure the reliability of content analysis, it is essential to perform accurate coding, maintain consistency among themes, and consider participants' competence in the research topic. Therefore, there are specific procedures in place to ensure reliability in content analysis. In this study, the reliability of the content analysis carried out in the context of qualitative research was ensured by three different techniques.

The first preferred reliability procedure to verify this was triangulation. The triangulation uses different methods and data sources to cross-check researchers' perspectives and interpretations as well as data and interpretations (Oliver-Hoyo and Allen 2006). In qualitative research, the triangulation can be carried out in four different ways: data triangulation, investigator triangulation, theoretical triangulation, and methodological triangulation (Denzin 1978). The investigator triangulation technique was preferred in this study. Investigator triangulation is achieved by involving more than one researcher in the collection, analysis, and interpretation of data (Holloway and Wheeler 1996). The opinions of experts in the relevant scientific field of study were sought during the creation of the interview form and the analysis of the data obtained. In other words, it means that the coding process is cross verified by an independent coder (investigator) who is not part of the research team (Denzin 1978; Thurmond 2001). To ensure the reliability of inter-coder agreement, the post cross-check coding consistency should be at or above 80% (Miles and Huberman 1994). To ensure that the coding process was conducted reliably, the opinions of an investigator well-versed in the theoretical background of the subject matter and proficient in qualitative research methods were sought. Documents containing the opinions of three different participants randomly selected were shared with the coder, and they were instructed to perform coding on the identified themes. The independent and unbiased coding performed by the coder was then compared to the coding conducted within the scope of this study. As a result of this comparative process, it was determined that the code compatibility reached a level of 85%. In the subsequent stages, discussions were held among the coders to reach a consensus on the sections where compatibility was not achieved.

The second preferred reliability procedure was to transcribe the interview recordings into documents and read them several times on different days in order to analyze the data and discover their compatibility with the themes. After the reading process, the texts in the documents were separated, and independent and meaningful sections were created according to the concept of the study. The sections created were coded into themes according to their final form. After completing the coding process, it is necessary to review the coding several times to ensure consistency with the conceptual framework of the study and among themes (Graneheim and Lundman 2004; Vaismoradi et al. 2013). Therefore, the reading of the sections under the same theme was repeated several times to ensure the initial control of the compatibility of the themes with the conceptual framework of the research.

The third reliability procedure to related to the sampling method of the research, especially in studies investigating challenges that cover a specific industry. Conducting in-depth interviews with participants who have a high level of knowledge about the subject allows for a comprehensive examination of the topic (Brounéus 2011). To ensure the validity and reliability of the coding process, purposive sampling, which is a method of transferability criteria, was used. Purposive sampling is a method in which the researchers select the participants according to their most appropriate characteristics for the study. When forming the study group, care was taken to involve participants who were knowledgeable parties in the subject matter under investigation within the scope of the research. During the data collection and analysis process, two researchers conducted the data collection and analysis in a coordinated manner. Participants with the expertise and knowledge to assess the challenges were identified through preliminary screening questions, considering factors such as their field of work, industry experience, and their position in the workplace.

3.3 Data analysis

The data obtained in the study were analyzed in eight different steps. All the data obtained from the interviews with the participants were transferred to the written documents and coded according to the themes. After this process, a code cloud was created to visualize the themes. In the next step, the sub-themes under the main themes were ranked by frequency to provide a comprehensive perspective. The reasons for this ranking were explained from the participants' point of view. As part of the analysis, the results of each category were reported. Detailed information on the flow of the method is presented in Fig. 1.

The main themes and sub-themes are presented in Table 2.

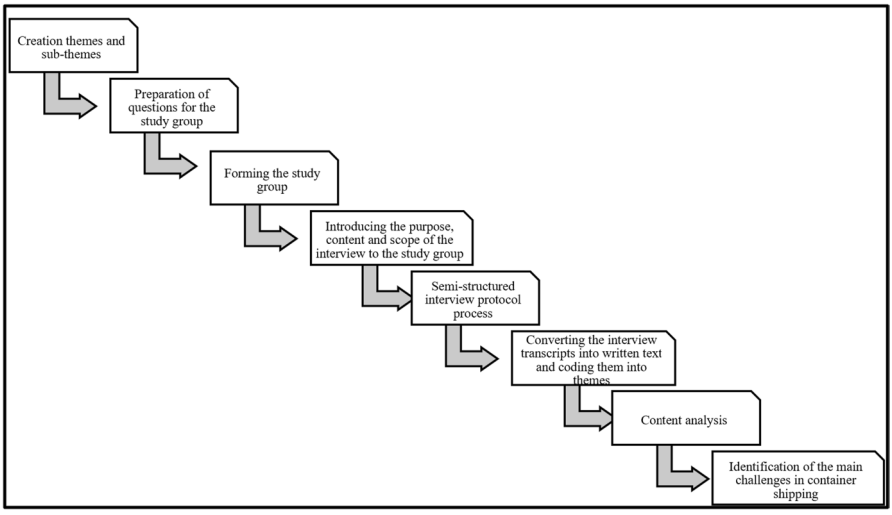

Fig. 1 Content analysis flowchart

Table 2 Themes used in the analysis

Main theme	Sub-theme	Abbreviation
Prolongation of the transport time (PTT)	Increasing in blank sailing announcements	IBSA
	Container shortage	CS
	Decreasing in the number of ports of call	DNPC
	Rollover increases	RI
	Uncertainty in the supply chain	USC
	Storage of the cargo from necessity	SCN
	Reduction or cancellation of container bookings	RCB
Port congestion (PC)	High-capacity ship management	HCSM
	Slowing down of port hinterland mobility	SDPHM
	Countermeasures against the pandemic	CAP
	Waiting ships in anchoring areas	WSAA
	Stocking containers	SC
	Lack of personnel in port operation	LPPO
	Inadequate port-centric logistics infrastructure	IPLI
Global scale impact (GSI)	Fluctuation in ship chartering costs	FSCC
	China-based container position	CBCP
	Deteriorating of supply–demand balance in global trade	DSBGT
	Dominating container services and lines by major shipping operators	DCSMO
	Keeping customer satisfaction in the background	KCSB
	Low level of sailing schedule reliability	LLSSR
	Profitability in Trans-Pacific trade	PTPT

Table 2 (continued)

Main theme	Sub-theme	Abbreviation
Increased shipping cost (ISC)	Increased storage costs	ISC
	Increased freight rates	IFR
	Increased fuel costs	IFC
	Increased demurrage and detention charge	IDDC
	Increased peak season surcharges	IPSS
	Increased inland transport costs	IITC
	Increased port charge	IPC

4 Results

In this study, in-depth interviews were conducted with participants consisting of industry experts using a semi-structured interview method. The participants' opinions obtained through these interviews were carefully analyzed using content analysis methods. During the content analysis process, participants' opinions were coded into main and sub-themes, and these themes were then analyzed to identify key results. This provided a basic conceptual framework for understanding the impact of the COVID-19 pandemic on container shipping. The experts' experiences and recommendations contributed to a better understanding of the challenges. The content analysis was conducted according to the guidelines found in many studies in the literature (Denzin 1978; Taylor and Bogdan 1984; Miles and Huberman 1994; Thurmond 2001; Kuckartz 2010; Brounéus 2011; Oliveira et al. 2013; Kuckartz and Rädiker 2019). The global challenges consist of four main themes, and each main theme contains seven sub-themes. The main themes, titled "prolongation of the transport time," "port congestion," "global-scale impact," and "increased shipping cost," are described through the views of the participants. Below are the views of participant number 8, who works for the beneficial cargo owner, on the first main theme, the prolongation of the transport time.

> Participant 8: *The decrease in the number of ports of call by ships during the COVID-19 period are increasing warehousing costs for beneficial cargo owners. For example, regular Israel ship schedules, which used to be weekly, are organized every two weeks due to COVID-19. This leads to the warehousing of export-ready goods. Beneficial cargo owners are forced to store their final products and struggle with port warehousing charges. In addition, they cannot proceed with the next production activities due to the inability to collect payments from importers.*

During COVID-19, the theme of port congestion, as described by participant 13 working for the container terminal operator, is elaborated with the following statements:

> Participant 13: *Firstly, the ships scheduled to call at the port had to comply with more detailed obligations under COVID-19. This situation led to delays in the start of the ships' operations and to congestion in the port's dock scheduling.*

The theme of increased shipping cost, which is one of the difficulties in this process, is explained by participant number 11, who works for the container shipping operator, participant number 8, who works for the beneficial cargo owner exporting hygiene materials, and participant number 7, who works for the beneficial cargo owner in the iron and steel sector.

> Participant 8: *In Turkey, beneficial cargo owners need to quickly procure raw materials to meet export demand. COVID-19 has caused many companies to spend time researching the necessary timeframes for raw material procurement, leaving them with insufficient time to fulfill orders. As a result, we are*

forced to favor air transport, which is a fast transport system. For example, we have to source raw materials from Japan as an alternative to China and transport them by air. This necessity need leads to an increase in our costs.

Participant 7: *During the COVID-19 pandemic, shipping operators have prioritized empty containers for companies exporting lightweight and expensive goods. This situation has led to an increase in export traffic in the Mediterranean region for small shipping operators. To solve these challenges, our company has started to work with small shipping operators providing services on nearby routes instead of working with large shipping operators. However, this situation has led to an increase in transport costs and additional financial losses for our company.*

Participant 11: *Despite the demand for exports, companies are forced to store their products in warehouses due to the shortage of empty containers and the challenge of finding slots on shipboards. This situation has an impact on global supply chains because the raw materials they import are also delayed, resulting in financial losses both in the domestic and foreign markets.*

The global-scale impact, which are categorized under the themes, are explained by participant number 4, who works for the freight forwarder.

Participant 4: *Due to the COVID-19 pandemic, factors such as production stoppages, factory closures, reduced ship voyages, and port cancellations in China, the country from which Turkey imports the most, have caused serious difficulties in logistics processes.*

Once the coding process was complete, a comprehensive perspective was provided by analyzing code clouds and code frequencies.

Figure 2 shows the impact of COVID-19 on container shipping. All themes in the challenges category are included in the word cloud. The minimum coding is set to one for all themes. The position of the themes in the cloud corresponds to their coding, with the theme in the center of the cloud representing the most coding. Thicker and larger fonts indicate themes that were emphasized more by the participants,

Fig. 2 Code cloud analysis of themes

while thinner and smaller fonts represent less emphasized themes. The results show that the most frequently coded theme is "prolongation of the transport time" among the main themes. Among the sub-themes, "uncertainty in the supply chain" and "increased freight rates" are the most frequently coded. After the code cloud analysis, the ranking of the sub-themes is examined through the code frequencies.

The coding process resulted in a detailed analysis of the main themes, sub-themes, and the frequency of these sub-themes. Throughout the research process, the first main theme reflecting the participants' opinions was identified as the prolongation of the transport time, under which seven different sub-themes were defined. Figure 3 summarizes this visual analysis. This analysis has allowed for a more in-depth examination of the participants' perspectives and facilitated the identification of sub-themes that needed particular emphasis, especially under the main theme of prolongation of the transport time.

The sub-themes that the participants in container shipping parties focused on the most were "uncertainty in the supply chain" (USC, 22.90%) and "container shortage" (CS, 21.30%). On the other hand, the sub-themes with the lowest code frequency were "rollover increases" (RI, 6.40%), "storage of the cargo from necessity" (SCN, 6.4%), and "reduction or cancellation of container bookings" (RCB, 6.4%). The reasons for the high emphasis on the sub-theme of supply chain uncertainty were explained by participant number 3, who works for a beneficial cargo owner, while the container shortage was detailed by participant number 4, who works for one of the world's largest freight forwarders, and participant number 25, who works for a beneficial cargo owner.

Participant 3: *During the COVID-19 outbreak, the number of port calls for container ships has been reduced, and blank sailing decisions have been*

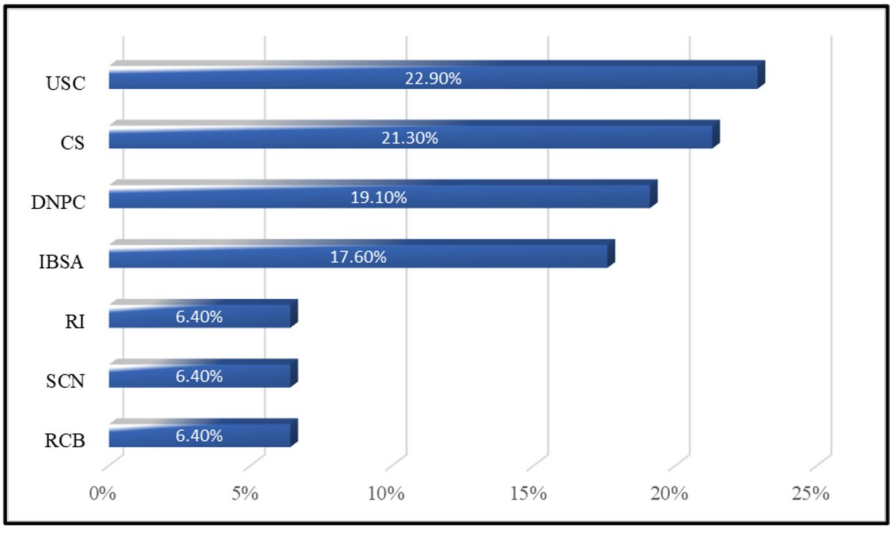

Fig. 3 Code frequency of sub-themes of PTT

made. These decisions have led to uncertainty in the production and transport planning of foreign trade companies.

Participant 4: *In a normal process, containers come to Turkey mainly filled from the Far East, are unloaded in Turkey and then refilled with export cargo to be sent to another country. This is a natural flow of containers. However, due to the challenge of empty containers staying in China, there has been a decrease in the number of already filled containers coming to Turkey. As a result, there has been a shortage of suitable containers for export products.*

Participant 25: *The integration of smaller capacity ships by shipowners into their services in Turkey, the announcement of blank sailing, the rollover of loaded containers from the scheduled ship to the next one, have led to a shortage of containers and the existing containers are in a poor condition.*

The code frequency results for the sub-themes of the second main theme relating to problems arising from COVID-19 are presented in Fig. 4. In the figure, the seven sub-themes form the main theme of "port congestion." According to the code frequencies, the sub-themes that participants focused on the most were "countermeasures against the pandemic" (CAP, 28.6%) and "lack of personnel in port operation" (LPPO, 22.7%). On the other hand, "high-capacity ship management" (HCSM, 1.7%) was the sub-theme with the lowest code frequency.

According to the participants' perspectives, the most significant factor causing port congestion due to the pandemic is the measures taken. Participant 6, who works for a container terminal operator in Turkey, describes the impact of the countermeasures against the pandemic on port operations. In addition, participant 18, who works in a major port providing container handling services in the

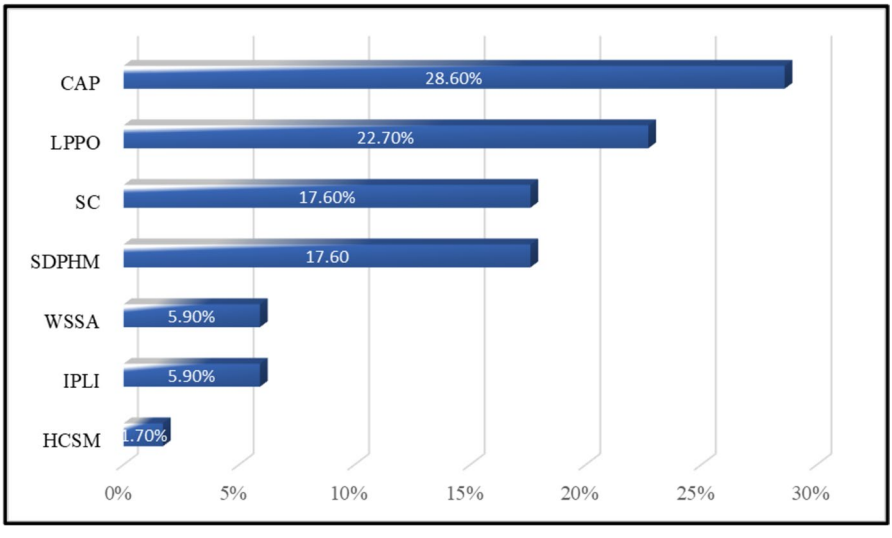

Fig. 4 Code frequency of sub-themes of PC

Aegean region, describes countermeasures against the pandemic and the lack of personnel in port operation.

> Participant 6: *Our workers in the operations department apply disinfection procedures to cargo and authorized personnel. The procedures we carry out as part of the COVID-19 measures naturally lead to cargo waiting at the port and, consequently, financial losses for foreign trade companies due to the resulting time delay.*
> Participant 18: *"he quarantine and hygiene practices carried out within the scope of COVID-19 led to ships waiting for hours offshore and disruptions in our port schedule. In addition to this, our operational activities continued as usual under the necessary precautions. As we mainly provide export-oriented services in the Aegean region, the reduced production volumes resulted in us not reaching the targeted handling volumes.*
> Participant 18: *At first, in addition to protective equipment, the obligation to use masks, gloves, and goggles was made mandatory. As the pandemic spread rapidly, social distancing zones were created in common areas, and changes were made to mealtimes. When these measures proved insufficient, the use of the cafeteria was suspended, and rations were distributed to the staff. In the following period, our company, which provided services in 3 shifts, changed to 2 shifts, and moved to a 14-day work, 14-day quarantine process. These practices led to a slowdown in operational processes.*

The information related to the sub-themes listed under the main theme of global scale impact is shown in Fig. 5. According to the data obtained from the participants, the sub-themes "China-based container position" (CBCP, 42.60%) and "deteriorating of supply–demand balance in global trade" (DSBGT, 19.10%) have the

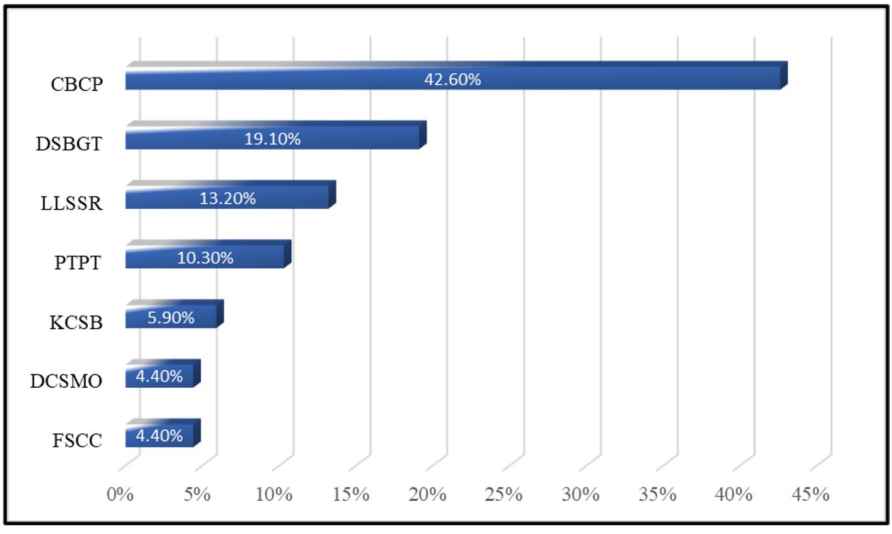

Fig. 5 Code frequency of sub-themes of GSI

highest code frequencies, while the sub-themes "dominating container services and lines by major shipping operators" (DCSMO, 4.4%) and "fluctuation in ship chartering costs" (FSCC, 4.40%) remain at the lowest level.

The reasons why the sub-theme China-based container position has the highest code frequency among the sub-themes forming the main theme of global-scale effects are explained by the statements of participant number 5, who works at the container terminal operator. The rationale behind the deteriorating of supply–demand balance in global trade is explained by participant number 27, who works for a container shipping operator.

> Participant 5: *The fact that the beginning of COVID-19 was in China has a significant negative impact on container transport. This is because there are container cycle processes within the global structure that are specifically designed for China. To briefly explain this cycle, a large proportion of containers in world trade must arrive empty in China, be filled, transported to the rest of the world, and then returned to China after unloading. However, due to COVID-19-related closures or restrictions in many different regions of the world, containers cannot be sent to China, and those that are sent remain in Chinese ports, effectively locking the container transport cycle.*
> Participant 27: *Due to the high demand for transport from the Pacific route during the pandemic, shipping companies diverted their ships and containers to this region. Regional trade routes that have had a certain level of shipping traffic for a long time have started to be disrupted and changed.*

Information on the sub-themes listed under the main theme of increased shipping cost is shown in Fig. 6. The information in the figure shows that the sub-themes with the highest frequency are "increased freight rates" (IFR, 40.20%) and "increased

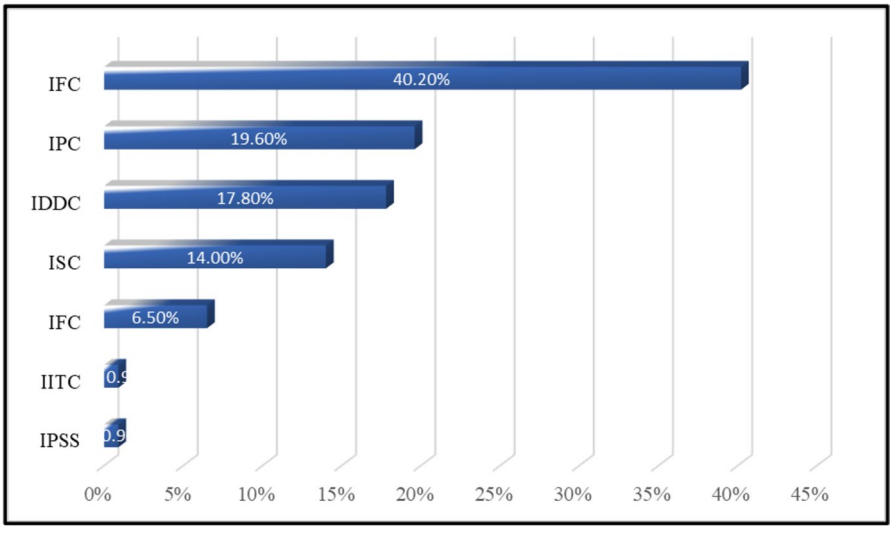

Fig. 6 Code frequency of sub-themes of ISC

port charges" (IPC, 19.60%), while those with the lowest frequency are "increased inland transportation costs" (IITC, 0.90%) and "increased peak season surcharges" (IPSS, 0.90%).

In this research, participant number 7, who works for a beneficial cargo owner in the iron and steel sector, explains the increase in freight rates, which is the most common frequent sub-theme with the highest code frequency under the main theme of increased shipping cost. In addition, participant number 10, who works for one of Turkey's largest container terminal operators, discusses the increase in port charges, while participant number 12, who works for a beneficial cargo owner exporting textiles, explains the increase in demurrage and detention charges.

> Participant 7: *COVID-19 has led to container shortages in Turkey, the inability to schedule ship programs, disruptions, container allocation challenges, and high port expenses. During this period, shipping agencies have prioritized profit orientation due to rising freight rates, which naturally puts customer satisfaction as a second or even third priority.*
> Participant 10: *Payment delays, cash flow disruptions, company closures, and the inability to send shipping documents on time during the COVID-19 process result in importers not being able to withdraw their containers on time. In such cases, from a subjective perspective, port expenses may appear to increase as profit, but due to the high fees incurred, many importers abandon their cargo to customs. So, unfortunately, port operators have financial losses in container operations.*
> Participant 12: *Due to the difficulty in finding containers, there have been delays in the delivery times promised to customers. When we secured containers for export, the import region was closed due to pandemic conditions. This has resulted in demurrage and detention charges for containers arriving at the port of destination. These unforeseen costs have put us in a very difficult position.*

5 Limitations

This study has two limitations. Firstly, the challenges examined in the research have global implications. However, the sample group of this study consists of sectoral experts working in Turkey. In future studies, conducting similar research with multinational sample groups may contribute to the development of global solution methods. Secondly, the adoption of the principle of remote/online/telecommuting work due to the COVID-19 policy resulted in limited face-to-face meetings conducted in limited time periods. In studies with limited time, a more effective use of time can be achieved by tailoring and pre-defining participant profiles at the sample group definition stage and by reducing the duration of preliminary interview processes for participation in the research. In this way, the data collection process can be managed more efficiently, and comprehensive results can be obtained by overcoming the challenges posed by restrictions.

6 Discussion and conclusion

This study was conducted by gathering the opinions of various parties in the container shipping industry to determine the impact of COVID-19 on shipping activities. In this context, the impact of COVID-19 on container shipping was examined using content analysis. It was concluded that the effects of COVID-19 were expressed through four main themes. This study has demonstrated that the COVID-19 pandemic has led to significant challenges in the container shipping industry. The results of the study indicate that the main challenges during this period include prolongation of the transport time, port congestion, and global-scale impact and increased shipping cost. Regarding the impact of COVID-19 on shipping processes, the codes identified in the study are compatible with many literature studies (Deb et al. 2020; Depellegrin et al. 2020; Humphreys et al. 2020; Millefiori et al. 2020; Zhu et al. 2020; Notteboom et al. 2021; Toygar et al. 2022). It was also concluded that the themes accurately represented container shipping and the parties involved in the processes.

The results of the study indicate that the challenges caused by COVID-19 have had negative effects on container shipping. According to the analysis results of the data collected from the participants, it is seen that COVID-19 has caused considerable shipping delays. This challenge, which is experienced on a global scale, is included in the study with the code prolongation of the transport time. Results from the first main theme indicate that uncertainty in the supply chain is the most significant challenge in prolongation of the transport time. The sharp reduction in the number of ports of call for ships operating in regions affected by this challenge disrupts commercial activity in the region concerned and leads to empty containers being stored in regions where they are not needed. As a result of all these factors, container shipping operators (CSOs), which are unable to obtain sufficient container bookings from ports in the region due to a lack of empty containers, often announce blank sailings to achieve the desired level of demand in the region. These announcements require that containers for which bookings have already been made to remain in storage for a certain period of time. It is understood that when the containers held in the warehouses are combined with those booked for the following week, the ships operating on the trade often cause the containers to rollover. In addition, holding containers in warehouses delays their repositioning process and creates empty container challenges in subsequent shipment planning. These challenges create shipping time uncertainty for the BCOs and cause a significant increase in the port storage costs borne by the CSOs due to the containers being held in port. Even countries with high production capacity have experienced weakened storage and distribution capabilities due to trade restrictions, port, and distribution center closures, as reported by Notteboom et al. (2021). Similar to the results of this study, Jumaeva's 2020 study shows that COVID-19 caused a decrease in global foreign trade volumes and negatively affected the economies of developing countries. Based on the opinions of the experts participating in this study, the reasons for the storage of containers and the stagnation of distribution activities were the halt in production and

the decrease in demand for consumer goods. In addition, the increase in blank sailings and the decrease in the number of ports of call during COVID-19 have caused empty containers being stored in regions where they are not needed and have prevented their repositioning, leading to the emergence of the container shortage challenge triggered by the balance loss in global trade, which is another important result of this study. This result is in line with some literature studies (Koyuncu et al. 2021; Yang et al. 2021). Therefore, other important codes highlighted by the participants regarding the negative effects of COVID-19 were the increase in blank sailings and the decrease in ports of call.

Quarantine practices and border closure policies of countries during COVID-19 are included in the study with the code of countermeasures against the pandemic (CAP). The results of the port congestion themes indicate that the most significant challenge in the second main theme is CAP. Similar to the results of the present study, Deb et al. (2020) reported that containment measures taken for COVID-19 negatively affected maritime trade. Yazir et al. (2020) concluded that mandatory quarantine and security measures in the port area due to COVID-19 caused operational losses for container shipping operators. Zhu et al. (2020) reported that COVID-19 slowed down ship loading and unloading operations, resulting in increased container dwell time in ports. In addition, port hinterland and foreland congestion has resulted in unnecessarily long waiting times for containers to reach their destinations (Toygar et al. 2022). The results of this study are consistent with many other studies in the literature and confirm the impact of the COVID-19 pandemic on container shipping.

The results of the third main theme indicate that China-based container position is the main concern on a global scale. This challenge has had a significant impact on container supply and demand on the European route, as well as on maritime trade on the Trans-Pacific trade route. Cargo imbalances, especially in export–import activities between China and Europe, are among the main challenges that intensify the empty container challenge (Xing et al. 2021). Despite the many benefits that globalization offers multinational companies, large-scale challenges affecting nations, such as pandemics and wars, can lead to unexpected disruptions in supply chain linkages (Toygar and Nart 2022). Such challenges can disrupt the regular flow of international trade and logistics, adversely affect production and distribution processes, and increase risks for companies. Indeed, at the onset of the pandemic, there was a decline in production, restrictions on economic activity and disruptions in supply chains (WTO 2020b). It created an imbalance between supply and demand and led to rapid fluctuations in container shipping. In addition, concerns about access to raw materials led companies to adopt high inventory production strategies, resulting in fluctuations and often increases in container demand. These fluctuations have led to rapid changes in container shipping volumes and uncertainties in shipping processes (BIMCO 2021). In addition, due to the intensity of commercial activity on the Trans-Pacific route, an increased demand for empty containers has been observed in Asian ports. This demand has led to an inability to locate containers at the right time and place and the necessity to reposition empty containers in Asian ports (Koyuncu et al. 2021; Notteboom et al. 2021). Given that global trade is intensive on the Trans-Pacific trade route, the design of global container positioning on

this route for high financial returns leads to serious challenges of container shortages on other trade routes. It has led to an increase in container shipping volumes at the hub ports on this route, which has had a negative impact on container shipping activities at the spoke ports on the other routes.

The results of the fourth main theme of the study show that freight rate increases are the most important challenge in this category. Due to the inability of supply to meet the increasing demand in global trade, the lack of equipment and slot availability on ships and the shortage of containers have reached serious levels, and these challenges have caused freight rates to rise exponentially in recent years. In addition, the storage of many empty and inactive containers in the port area leads to high storage costs and increases freight rates. In line with these results, a study by Notteboom et al. (2021) concludes that container shipping operators keep low TEU capacity ships idle and operate fewer high TEU capacity ships, leading to increased freight rates. Studies examining the increase in freight rates from a supply-side perspective can also be found in the literature. The study by Schinas and Ourolidis (2022) highlights the emergence of COVID-19 as one of the main reasons that significantly affected the operational profitability of shipping operators. Erol (2023) found that financing costs in the Turkish sea freight transport sector increased by 86% year-on-year during the pandemic period. The high supply-side costs explain the increase in freight rates and, consequently, shipping costs in the sector.

7 Recommendations for the industry

The results of this study provide important insights to better understand the complex impact of the pandemic on container shipping, to address the challenges faced during the pandemic, and to be prepared for similar situations in the future. It is believed that shifting global container positioning to routes other than the Trans-Pacific trade route, which has high trade volumes and high economic returns, may be beneficial in addressing these challenges. In addition, it is considered that arranging additional inducement calls in regions with low trade volumes may have an impact on eliminating the negative effects by eliminating disruptions in companies' supply chains and ensuring global trade balance. On the other hand, it was concluded that countries can make quick decisions on foreign trade during COVID-19. In other words, until a container ship's departure from the exporting country and arrives in the importing country, some new measures can be taken in the importing country regarding COVID-19. In addition to these measures, quarantine measures in the importing country and segregation of the cargo at the port of discharge cause additional storage and warehousing costs. In addition, the countermeasures taken to reduce the impact of COVID-19 cause delays in the loading/unloading of ships, resulting in congestion in port dock scheduling. To overcome these challenges in regions where quarantine measures are high, CSOs store BCO cargoes in their own warehouses in hub ports until the restrictions are lifted. The storage of containers in the hub ports indirectly causes congestion on the trade lanes and leads to container shortages in other regions. A solution to counteract all these negative effects could be that instead of using the hub ports as storage centers, CSOs could offer low-cost

storage services in other regions as part of the end-to-end (E2E) services they provide to their customers. These strategies could reduce the storage costs of BCOs and could possibly contribute to eliminating the congestion at hub ports. This could allow foreign trade to continue its activities with all its tools and mechanisms. When assessing the situation in general, it is crucial for all parties involved in the foreign trade process to analyze the gap in the supply chain instead of applying conventional trade methods and to develop new methods to minimize possible negative effects during all kinds of crises. Accordingly, it is believed that the results of this study will provide a guide for the relevant literature and practitioners.

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Declarations

Conflict of interest The authors declare no competing interests.

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