

Received: 06.5.2021

Accepted: 02.11.2021

Published Online: 30.06.2022

DOI: 10.18613/deudfd.933816

**Research Article**

Dokuz Eylül University

Maritime Faculty Journal

Vol:14 Issue:1 Year:2022 pp:51-79

E-ISSN: 2458-9942

## THE EFFECT OF SUEZ CANAL BLOCKAGE ON SUPPLY CHAINS

Özden ÖZKANLISOY<sup>1</sup>

Erkut AKKARTAL<sup>2</sup>

### ABSTRACT

*The purpose of supply chain risk management is to understand the risks and their impacts, to take preventive actions and to determine plans to be implemented when risk events occur. Even if supply chain risks appear to be a minor risk event that was initially ignored, they can cause billions of dollars in costs and long-term supply chain disruptions at the macro level. The ship named Ever Given, which blocked the canal by accident during transportation in the Suez Canal on March 23, 2021, caused significant adverse effects in the supply chains, but also caused a break in the supply chain. In this study, the occurrence of the event is examined in terms of past marine accidents and supply chain risk management. In addition, alternative scenarios that occurred during the accident were examined, their effects on supply chains were determined, and suggestions were made against such accidents in the future. Furthermore, in the conclusion part of the study, the changes it will bring about in the supply chain approaches are included.*

**Keywords:** Suez Crisis, Suez Blockage, Ever Given Accident, Marine Accidents, Supply Chain Disruptions

---

<sup>1</sup> Res. Asst., Istanbul Aydin University, Department of Aviation Management, Istanbul, Turkey, ozdenozkanlisoy@aydin.edu.tr, ORCID: 0000-0001-7879-0733

<sup>2</sup> Prof. Dr., Yeditepe University, Faculty of Commerce, Istanbul, Turkey, erkut.akkartal@yeditepe.edu.tr, ORCID: 0000-0002-7090-4449

## **SUEZ KANALI BLOKAJININ TEDARİK ZİNCİRLERİNE ETKİSİ**

### **ÖZ**

*Tedarik zinciri risk yönetiminin amacı, riskleri ve etkilerini anlamak, riskleri önleyici tedbirler almak ve risk olayları meydana geldiğinde uygulanacak planları belirlemektir. Tedarik zinciri riskleri, başlangıçta göz ardı edilen küçük bir risk olayı gibi görünse bile, makro düzeyde milyarlarca dolarlık maliyetlere ve uzun vadeli tedarik zinciri kesintilerine neden olabilmektedir. 23 Mart 2021'de Süveyş Kanalı'nda taşıma sırasında kanalı kaza sonucu tıkayan Ever Given adlı gemi, tedarik zincirlerinde önemli olumsuz etkilere neden olurken, tedarik zincirinde de kırılmalara neden olmuştur. Bu çalışmada, olayın meydana gelmesi geçmiş deniz kazaları ve tedarik zinciri risk yönetimi açısından incelenmiştir. Ayrıca kaza sırasında oluşan alternatif senaryolar incelenmiş, tedarik zincirlerine etkileri belirlenmiş ve ileride ortaya çıkacak bu tür kazalara karşı önerilerde bulunulmuştur. Ayrıca çalışmanın sonuç bölümünde tedarik zinciri yaklaşımlarında getireceği değişikliklere yer verilmiştir.*

**Anahtar Kelimeler:** Süveyş Krizi, Süveyş Blokağı, Ever Given Kazası, Deniz Kazaları, Tedarik Zinciri Kesintileri

### **1. INTRODUCTION**

Due to the increase in global competition and the strengthening of consumers, the necessity of planning and managing the supply chain (SC) has emerged in order for businesses to be successful in competition (Weele, 2001: 250-253). Supply chain management is causing administering and controlling the entire flow of materials in a SC. It involves the transportation of materials from suppliers to various parts of the company and from these departments to distribution centers or ultimate consumers. The flow of materials in the SC is affected by any unexpected events that may disrupt the SC movement, also recognized as a potential risk (Mason-Jones and Towill, 1998: 17).

Supply chain risk (SCR); it can be defined as the probability of an error, damage or loss caused by unexpected events. (Zsidisin and Ritchie, 2009: 1; Waters, 2011). SCRs are also defined as realization of operational and financial outcomes negatively or differently than expected. These risks cause supply chain flows to be interrupted as a result of some unexpected events (Craighead et al. 2007: 52). This situation, which is called a SC break or interruption, can be defined as the occurrence of emergencies or disruptions in any link of the SC that will interrupt business continuity or the separation of SC members from the chain (Nooraie and Parast, 2015: 192). Nowadays, SC uncertainties and risks have increased due to

increased competition, the effect of globalization, variation of technological solutions and unrestricted customer prospects (Valinejad and Rahmani, 2018: 53; Abdel-Basset and Mohamed, 2020: 1) and has become a significant difficulty for managers of SC (Daultani et al. 2015: 5685; Helbing et al. 2006: 319).

Risks and uncertainties in the SC disrupt the operational efficiency of the SC and negatively affect the profits of the firms and their SC (Kumar et al. 2010: 3717). Therefore, managing SCR is a significant component of supply chain management (Garvey et al. 2015: 619). Managing these risks or disruptions is a significant task of supply chain management. Supply chain risk management (SCRM) is the fulfillment of strategies to administer risks throughout the SC, based on continuous risk assessment to decrease vulnerability and provide continuity (Ho et al. 2015: 5031). The purpose of SCRM is to designate potential sources of risk and fulfill appropriate actions to prevent SC vulnerability (Jüttner et al. 2003: 197; Hallikas et al. 2004: 47).

SCRs are generally separated to two groups as internal risks and external risks (Azevedo-Sa et al. 2021: 2). Internal risks can be separated to internal risks that can be controlled and partially controlled (Khojasteh, 2018: 98). External risks originate from outside the SC, and managers have little or no control over them. External risks in SCs can be separated to three types as externally controllable risks, external partially controllable risks and external uncontrollable risks (Wu, 2016: 350-365). One of the major SC external risks that have emerged recently and caused SC disruption has arisen during maritime transport. The ship named "The Ever Given" ran aground during its voyage on the Suez Canal on 23 March 2021, and this situation caused the maritime traffic to stop (Supply Chain Brain, 2021).

The blockage of the canal by the ship caused the SC to be disrupted. Nowadays, 90% of global trade is made by maritime transport and 12% of this trade passes through the Suez Canal, which has further increased the sensitivity of this situation (Schiffli and Valantasis, 2021). This cargo ship was caught in a sandstorm on the canal road and after the sandstorm it was caught, it got off course and hit the shore and got stuck in the canal. This event caused great economic losses. While the estimated daily damage of the incident to Egypt is estimated at 12-14 million dollars, the daily damage to global trade is estimated to be around 10 billion dollars (NTV, 2021).

The ship was rescued after six days (New York Times, 2021). However, in order for companies to work up resilient SCs, it is crucial that

they are able to correctly clarify SCR and interpret operations to meet these risks (Ambulkar et al. 2015: 111; Pettit et al. 2016: 24). This disruption in maritime transport and SC has resulted in some negative consequences such as the obligatory route change of sea vehicles, prolonged transportation periods, and the inability of the goods to reach the company and final consumers on time. The consequences of this situation are not limited to the losses experienced. Furthermore, it has revealed the need for changes in SC approaches. The purpose of this study is to assess this crisis in the Suez Canal, which is a striking case of the breakdown in SCs, in terms of SCRM, to discuss the effects of the risk, and to provide recommendations to SCs on how to meet the risks when such risks occur.

## **2. BACKGROUND**

### **2.1. Importance of the Suez Canal**

The opening of the Suez Canal is described a significant industrial revolution in the maritime field in the 19th century. The opening of this canal is an event affecting all maritime activities, including shipbuilding (Fletcher, 1958: 556). The canal, which was opened in 1869, further increased the value of Egypt and also shortened the colonial routes of India and the Far East. In addition, it caused Britain and France to pursue a more active policy on Egypt (Nevens, 2012).

The Suez Canal is also crucial as it is the first canal in the World. In order to create a new canal in maritime trade, it is necessary to know the existing canal that was previously built and successful. Another factor that makes the canal significant is that it is the shortest connection between west and east. The canal was created to stimulate world trade. It passes from the Mediterranean to the Gulf of Suez and the Red Sea by the tributaries of the Nile River (Suez Canal Authority, 2019). The characteristics of the Suez Canal, which is so important, are detailed in Table 1 below (Sabek, 1987):

The canal took 10 years to build and is 101 miles long. When the canal was built, it saved 7 to 10 days in terms of the transportation process to travel around Africa. At that time, it reduced the transport distance by about 7,000 km / 4,300 nautical miles. Nowadays, although the Suez Canal still maintains its significance, it supports almost 8% of the world's shipping traffic. The canal is defined as a very significant transport link, which greatly reduces shipping time and distance (Suez Canal Authority, 2017; Kaushik, 2020).

**Table 1:** The Characteristics of the Suez Canal

Overall length	192 kms
From port-said to Ismailia	78 km
From Ismailia to Port-Tewfik	84 km
Approach canals at the Port-Said and Suez	30 km
Breadth at Water Level	300/400 m.
Breadth between buoys	160/210 m.
Maximum permissible draughts of ships	53 ft.
Depth of the Canal	19.5/20 m
Cross sectional area	3,250 /4,800 m <sup>2</sup>
Length of by-passes	About 66.5 km.

Source: Reproduced from Sabek, 1987.

When the canal statistics are examined, a total of 18,174 ships with a weight of 1,139,629.000 gross tons passed through the canal in 2018, and the daily average of 2018 is 50 ships. (Suez Canal Authority, 2019). According to the data of 2019, the average number of ships passing through the Suez Canal per day is 52 and the annual value of the cargo transported is 9 billion dollars (Schiffing and Kanellos, 2021).

Marine accidents are not common in the Suez Canal. While the canal generally has a good security record. A total of 75 accidents occurred in the canal between 2010 and the end of 2019. More than a third of these accidents are related to container ships. Grounding accidents account for one third of the accidents in the canal in the last 10 years. Half of the accidents that occurred in the last ten years consist of collision, grounding and contact accidents (Allianz, 2021).

During the "Yom Kippur War" in the early 1970s, the Suez Canal was closed to ship traffic. Due to the closure of the canal to ships, ships that normally used the canal had to travel around the African Continent. This has increased the transport distance, in other words, the average distances (Donatus and Geraldine, 2012: 188). With the blockage in the Suez Canal, the question was raised what would happen if the canal was closed again. It has been argued that if the canal is closed, the greatest impact on the supply chain will be felt in the European market. Given the interconnected nature of global production and trade, closing the canal is likely to have a knock-on effect for the United States (Neuman and Northam, 2021).

## **2.2. Marine Accidents Causing a Supply Chain Disruption**

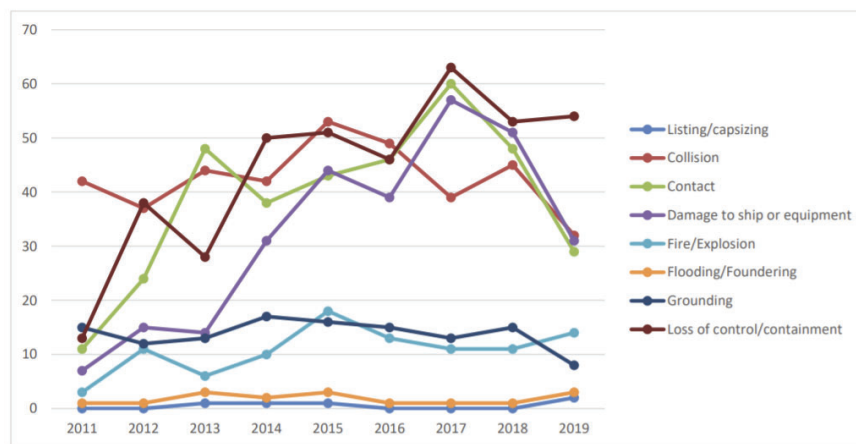
The maritime industry has witnessed many marine accidents that caused loss of life and property, caused environmental disasters and SC disruptions. In most of these marine accidents, many international regulations and rules have been implemented to inhibit recurrence of accidents, to ensure the safety of life and property and to prevent environmental disasters. Despite this, the risk of maritime accidents to occur still continues (Ringdahl, 2001). Accidents are defined as the loss of an individual, object or its environment as a result of an unlikely or involuntary event (Grabowski et al. 2010: 263; Kristiansen, 2013). There is no guarantee that the activities of the ships at sea will be completely safe and the risk of possible accident always continues (Gasparotti, 2010: 527).

The importance of marine accidents was first revealed with the Titanic shipwreck. It is crucial to determine the factors that cause the occurrence of accidents in order to receive preventive and protective measures against accidents (Soares and Teixeira, 2001: 299). This is called accident researches and highlights the importance of these researches (Schröder-Hinrichs et al. 2012: 151). In this part of the study, maritime accidents that occurred in the past and resulted in the grounding of the ship, such as “The Ever Given”, are examined together with the causes of the accidents.

### **2.2.1. History**

The accident that occurred in 1912 when the Titanic ship hit an iceberg in the North Atlantic is a turning point in terms of marine accidents. Exactly 100 years after the Titanic accident, the Costa Concordia accident occurred. This accident brought a different perspective to accident research. This ship also hit an iceberg, but the ship was saved from sinking due to being in shallow water. While evaluating the two accidents, there are significant differences between the two accidents in terms of technology, materials used in shipbuilding and technologies that support navigation. Despite all these differences, in both accidents, the hull structure was severely damaged as a result of the collision with an underwater object (Schröder-Hinrichs et al. 2012: 151). These two cases of accidents highlight the significance of accident researches and subsequent recommendations to the parties that similar accidents may occur in the future despite changing circumstances and conditions.

Container shipping of more than 90% of the world's non-bulk cargo transported by sea has increased the significance of container ships in the global supply chain. Marine accidents occur for many reasons. According to the report made with the European Maritime Accidents Information Platform (EMCIP) data covering the marine accidents between 2011 and 2019, the accidents that occur on the ships are given in Figure 1 below according to the types (European Maritime Safety Agency (EMSA), 2020) and then the cases of the types of grounding accidents in maritime transport have been examined respectively.



**Figure 1:** Accidents Occurring on Ships According to Accident Types from 2011 to 2019

Source: European Maritime Safety Agency (EMSA), 2020.

When examining the cases of marine accidents that resulted in the grounding of the ship, bulk carrier named "Csl Trimnes" ran aground on July 17, 2011. The cause of the accident was that the shift officer on the bridge fell asleep and the planned turn on the route could not be made. Technically, the reasons leading to the accident are not performing the bridge shift properly, not using the bridge navigational devices effectively, and the lack of communication on bridge resource management (Transport Malta, 2012: 8). This accident emphasizes the importance of safe navigation conditions and human factors in maritime transport.

The bulk carrier named "Eleftheria K" experienced an accident while passing through the Suez Canal on August 10, 2011. The reasons causing the accident are the violation of the pilotage rules in the Suez Canal, not having enough information about the rules of the Suez Canal crossing, and the inability of the draft values of the ship to pass through the Suez Canal (Panama Maritime Authority, 2012a). This accident



emphasizes the importance of having the necessary knowledge about the canals and critical areas during maritime transport and taking preventive measures in advance.

The bulk carrier "Robusto" ran aground at the entrance of the El Dekheila canal in Egypt November 22, 2016. The causes of the accident were the failure to implement the current voyage plan of the ship and the lack of communication on bridge resource management (Transport Malta, 2017: 18). While the bulk carrier named "Universal Durban" was sailing from Tasmania to Malaysia on May 13, 2017, the ship ran aground in the southern shallows of the island of Pulau Serasan. The reasons leading to the accident are the improper use of ECDIS equipped with an unsuitable scale electronic map during the cruise (Transport Malta, 2018: 14). The bulk carrier "Flash" ran aground off Tunisia on June 25, 2012. The reasons leading to the accident are the extreme tiredness of the shift officer, the absence of an additional guard on the bridge, and the watch officer being alone on the bridge (Transport Malta, 2013). This accident emphasized how dangerous it is to keep a single cruise watch during night travel and revealed that measures should be taken to prevent the shift officer from sleeping.

The bulk carrier "Smart" left the port in the presence of a pilot after loading from the port of Richards Bay in South Africa on August 17, 2013. In the following process, after the pilot captain left the ship, the Smart ship started to go off course gradually. The captain of the ship gave incorrect commands to correct the minor course deviations that occurred (Panama Maritime Authority, 2014: 4-7). This situation reduced the speed of the ship and caused it to continue deviating from course. As a result, the ship ran aground. The reasons leading to the accident can be listed as the departure of the pilot from the ship in the canal, the lack of communication on the bridge resource management, the maneuvering error by the ship's captain (Panama Maritime Authority, 2014: 42). The bulk carrier "Sst", after supplying fuel and provisions from Singapore on June 26, 2012, while continuing its voyage towards China, crashed into the Middle Rock region and as a result, ran aground (Panama Maritime Authority, 2012b: 4).

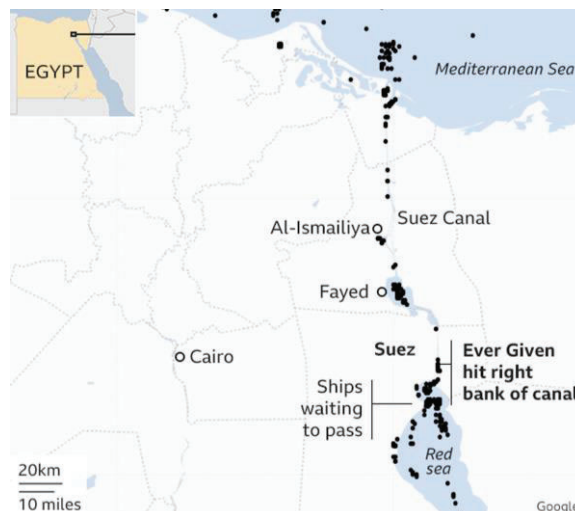
### **2.2.2. The Ever Given Accident**

The ship that caused the accident, Ever Given, is owned by a Japanese company managed by a German company. This ship is operated by a Taiwanese company and registered in Panama. The Taiwanese company that operates the ship is called Evergreen Marine, and the company has a total of 11 ships the size of Ever Given. The names of all these ships all begin with "Ever G" (Schmemmann, 2021). This ship, named



Ever Given, is 1,300 foot long and has a carrying capacity of 20,000 containers, usually 40 foot long (McCabe, 2021). Ever Given has the capacity to transport goods to be transported by 200 trains on a single journey, large enough to transport from China to Europe at once (Pascha, 2021). In fact, this shows why rail transport has a 1-2% share in China-Europe trade volume, while the share of maritime transport is more than 95% (Taube, 2020: 7).

This ship, which deviated from its route during an unexpected wind and dust storm on March 23, 2021 and settled on the beaches of the Suez Canal, stopped the marine traffic of the Suez Canal, one of the most vital shipping routes in the world. The ship was only able to be floated again after six days (Ankel, 2021). This congestion has led to both supply chain uncertainty and supply chain disruption (AlFadhli et al. 2021: 64). The first image of this blockage affecting the supply chain is shown in Figure 2 below (Marine Traffic, 2021):



**Figure 2:** The Ever Given Hit Right Bank of Canal

Source: Marine Traffic, 2021.

One of the causes of the accident is thought to be the increase in resistance when working in shallow water. This situation needs to be compensated by a drop in speed, which is also used to insure against grounding, which is the most common type of accident that occurs in the Suez Canal. It creates a ground junction with a low forward speed, which is structurally harmless to the ship. This has been highlighted by the Ever Given accident (Terziev et al. 2021: 2). It is necessary to continue the journey at low speed at points where waterways become bottlenecks and limit the amount of passing load (Suez Canal Authority, 2018).

Despite the ship's rescue, Egyptian officials reported that the ship named Ever Given would not leave the Suez Canal until \$1 billion in compensation was paid. The head of the Suez Canal Authority stated that the compensation would be compensated for the costs of the equipment and machinery used to clean the waterway and the damage caused by the dredging, as well as the wages of approximately 800 employees working to release the 200,000 tonne vessel. In addition, with the compensation to be received, costs arising from the blockage of the canal causing traffic congestion for more than 400 ships on both sides of the canal will also be reimbursed (Ankel, 2021). According to London-based financial firm Refinitiv, the Egyptian state lost 95 million dollars in transit fees due to the blockage (Malsin et al. 2021). The tenant of Ever Given's, Evergreen Marine Corp.'s president, declared that the company is "*not liable for cargo delays, the compensation will be covered by insurance*" (Wang, 2021). According to the statement of Evergreen Marine, the operator of the ship, the ship encountered a sudden strong wind about six nautical miles from the south end of the canal. This situation caused the ship's hull to deviate from its course and the ship accidentally ran aground (CIPS, 2021).

### **3. ALTERNATIVE SCENARIOS DURING THE BLOCKAGE**

Until the early 21<sup>st</sup> century, there was almost no alternative to the shortest sea route from Europe to the Asia-Pacific region and vice versa via the Suez Canal (Rusinov et al. 2021: 719). As the ship Ever Given, traveling from China to Rotterdam, was jammed diagonally along the canal, traffic on this canal was stopped in both directions and at first sight of the situation, it was in the opinion of rescuers that the situation could last for weeks (Sheppard et al. 2021). Alternative scenarios have been developed in which alternative ways the goods will be transported or unloaded and how the ship will be saved with the blockage of the canal. These scenarios are explained in detail below:

Logistics companies warned the companies about the delays of the goods. According to the statement made by the President of the Suez Canal Management one day after the date of the incident, he stated that the process could take weeks since the ship was too heavy to withdraw from its current location. He also suggested working in conjunction with a weight reduction by removing containers, water and oil from the ship, towing the ship, and digging sand. By all opinion, evacuation of the ship was seen as the worst case scenario. There is no port infrastructure in the Suez Canal. Another view regarding the rescue of the ship is that another ship must be brought in to transport the containers in a process that will take weeks or even months. The British Government has warned British companies about the delay of goods. Global shipping companies have

considered rerouting ships off the coast of Africa if the mega container ship blocking the canal fails to be rescued. It was emphasized that this guidance will result in increasing costs that will affect every sector all over the world. (Lojiport, 2021).

During the blockage of the Suez Canal, according to Lloyd's List's tracking data, there were more than 160 ships waiting at both ends of the canal. It has been suggested that another way of getting the goods during this period was to pass through the Horn of Africa. This will extend the journey for another seven days. It was unfortunate that the congestion in the canal occurred when things were just starting to improve, because the shortage of containers and the shortage of ships had just begun to overcome at that time. Firms were about to run out of stocks. The cost of shipping the squeezed raw materials and the cost of transporting them amounted to £16,000 (Russon and Smith, 2021).

Shipping companies are now evaluating their options, waiting in maritime traffic congestion will result in significant losses. However, wandering around Cape of Good Hope adds safety risks as well as a week or two travel time (Schiffing and Kanellos, 2021). Last year, due to a combination of overcapacity and falling fuel prices, some shippers made their shipments on the African route to avoid Suez Canal transit charges (Neuman and Northam, 2021).

Another transport is a shorter route along the North Pole, also known as the alternative Northeast Pass or North Sea Route or NSR. Thanks to global warming, the number of ships using this transport route has increased to several hundred. However, this route is still not practical by many transport companies. (Neuman and Northam, 2021). If the blockage continues, some of the suggestions are to transport replacement items by air or by rail for higher value items (Harper, 2021).

#### **4. THE EFFECTS OF THE SUEZ BLOCKAGE ON SUPPLY CHAINS**

The blockage of the channel has many impacts on the supply chain, such as the supply chain disruption caused by COVID-19 in world trade last year, as well as high rates of ship cancellations, container shortages, and trade volumes impacted by slower handling speeds at ports (Maguire and Tan, 2021). Supply chains are also more difficult when the accident occurred in a situation where demand for goods, whose supply was constrained by the coronavirus epidemic, increased sharply. During the period of the accident, while container carrying capacity was limited, there

was an increase in demand from both companies and consumers (Roberts, 2021). The negative effects of blockade are not limited to this. The effects of the ship named Ever Given on the supply chain due to the blockage caused in the Suez Canal are explained in belows:

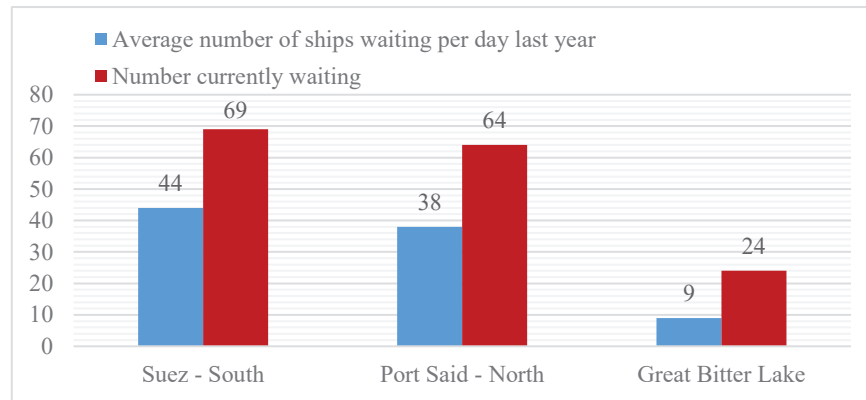
#### **4.1. Ripple Effect**

This ship named Ever Given, stranded, created a ripple effect in the supply chains. Despite the resumption of global trade, the effects of the situation still persist for global supply chains. Goods have begun to be unloaded at destination ports and suppliers are struggling to make up for deficiencies in essential materials that threaten the production and production of consumer goods (Segal, 2021). Furthermore, two days before Ever Given reopened, The Washington Post reported an increase in oil and African coffee bean prices due to famine fears. He warned that other commodities such as chemicals, apparel, iron ore and manufactured goods could also be affected. In addition, there is a real danger that the sudden increase in transportation costs will have knock-on effects on inflation. This is another fluctuation effect that will affect supply chains (Cogoport, 2021).

#### **4.2. Changing Transport Route and Increasing Transport Distance**

As the ship named Ever Given blocked the canal, there was a delay for the ships following it. As a result, sea carriers had to change their transport routes. The ships were diverted to the gateway around South Africa's Cape of Good Hope, which is an alternative to a longer route (TT Club, 2021). The change in the number of ships waiting in and around the Suez Canal is shown in Figure 3 (Harper, 2021):

For small volumes of freight, there has been a shift towards rail links between China and Europe in order to provide critical supplies. Travel times on rail routes from China via Kazakhstan or Mongolia to Russia and then to shipping hubs in Europe are typically 16-18 days compared to four weeks by sea and less than a week by air. There has been an increase in interest in rail transport between Europe and Asia (Saul and Aeppel, 2021). Travel times on rail routes from China via Kazakhstan or Mongolia to Russia and then to shipping hubs in Europe are typically 16-18 days compared to four weeks by sea and less than a week by air.



**Figure 3:** The Change in the Number of Ships Waiting in and around the Suez Canal (%)

Source: Harper, (2021).

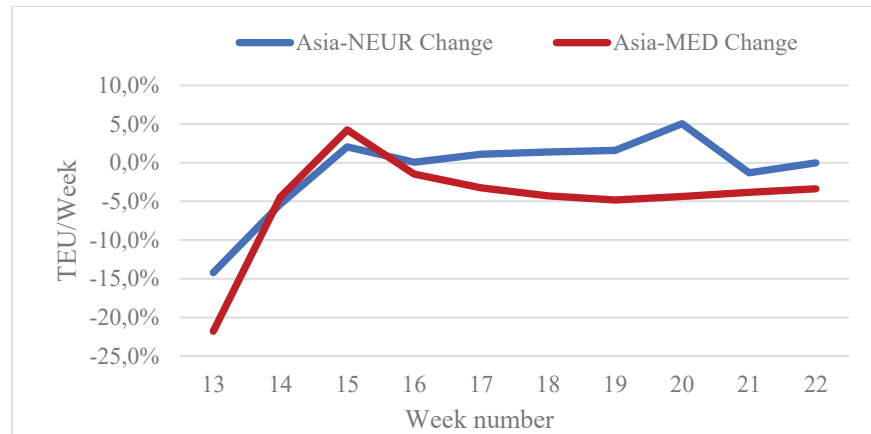
With the temporary closure of the Suez Canal during the blockage, both the queues of the waiting ships were tried to be cleared and the time taken for the shifting ships to reach their destination has increased. A capacity-reducing effect occurred in the global container shipping market, which was already overstretched before the blockage. Analysts expect the deepening supply-demand imbalance in container nests and equipment to resonate in the second quarter of 2021 (DHL, 2021).

The mega container ship Ever Given, stranded on the Suez Canal, prevented an estimated \$9.6 billion (£7 billion) of goods being transported per day, according to shipping data. The canal's westward sea traffic is approximately US \$5.1 billion per day, while daily marine traffic to the east is approximately US \$4.5 billion (Harper, 2021). Although the canal is now operating normally, there was a delay in transit of 300 ships during the blockage (TT Club, 2021). Moreover, increasing the transport distance causes additional fuel costs. Additional fuel charges for the trip usually range from \$30,000 to \$800,000 per day, depending on the ship and the length of the trip (Goodman and Reed, 2021).

#### 4.3. Transportation Capacity

The immediate impact of the Suez blockage is a 60% to 80% reduction in export capacity on Asia-Europe routes. This means that export cargoes in Europe must wait at least two weeks before transporting (Cogoport, 2021). Rerouting shipping around Africa will reduce global transport capacity by 6%. In some cases, this rate includes rerouting via Panama to the Asia-US East Coast. When this value is considered in terms of a nominal fleet equivalent, it is equal to the 1.48 million TEU capacity

of the global fleet. It has a capacity of 74 ultra-large 20,000 TEU container ships (Sea-Intelligence, 2021a). The graph in which the weekly shipping capacity change is considered cumulatively is given in Figure 5 below:



**Figure 5:** Cumulative Change in Weekly Capacity from Before to After Suez Blockage

Source: Reproduced from Sea-Intelligence, 2021b.

The figure shows this cumulative impact on Asia-North Europe (Asia NEUR) and Asia-Mediterranean (Asia MED). For Asia-Northern Europe, the effects are initially very quick to recover. For Asia-North Europe trade, there is an outlook for all effects to disappear in early June (Sea-Intelligence, 2021b).

#### 4.4. Wider Logistics Narrow Straits

Container shipping companies carrying products ranging from mobile phones to designer items have led to wider logistics bottlenecks, including the US's largest consumer market, with disruptions caused by the coronavirus outbreak for months and increased demand for retail products (Saul and Aeppel, 2021). The blockage resulted in the lowest ship schedule reliability of all time. It is estimated that the blockage of the Suez Canal has had the effect of reducing effective vessel capacity by about 15 to 25% in the Asia-Europe shipping trade lane, due to the longer distance for shifting ships to travel around Africa. A secondary effect was the further reduction of equipment capacity due to various delays. (DHL, 2021).

#### 4.5. Just in Time Issue

It turned out that just-in-time systems have serious disadvantages with Covid-19, and these systems caused serious supply chain disruptions

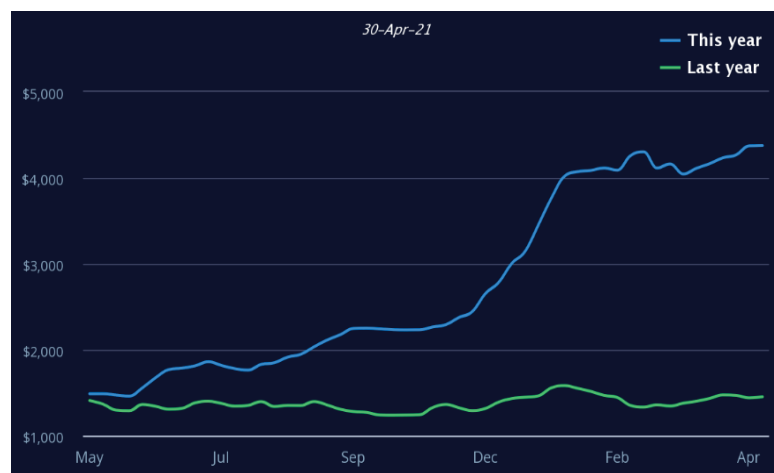
during the pandemic. According to the estimates of the insurance company Allianz, this problem created by just-in-time systems will reduce global growth by 1.4%. This corresponds to a loss of 230 billion dollars. Many companies are now looking for new alternatives to the just-in-time production approach. Neither the coronavirus nor the Suez Canal crisis is the last word to be caught in the wheel of global trade. The possibility that all the delayed ships arrive at the same time has revealed the problem of how the cargo will be handled (Deutsche Welle, 2021).

#### **4.6. Local Alternatives**

With the impact of the Covid-19 pandemic on global supply chains, the issue of local alternative suppliers has come up (SAM, 2020). Suez Blockage has once again emphasized the significance of this issue. In the short term, it is crucial that critical suppliers complete a first-tier assessment to determine if there are any suppliers in the affected area. Subsequently, making a decision to work with alternative suppliers in the unaffected regions of the world and to engage them to compensate for the delays of the suppliers in the affected region is critical in such cases (Segal, 2021).

#### **4.7. Container Shortages and Increase in Freight Rates**

Daily ocean container freight rates from Asia to Europe have been increasing from last year to this year (Boston and Nassauer, 2021). The change in freight rates between 2020-2021 before the Suez Blockage is shown in Figure 4 below (Freightos, 2021):



**Figure 4:** Change in Price per Container from 2020 to 2021

Source: Freightos, 2021.



In addition to the delay in the cargo delivery process of the ships affected by the blockage, this situation also affected the containers to be unloaded at the destination ports. With the blockage, the problem of empty container imbalance, which is the current problem in maritime transport, has worsened because the blockage has caused the loaded containers to be tied up. Hence, the availability of empty containers has deteriorated (TT Club, 2021).

Before the blockage, container shipping supply was already struggling to keep up with the epidemic change in consumer spending. As a result of the accident, there was a near-record increase in freight rates on the East-West trade routes, which is thought to be permanent (DHL, 2021). Container shipping companies have already been affected by disruptions caused by the coronavirus and increased demand for retail products. Furthermore, the blockage of the Suez Canal negatively affected them. The effects of this situation on the supply chain are expected to continue until the second half of this year (SCMP, 2021).

#### **4.8. Financial Consequences**

The suspension of voyages over the waterway has left shipping companies, including container lines, at millions of dollars extra costs that are not covered by insurance (Saul and Aeppel, 2021). The financial impact of a delay of two to four weeks due to the transport route is estimated to result in an extra cash cost of several million dollars (Neuman and Northam, 2021). The situation is expected to affect global trade as a trade cut of approximately \$40 billion (CIPS, 2021).

##### **4.8.1. Additional Costs for Consumers**

In the past decade, global trade has expanded further and with container ships that have doubled in size in the maritime industry. However, this made it difficult to transport them when they got stuck. The three-day wait as a result of the blockage causes a six-day delay in supply chain processes. The stranded ship is also delaying thousands of containers loaded with consumer products. Moreover, the empty containers required for export cannot be used. As a result of this crisis, there was an 80% increase in the ships waiting in and around the Suez Canal. Unfortunately, the high costs arising from the changes in the transportation route and the extension of the transportation distance will have to be reflected on the consumers (Harper, 2021).

The Suez Canal is 193 kilometers, or 120 miles long, and 13% of globally traded goods pass through this channel. The fact that the Suez Canal is the shortest route / route between Asia and Europe is one of the aspects that makes it important in terms of marine transportation. Supply chain interruptions that will occur here cause the world trade to be clicked (Deutsche Welle, 2021).

#### **4.8.2. Increase in Demurrage Charges**

Demurrage is the charge invoiced by the shipowners to the buyer when shipping is delayed. In fact, demurrage charges are thought to be the most likely mechanism to compensate for delays in the Suez Canal transition (Gupte and Buccioni, 2021).

The congestion in the canal undoubtedly affected the demurrage charges. Of course, this is not the only reason for this unpredictable channel blockage. The volatile global economic conditions, the sudden increase in imports and the increase in container shortages are other factors affecting the demurrage fee increase. Senders should avoid unnecessary free time charges. For this, it must preserve its profit margins and be strategic. However, before the blockade on the Suez Canal, the biggest problem in maritime transport was the shortage of empty containers in key locations (Magaya, 2021). Ever Given's holding the containers that needed to be emptied also negatively affected this problem.

#### **4.8.3. Increase in Insurance Premiums**

Another effect of the congestion in the canal is reflected in insurance premiums. The financial consequences of a prolonged blockage in the channel will first be borne by the owners and then passed to the insurers. This will eventually result in an increase in insurance premiums (Neuman and Northam, 2021).

#### **4.8.4. Increase in Oil Prices**

Blockage of the Suez Canal is an "external shock" that could cause an increase in oil prices due to a cut in supply or an increase in preventive demand. (Coleman, 2012: 318; Kilian, 2014:133). These shocks increase the volatility in the market during the crisis caused by the uncertainty and instability affecting the market (Zhang et al. 2009: 768). Since the increase in oil prices will directly affect supply chain costs, it will adversely affect supply chains.

#### **4.9. Theft and Security in Ports**

With the blockage, the problem of theft is encountered during handling and storage in ports and cargo warehouses, and the importance of security has increased even more (TT Club, 2021).

### **5. DISCUSSION AND CONCLUSION**

Global shipping accounts for 70% of international trade. Therefore, marine accidents are of great importance in global supply chains and supply chain risk management. The Suez Blockage caused by the ship named Ever Given has shed light on many problems both in global maritime transport and in global supply chains. The blockage not only highlighted the dependence of global trade and supply chains on mega-ships and continuous maritime shipping, but also demonstrated that any disruption to trade routes could significantly expose many organizations to business disruption risks (CIPS, 2021). In this study, the effects of Suez Block on global supply chains are examined.

The marine route congestion and the epic of Ever Given caused a significant disruption in supply chains. The accident caused fluctuations in the supply chain, transport routes changed, transport distances increased, resulting in increased lead times and shipping costs. The container shortage that existed before the blockage in maritime transport has been carried further and freight rates have also increased. Logistics bottlenecks have widened. There have been many financial impacts of the blockage on supply chains. These are additional costs to customers, an increase in demurrage charges and insurance premiums, an increase in oil prices, and security problems in ports. Moreover, it has once again been revealed that just-in-time systems, which have disadvantages due to Covid-19, cause many supply chain difficulties with the Suez Canal Blockage.

With the effects caused by the blockage, it has been understood how important supply chain risk management is for businesses and supply chains. Proactive implementation of risk management reduces the vulnerability of supply chains that arise in times of crisis. In order to ensure permanence throughout the supply chain, risk assessment studies should be carried out continuously and strategies to manage the identified risks should be implemented (Wieland and Wallenburg, 2012: 890).

With the Suez Canal blockage, new issues have emerged that need to be taken into account in supply chains. These are the necessity of turning the supply chains of businesses into agile supply chains that can rapidly

turn against unexpected risks in supply chains. Furthermore, there is a need for supply chains to be geographically dispersed and to invest more in data and technology (Segal, 2021).

If the Suez Blockage had not been experienced during an ongoing crisis in supply chains (Covid-19), the effects might have been slightly less severe. However, supply chain risks or disruptions that will occur after the blockage will also be affected by the effects of Covid-19 on the supply chain. Therefore, it would not be wrong to say that these effects will not be mild. Therefore, considering the effects of Suez Blockage on global supply chains, the following recommendations are made to businesses and their managers to mitigate the impact of risks:

- Firms should identify local alternatives for their suppliers. For this, it should create a list and act in accordance with this list in case of any risk. This situation is more important than the high cost to be incurred in times of crisis because lack of stock causes customer dissatisfaction and loss of customers and also stops production. It is critical in terms of production, especially in the supply of spare parts. Local stocks should be well monitored. Alternative suppliers and local inventory should be included in this plan.
- As alternatives are determined for suppliers, alternatives should also be developed for the transportation plan. All options for transporting the product should be evaluated and an alternative to the planned transportation should be determined and set out.
- A support inventory (shoring-up) should be kept in order to ensure financial flow in the supply chain and for businesses to continue their activities. The use of just-in-time systems should be reviewed.
- The effects of Suez Blockage highlight the importance of supply chain visibility as well as Covid-19 pandemic. Businesses need to engage in studies to increase their supply chain visibility. It is important to have quality and useful information for all suppliers for visibility.
- Supply chains need to be agile as well as flexible in order to cope with such problems. Real-time, fully integrated and digital supply chains are needed to minimize the impact of such events. This will also increase supply chain visibility.

- A handbook should be prepared for supply risks and the disruptions they will cause. When these risks occur, this book should be used. In addition, crisis plans must be produced and implemented. Consider how best to deal with business counterparties and potentially financial creditors, particularly where an event is contractual and / or leads to financial breaches or default.
- The contracts are an important issue in supply chains. It should be examined where the contracts are flexible and where the pressure points are. Expert advice should be sought regarding the options available for termination and suspension of contracts. While examining contracts, the existence of provisions that may excuse / exempt one or more parties from performance arising from the contract should be examined. Businesses should also identify the existence and consequences of other contractual terms that can provide flexibility and / or business assistance.

Supply chain risks such as Suez Channel Blockage will continue to cause significant disruptions to global supply chains unless a robust supply chain risk management program is in place. In order to prevent these disruptions or to avoid them with the least negative impact, the above suggestions should be taken into account.

## REFERENCES

- Abdel-Basset, M. and Mohamed, R. (2020). A novel plithogenic TOPSIS-CRITIC model for sustainable supply chain risk management. *Journal of Cleaner Production*, 247, 119586.
- AlFadhli, M.S., AlAli, M.S. and AlKulaib, H.A. (2021). The effect of Suez Canal blockage on crude oil prices: An event study analysis. *IOSR Journal of Business and Management (IOSR-JBM)*, 23(4), 64-66.
- Allianz. (2021). *The Suez Canal Blockage – Lessons to be Learned*. <https://www.agcs.allianz.com/news-and-insights/expert-risk-articles/suez-canal-lessons-learned.html>, Access Date: 26.04.2021.
- Ambulkar, S., Blackhurst, J. and Grawe, S. (2015). Firm's resilience to supply chain disruptions: Scale development and empirical examination. *Journal of Operations Management*, 33, 111–122.

Ankel, S. (2021). *Ever Given Ship Forbidden to Leave the Suez Canal until Its Owners Pay up to \$1 Billion in Compensation for the Chaos It Caused*. <https://www.businessinsider.com/ever-given-forbidden-leave-suez-canal-until-owners-pay-compensation-2021-4>, Access Date: 26.04.2021.

Azevedo-Sa, H., Zhao, H., Esterwood, C., Yang, X.J., Tilbury, D.M. and Robert Jr., L.P. (2021). How internal and external risks affect the relationships between trust and driver behavior in automated driving systems. *Transportation Research Part C: Emerging Technologies*, 123, 102973, 1-17.

Boston, W. and Nassauer, S. (2021). *Companies Consider Alternative Routes, Assess Costs as Suez Canal Blockage Continues*. <https://www.wsj.com/articles/companies-consider-alternative-routes-assess-costs-as-suez-canal-blockage-continues-11616693465>, Access Date: 02.05.2021.

CIPS. (2021). Suez Canal Blockage 'Could Have \$40bn Supply Chain Impact'. <https://www.cips.org/supply-management/news/2021/march/suez-canal-blockage-could-have-40bn-supply-chain-impact/>, Access Date 30.04.2021.

Cogoport, (2021). *Shipping Challenges Persist in 2021: From Covid-19 to Suez Canal Blockage*. <https://www.cogoport.com/blogs/shipping-challenges-persist-in-2021-from-covid-19-to-suez-canal-blockage>, Access Date: 03.05.2021.

Coleman, L. (2012). Explaining crude oil prices using fundamental measures. *Energy Policy*, 40, 318-324. <https://doi.org/10.1016/j.enpol.2011.10.012>

Craighead, C.W., Blackhurst, J., Rungtusanatham, M.J. and Handfield, R.B. (2007). The severity of supply chain disruptions: Design characteristics and mitigation capabilities. *Decision Sciences*, 38(1), 131-156.

Daultani, Y., Kumar, S., Vaidya, O.S. and Tiwari, M.K. (2015). A supply chain network equilibrium model for operational and opportunism risk mitigation. *International Journal of Production Research*, 53(18), 5685–5715.

Deutsche Welle. (2021). *Opinion: Suez Canal Blockage Reveals Globalization Bottlenecks*. <https://www.dw.com/en/opinion-suez-canal-blockage-reveals-globalization-bottlenecks/a-57040234>, Access Date: 19.04.2021.

DHL. (2021). Global Supply Chain Woes Deepen After Suez Canal Blockage. Retrieved from <https://lot.dhl.com/global-supply-chain-woes-deepen-after-suez-canal-blockage/>, Access Date: 30.04.2021.

Donatus, O. and Geraldine, O. (2012). An evaluation of Nigeria's seaborne trade and demand for sea transport. *European Journal of Business and Management*, 4(13), 187-195.

European Maritime Safety Agency (EMSA). (2020). *Safety Analysis of Data Reported in EMCIP - Analysis on Marine Casualties and Incidents involving Container Vessels*. <http://www.emsa.europa.eu/newsroom/latest-news/item/4276-safety-analysis-of-data-reported-in-emcip-analysis-on-marine-casualties-and-incidents-involving-container-vessels.html>, Access Date: 04.05.2021.

Fletcher, M.E. (1958). The Suez Canal and world shipping, 1869-1914. *The Journal of Economic History*, 18, 556-573. <https://doi.org/10.1017/S0022050700107740>

Freightos. (2021). *Freight Index*. <https://fbx.freightos.com/>, Access Date: 05.05.2021.

Garvey, M.D., Carnovale, S. and Yeniyurt, S. (2015). An analytical framework for supply network risk propagation: A Bayesian network approach. *European Journal of Operational Research*, 242(2), 618–627.

Gasparotti, C. (2010). Risk assessment of marine oil spills. *Environmental Engineering & Management Journal (EEMJ)*, 9(4), 527-534.

Goodman, P.S. and Reed, S. (2021). *With Suez Canal Blocked, Shippers Begin End Run Around a Trade Artery*. <https://www.nytimes.com/2021/03/26/business/suez-canal-blocked-ship.html>, Access Date: 03.05.2021.

Grabowski, M., You, Z., Song, H., Wang, H. and Merrick, J.R. (2010). Sailing on Friday: Developing the link between safety culture and performance in safety-critical systems. *IEEE Transactions on Systems, Man, and Cybernetics-Part A: Systems and Humans*, 40(2), 263-284.



Gupte, E. and Bucchioni, C. (2021). *Suez Canal Flows Could Resume Soon as Container Ship Partially Refloated: Sources*. <https://www.spglobal.com/platts/en/market-insights/latest-news/shipping/032421-suez-canal-blocked-ever-given-container-ship-maritime-trade>, Access Date: 03.05.2021.

Hallikas, J., Karvonen, I., Pulkkinen, U., Virolainen, V.M. and Tuominen, M. (2004). Risk management processes in supplier networks. *International Journal of Production Economics*, 90, 47-58

Harper, J. (2021). *Suez Blockage is Holding up \$9.6bn of Goods a Day*, *BBC News*. <https://www.bbc.com/news/business-56533250>, Access Date: 17.04.2021.

Helbing, D., Ammoser, H. and Kühnert, C. (2006). Disasters as Extreme Events and the Importance of Network Interactions for Disaster Response Management, in Alberverio, S. Jentsch, V. and Kantz, H. (Eds.), *Extreme Events in Nature and Society*, pp. 319–348. Berlin: Springer.

Ho, W., Zheng, T., Yildiz, H. and Talluri, S. (2015). Supply chain risk management: A literature review. *International Journal of Production Research*, 53(16), 5031–5069.

Jüttner, U., Peck, H. and Christopher, M. (2003). Supply chain risk management: outlining an agenda for future research. *International Journal of Logistics: Research and Applications*, 6(4), 197–210.

Kaushik, M. (2020). *A Brief Story of the Suez Canali Marine Insight*. <https://www.marineinsight.com/maritime-history/a-brief-history-of-the-suez-canal/>, Access Date: 07.04.2021.

Khojasteh, Y. (2018). Developing Supply Chain Risk Mitigation Strategies, in Khojasteh, Y. (Ed.), *Supply Chain Risk Management*, pp. 97-103. Singapore: Springer.

Kilian, L. (2014). Oil price shocks: Causes and consequences. *Annual Review of Resource Economics*, 6(1), 133-154. <https://doi.org/10.1146/annurev-resource-083013-114701>

Kristiansen, S. (2013). *Maritime Transportation: Safety Management and Risk Analysis*. UK:Routledge.

Kumar, S.K., Tiwari, M.K. and Babiceanu, R.F. (2010). Minimisation of supply chain cost with embedded risk using computational intelligence approaches. *International Journal of Production Research*, 48(13), 3717–3739.

Lojiport. (2021). *Evergreen Domino Etkisiyle Ekonomileri Vuracak*. <https://m.lojiport.com/evergreen-domino-etkisiyle-ekonomileri-vuracak-110154h.htm>, Accessed Date: 07.04.2021.

Magaya, (2021). *The State of Detention and Demurrage by Magaya*. [https://info.magaya.com/detention-and-demurrage-white-paper?utm\\_campaign=Demurrage+and+Detention+for+Freight+Forwarders+-+02/02/2021+11:55+AM&utm\\_source=linkedin&utm\\_medium=paid&hsa\\_acc=506501733&hsa\\_cam=605344844&hsa\\_grp=175620143&hsa\\_ad=126933073&hsa\\_net=linkedin&hsa\\_ver=3](https://info.magaya.com/detention-and-demurrage-white-paper?utm_campaign=Demurrage+and+Detention+for+Freight+Forwarders+-+02/02/2021+11:55+AM&utm_source=linkedin&utm_medium=paid&hsa_acc=506501733&hsa_cam=605344844&hsa_grp=175620143&hsa_ad=126933073&hsa_net=linkedin&hsa_ver=3), Access Date: 19.04.2021.

Maguire, G. and Tan, F. (2021). *Ship Stuck in Suez Like a “Beached Whale”, Firm Aiming to Free It Says*. <https://www.reuters.com/world/asia-pacific/low-tide-slows-work-clear-suez-ship-blockage-traffic-jam-builds-2021-03-25/>, Access Date: 30.04.2021.

Malsin, J., El-Fekki, A. and Faucon, B. (2021). *Suez Canal Has Reopened, but Ever Given Isn't Free to Go*. <https://www.wsj.com/articles/suez-canal-has-reopened-but-the-ever-given-is-stuck-again-11617898144>, Access Date: 26.04.2021.

Marine Traffic. (2021). *Canlı Harita*. [www.marinetraffic.com](http://www.marinetraffic.com), Access Date: 24.03.2021.

Mason-Jones, R. and Towill, D.R. (1998). Shrinking the supply chain uncertainty circle. *Control*, 24(7), 17–22.

McCabe, S. (2021). *For the Love of Canals*. <http://www.open-access.bcu.ac.uk/11487/1/For%20the%20Love%20of%20Canals.pdf>, Access Date: 26.04.2021.

Nevens, K. (2012). The youth are revolting. *Harvard International Review*, 34(2), 44-47.

New York Times. (2021). *With the Suez Canal Unblocked, the World's Commerce Resumes Its Course*. <https://www.nytimes.com/live/2021/03/29/world/suez-canal-stuck-ship> Access Date: 26.04.2021.

Neuman, S. and Northam, J. (2021). *How a Long Shutdown of the Suez Canal Might Have Roiled the Global Economy*. <https://www.npr.org/2021/03/26/981600153/heres-how-a-long-shutdown-of-the-suez-canal-might-roil-the-global-economy>, Access Date: 28.04.2021.

Nooraie, S.V. and Parast, M.M. (2015). A multi-objective approach to supply chain risk management: Integrating visibility with supply and demand risk. *International Journal of Production Economics*, 161, 192–200.

NTV. (2021). *Süveyş'te Sıkışan 'Ever Given' Gemisinin Faturası Mısır'ın İlk Kadın Kaptanına Kesildi*. [https://www.ntv.com.tr/dunya/suveyste-sikisan-ever-given-gemisinin-faturasi-misirin-ilk-kadin-kaptanina-kesildi,gK6-kYavUk-XO4INkW\\_5ZQ](https://www.ntv.com.tr/dunya/suveyste-sikisan-ever-given-gemisinin-faturasi-misirin-ilk-kadin-kaptanina-kesildi,gK6-kYavUk-XO4INkW_5ZQ), Accessed Date: 07.04.2021.

Panama Maritime Authority (PMA). (2012a). *Casualty investigation report grounding of Eleftheria K. (Report No: R-009-2012-DIAM)*. Panama: Panama Maritime Authority.

Panama Maritime Authority (PMA). (2012b). *Investigation report M/V SST. (Report No: R-003-2014-DIAM)*. Panama: Panama Maritime Authority.

Panama Maritime Authority (PMA). (2014). *Preliminary report on the investigation of the grounding of M/V Smart. (Report No: R-003-2014-DIAM)*. Panama : Panama Maritime Authority.

Pascha, W. (2021). *Duisburg and Its Port, Endpoint of China's Silk Road: Opportunities and Risks*. [http://ordnungspolitisches-portal.com/wp-content/uploads/2021/04/2021-1-Pascha-Port\\_of\\_duisburg.pdf](http://ordnungspolitisches-portal.com/wp-content/uploads/2021/04/2021-1-Pascha-Port_of_duisburg.pdf), Access Date: 26.04.2021.

Pettit, T.J., Simpson, N.C., Hancock, P.G., Clark, H., Haydel, T. and Pierce, J. (2016). Exploring operational resilience in the context of military aviation: Finding the right mode at the right time. *Journal of Business and Behavior Sciences*, 28(2), 24.

Ringdahl, L.H. (2001). *Safety Analysis*. New York: Taylor & Francis.

Roberts, T. (2021). *The Suez Crisis Has Put the Global Supply Chain in a More Difficult Situation*. <https://ieconomy.io/the-suez-crisis-has-put-the-global-supply-chain-in-a-more-difficult-situation/>, Access Date: 30.04.2021.

Rusinov, I., Gavrilova, I. and Sergeev, M. (2021). Features of Sea Freight through the Suez Canal. *Transportation Research Procedia*, 54, 719-725.

Russon M. and Smith, O. (2021). *Our Customers are Worried about the Suez Canal Blockage*, *BBC News*. <https://www.bbc.com/news/business-56541193>, Access Date: 16.04.2021.

Sabek, G. (1987). *Assessment of the impact from transporting radioactive materials in the Suez Canal (No. IAEA-R--4292-F)*. International Atomic Energy Agency.

SAM. (2020). *COVID-19 Sonrası Küresel Sistem: Eski Sorunlar, Yeni Trendler Raporu*. <http://sam.gov.tr/tr/wp-content/uploads/2020/04/sam-covid-kitap.pdf> Access Date: 04.05.2021.

Saul, J. and Aeppel, T. (2021). *Suez Canal Blockage Continues to Disrupt Global Trade, Hitting Supply Chains*. <https://www.insurancejournal.com/news/international/2021/04/09/609169.htm#:~:text=%E2%80%9CThe%20blockage%20of%20the%20Suez,Helmann%20Worldwide%20Logistics%2C%20told%20Reuters>, Access Date: 28.04.2021.

Schiffing, S. and Valantasis K.N. (2021). *Ship Happens: Ever Given and Forgotten*. <http://researchonline.ljmu.ac.uk/id/eprint/14747/3/Ship%20Happens%20Ever%20Given%20and%20Forgotten.pdf>, Access Date: 23.04.2021.

Schmemmann. (2021). *The Freeing of the Ever Given*. <https://www.nytimes.com/2021/04/01/opinion/ever-given-ship-suez-canal.html>, Access Date: 19.04.2021.

Schröder-Hinrichs, J.U., Hollnagel, E. and Baldauf, M. (2012). From Titanic to Costa Concordia - A century of lessons not learned. *WMU Journal of Maritime Affairs*, 11, 151-167.

SCMP. (2021). *Container Backlog, Global Supply Chain Disruption from Suez Canal Crisis Could Take Months to Clear*. <https://www.scmp.com/economy/global-economy/article/3128871/container-backlog-global-supply-chain-disruption-suez-canal>, Access Date: 30.04.2021.

Sea-Intelligence. (2021a). *Suez Blockage: 6% Global Capacity Reduction*. <https://www.sea-intelligence.com/press-room/59-suez-blockage-6-global-capacity-reduction>, Access Date: 03.05.2021.

Sea-Intelligence. (2021b). *Suez: Europe Ripples Gone 1st Week of June*. <https://www.sea-intelligence.com/press-room/62-suez-europe-ripples-gone-1st-week-of-june>, Access Date: 03.05.2021.

Segal, E. (2021). *Impact of Suez Canal Crisis on Companies around the World Could Last Weeks*. <https://www.forbes.com/sites/edwardsegal/2021/03/31/impact-of-suez-canal-crisis-on-companies-around-the-world-could-last-weeks/?sh=28c1e7a42d8d>, Access Date: 30.04.2021.

Sheppard D., Greeley, B. and Saleh, H. (2021). *Suez Canal Clearance Could Take 'Weeks', Says Salvage Company*. <https://www.ft.com/content/31dbe2b9-3ff2-4bcc-a3e3-813600caeb49>, Access Date: 30.04.2021.

Soares, C.G. and Teixeira, A.P. (2001). Risk assessment in maritime transportation. *Reliability Engineering & System Safety*, 74(3), 299-309.

Suez Canal Authority. (2017). *Suez Canal History*. <https://www.suezcanal.gov.eg/English/About/SuezCanal/Pages/CanalHistory.asp>, Access Date: 19.10.2017.

Suez Canal Authority. (2018). *Suez Canal traffic statistics*. Annual Report 2018.

Suez Canal Authority. (2019). *Suez Canal Navigation [Statistics]*. <https://www.suezcanal.gov.eg/English/Navigation/Pages/NavigationStatistics.aspx>, Access Date: 05.05.2021.

Supply Chain Brain. (2021). *Suez Canal Remains Blocked*. <https://www.supplychainbrain.com/articles/31024-coronavirus-watch-governments-rush-to-secure-ventilators>, Access Date: 26.04.2021.

Taube, M. (2020). The Global Economic Regime at a Critical Juncture – The “Belt & Road Initiative” as a Means to Leverage Chinese Interests, in: Noesselt, N. (Ed.), *China's New Silk Road Dreams, Berliner China-Hefte*, pp. 7-20. Zurich: Lit Verlag.

Terziev, M., Tezdogan, T. and Incecik, A. (2021). A numerical assessment of the scale effects of a ship advancing through restricted waters. *Ocean Engineering*, 229, 108972, 1-11.

Transport Malta. (2012). *Safety investigation report (Report No: 02/2012)*. Malta: Transport Malta.

Transport Malta. (2013). *Marine safety investigation report (Report No: 09/2013)*. Malta: Transport Malta.

Transport Malta. (2017). *Marine safety investigation report (Report No: 24/2017)*. Malta: Transport Malta.

Transport Malta. (2018). *Safety investigation report (Report No: 10/2018)*. Malta: Transport Malta.

TT Club. (2021). Suez Canal Blockage: Supply Chain Risks Assessed. <https://www.ttclub.com/news-and-resources/news/press-releases/2021/suez-canal-blockage-supply-chain-risks-assessed/>, Access Date: 28.04.2021.

Valinejad, F. and Rahmani, D. (2018). Sustainability risk management in the supply chain of telecommunication companies: A case study. *Journal of Cleaner Production*, 203, 53-67.

Wang, C. (2021). *Evergreen, Charterer of Ever Given, Says It's Not Responsible for Cargo Delays*. <https://www.bloomberg.com/news/articles/2021-04-01/charterer-says-it-s-not-responsible-for-ever-given-cargo-delays>, Access Date: 29.04.2021.

Waters, D. (2011). *Supply Chain Risk Management: Vulnerability and Resilience in Logistics*. Second ed. United Kingdom: Kogan Page.

Weele A.J.V. (2001). *Purchasing and Supply Chain Management: Analysis, Planning and Practice*. Toronto: Thomson Learning.

Wieland, A. and Wallenburg, C.M. (2012). Dealing with supply chain risks: Linking risk management practices and strategies to performance. *International Journal of Physical Distribution & Logistics Management*, 42(10), 887-905.

Wu, T., Blackhurst, J. and Chidambaram, V. (2006). A model for inbound supply risk analysis. *Computers in Industry*, 57, 350–365.

Zhang, X., Yu, L., Wang, S. and Lai, K.K. (2009). Estimating the impact of extreme events on crude oil price: An EMD-based event analysis method. *Energy Economics*, 31(5), 768-778. <https://doi.org/10.1016/j.eneco.2009.04.003>

Zsidisin, G.A. and Ritchie, B. (2009). Supply Chain Risk Management-Developments, Issues and Challenges, in Zsidisin, G.A., Ritchie, B. (Eds.),

*Supply Chain Risk: A Handbook of Assessment, Management, and Performance*, pp.1-12. Boston: Springer.