Opportunities for a Digital Transformation of the Global Supply Chains: Case Study of the Suez Canal Blockade

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***Abstract**. Supply chains (SC) are the heart of global trade. Shortening the routing distance, lower transport and distribution costs, the global connection between countries and partners, as well as worldwide customer supply, are just a few of the major advantages of the global supply chains. However, like every other global process, supply chains also face obstacles in their continuity. One of the recent, bigger disruptions (DISR) happened when the Ever Given container vessel got stranded in the Suez Canal causing a global blockade of the customer supply. A question arises if such an incident would have been prevented if there was less impact of a human hand and greater use of digital technology in the supply process itself. This paper aims to show how the usage of digital technologies can improve the quality and continuity of the supply chains, prevent disruptions such as the Suez Canal blockade and prove that digital transformation is the future of a high-quality distribution process.*

Keywords. Supply chains, Suez Canal blockade, digital transformation, digital technologies

1 Introduction

In the year 2020, the world faced a major crisis when the first patient of the COVID-19 virus was confirmed. The fast spread of the virus closed the world and stopped human activities such as education, healthcare, tourism, travel, production, trade and transportation. The COVID-19 measures had a significant impact on the global supply chains since the actors were connected all over the world.

Due to closures and disruptions in the supply chains, international trade has weakened but was still organized and performed. In March 2021, the supply chains faced another big crisis when the Suez Canal, one of the world's most important trading paths, got blocked by the container vessel Ever Given. This incident caused delivery delays, interruption of supply, production losses and higher costs of transportation, products and services.

Regarding such events, it is clear that supply chain disruptions cause a loss of up to half of an annual profit for an average company (Chupanova et al., 2021). Because such events are unpredictable and sudden, companies have to create, implement and use digital solutions to mitigate their impact on the business.

Digital technologies are being adopted in modern supply chains for product traceability, enabling data sharing amongst trading partners, quick availability of product data and end-to-end visibility of products (Syed et al., 2022). The most used technologies fall into the category of Internet of Things technologies which help to collect data and make it understandable thus minimizing the problems that may arise in supply chains. Looking back on recent events, it is important to support the logistics processes with the Internet of Things enabled technologies, especially in supply chains that are vulnerable to disruptions (Kazancoglu et al., 2022).

This paper aims to show how digital technologies can strengthen the processes and components of the supply chains so that they are more resistant to disruptions. For this purpose, the authors defined the following three research questions (RQ): (RQ1) Which disruptions occur in the supply chains?; (RQ2) Which technologies are most prevalent in the supply chains?; (RQ3) How can technologies strengthen the supply chains' resilience to disruptions?

Related to the mentioned, the paper consists of seven chapters. Apart from the introduction, the second chapter shows the methodology used to get the relevant information, the third chapter counts and explains the main disruptions that occur in the supply chains and the fourth chapter provides the recognized digital technologies and their impact on the disruptions in the supply chains. The following fifth chapter deals with the case study of the Ever Given vessel, together with the causes, impacts on the supply chains and technology solutions, while the sixth chapter is the discussion about the used and potential new technology in the supply chains. In the last, seventh, chapter of the paper, the authors state relevant conclusions, practical implications and research limitations.

2 Methodology

In order for the authors to get answers on the, initially set, three research questions, it was necessary to search relevant databases with the purpose of collecting secondary data for literature analysis. The research query was made in the Scopus and Web of Science (WoS) databases, and it included the keywords below: *("supply chain management" OR "supply chain") AND ("digital technologies" OR "digital transformation") AND ("disruption" OR "accidents")*. When defining a research query in WoS, no limitations were set, so all fields were covered by the search and the papers were classified according to the highest citation. Furthermore, when setting the research query in Scopus, the authors put a limitation on title-abstract-keywords, because without limitation, there was a larger set of papers (more than two thousand papers), which were not relevant to this research. As in WoS, the papers were sorted according to the highest citations. The search resulted in a total of 65 papers in Scopus and 38 papers in WoS. After the analysis of each paper, those unavailable and overlapping in the mentioned two databases were removed and ultimately, the literature review was based on the analysis of a total of 47 papers (43 papers from the Scopus and 4 from the WoS). With the detailed analysis of the mentioned papers, the authors tried to determine the answers to the RQ and thus contribute to the field of supply chain management (SCM), while looking at the impact of digital technologies and their significance in mitigating disruptions.

3 Disruptions in Supply Chain Management

In the last few years, incidents in the environment have shown a rather large impact on the usual functioning of the supply chain business. The common name of such incidents is disruptions and their unique features make a serious impact on processes, which leads to complexity and their spread through multiple stages in the supply chain, called the ripple effect (Ivanov & Dolgui, 2019; Lohmer et al., 2020; Paul & Chowdhury, 2020). In this research, disruptions in the supply chain are categorized into two key categories as follows in Figure 1: *external disruptions* and *internal disruptions*. By classification of disruptions, the authors answered the first research question (RQ1).

External disruptions are related to factors that are not under the organization’s control and appear suddenly in the supply chain. Natural disruption includes incidents such as fire, flood, earthquakes or tempests (Ivanov et al., 2018, 2019; Ivanov & Dolgui, 2019; Weber-Snyman, 2021). Economic and financial disruption presents devaluation and revaluation risk, exchange rate risk, crisis, stock market crash, inflation and stagflation, while legal disruption can be non-compliance with regulations, protests or political instability (Ali & Govindan, 2021; Moretto & Caniato, 2021). The external disruptions with the most significant impact are demand disruptions which are customer bankruptcy, imbalanced demand, price fluctuation, changing customer requirements as well as low data visibility about customers (Das et al., 2019; Ivanov et al., 2018; Paul & Chowdhury, 2020), and supply disruptions present supplier bankruptcy, price fluctuations, unstable quality and quantity of inputs (Ivanov et al., 2018), imbalanced supply, delivery risk and complex mix of product specification (Paul & Chowdhury, 2020). A pandemic disruption, whose impact has left an indelible mark on the entire supply chain, is Covid-19 and one of the most famous in the last twenty years was the Ebola pandemic.

Internal disruptions are related to factors that are under the organization’s control and they can be reduced or prevented. Information disruption presents a communication breakdown, while time disruption includes delays in processes and time bottlenecks. Inability to adapt to digital solutions presents digital and technology disruption. Logistics and transportation disruption imply risks such as delivery delays, packaging problems or automated vehicle accidents (Ali et al., 2021). Capacity and process disruption represents operational, infrastructural and human capabilities within the organization (Das et al., 2019).

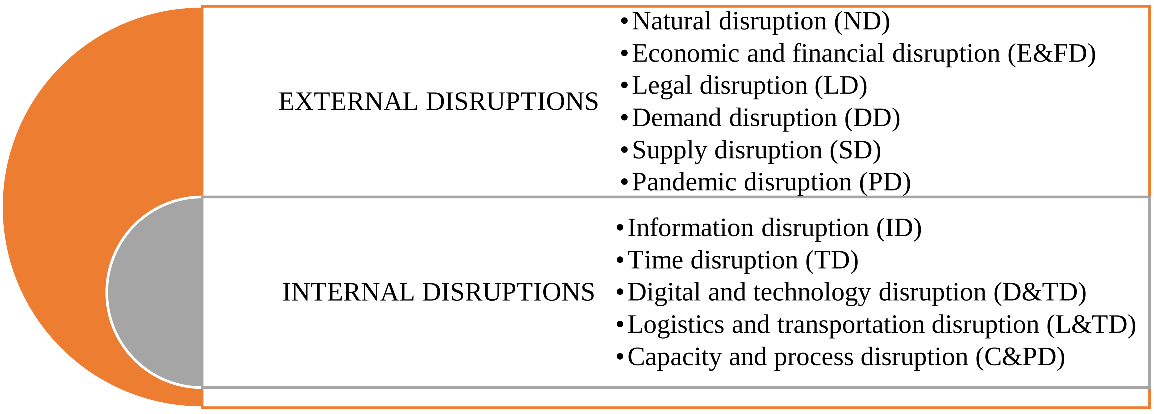

Figure 1. Identified disruptions in the supply chain

4 Digital Transformation and Supply Chain Management

The investigation process consisted of setting three research questions. In the first phase of the research, through literature analysis, the answer to the second research question (RQ2) was obtained: Which technologies are most prevalent in the supply chain? In the results in Table 1, the technologies represented in supply chain management are identified. The technologies are classified according to the authors' previous research (Hrustek et al., 2022). They are Big Data Analytics (BDA), Robotics and Autonomous Technology (R&AT), Internet of Things (IoT), Artificial Intelligence (AI), Blockchain (BC), Digital Twin (DT), Virtual and Augmented Reality (VR&AR), Cloud Computing (CC), Digital Platforms (DP), Social Media (SM), Cyber Physical System (CPS) and Mobile Technology (MT). Each of the mentioned technologies was recognized in the literature review and contributes to the efficient management of the supply chain.

Table 1. Recognized technologies per authors based on literature review

TECH	AUTHORS
BDA	(Afanasyev et al., 2019; Ali et al., 2021; Ali & Govindan, 2021; Butt, 2021; Chaouni Benabdellah et al., 2021; Chatterjee et al., 2021; Das et al., 2019; Haleem et al., 2022; Hopkins, 2021; Irfan et al., 2022; Ivanov, 2021; Ivanov et al., 2018, 2019; Kapoor et al., 2021; Martinelli et al., 2021; Menon & Shah, 2020; Obade & Gaya, 2021; Pyun & Rha, 2021; Rajesh, 2016; Reyes et al., 2021; Saleh & Awny, 2020; Shah et al., 2021; Tortorella et al., 2021)
R& AT	(Ali et al., 2021; Ali & Govindan, 2021; Butt, 2021; Chatterjee et al., 2021; Cozmiuc & Petrisor, 2018b; Fleury & Fleury, 2020; Hald & Coslugeanu, 2021; Haleem et al., 2022; Hopkins, 2021; Ivanov et al., 2018; Kapoor et al., 2021; Mavlutova et al., 2021; Obade & Gaya, 2021; Pyun & Rha, 2021; Reyes et al., 2021; Sajjad, 2021; Shah et al., 2021; Shaw & Chisholm, 2020; Sun & Zhao, 2018)
IoT	(Afanasyev et al., 2019; Ali et al., 2021; Ali & Govindan, 2021; Butt, 2021; Chaouni Benabdellah et al., 2021; Chatterjee et al., 2021; Cozmiuc & Petrisor, 2018b; Das et al., 2019; Dev et al., 2021; Fleury & Fleury, 2020; Hald & Coslugeanu, 2021; Haleem et al., 2022; Hopkins, 2021; Irfan et al., 2022; Ivanov et al., 2018, 2019; Ivanov, 2021; Kapoor et al., 2021; Kazancoglu et al., 2022; Mavlutova et al., 2021; Obade & Gaya, 2021; Pyun & Rha, 2021; Quayson et al., 2020; Rapaccini et al., 2020; Reyes et al., 2021; Sajjad, 2021; Santos et al., 2021; Sermuksnyte-Alesiuniene, 2021; Shah et al., 2021; Shaw & Chisholm, 2020; Sun & Zhao, 2018; Tortorella et al., 2021; Varriale et al., 2021),
AI	(Afanasyev et al., 2019; Belhadi et al., 2021; Chaouni Benabdellah et al., 2021; Chatterjee et al., 2021; Cozmiuc & Petrisor, 2018b; Hald & Coslugeanu, 2021; Haleem et al., 2022; Hopkins, 2021; Irfan et al., 2022; Ivanov et al., 2019; Ivanov, 2021; Kapoor et al., 2021; Mavlutova et al., 2021; Moretto & Caniato, 2021; Obade & Gaya, 2021; Reyes et al., 2021; Sajjad, 2021; Saleh & Awny, 2020; Serrano et al., 2021; Shaw & Chisholm, 2020; Sun & Zhao, 2018; Tortorella et al., 2021),
BC	(Afanasyev et al., 2019; Ali & Govindan, 2021; Chaouni Benabdellah et al., 2021; Chatterjee et al., 2021; El Idrissi et al., 2021; Hald & Coslugeanu, 2021; Haleem et al., 2022; Hopkins, 2021; Irfan et al., 2022; Ivanov, 2021; Ivanov et al., 2018, 2019; Lohmer et al., 2020; Mavlutova et al., 2021; Menon & Shah, 2020; Moretto & Caniato, 2021; Quayson et al., 2020; Rauniyar et al., 2022; Reyes et al., 2021; Sajjad, 2021; Saleh & Awny, 2020; Santos et al., 2021; Taghizadeh & Taghizadeh, 2021; Tortorella et al., 2021; Varriale et al., 2021; Zhang, 2021),
DT	(Afanasyev et al., 2019; Ivanov et al., 2019; Reyes et al., 2021; Serrano et al., 2021; Tortorella et al., 2021)
VR& AR	(Chaouni Benabdellah et al., 2021; Hald & Coslugeanu, 2021; Haleem et al., 2022; Hopkins, 2021; Pyun & Rha, 2021; Reyes et al., 2021; Sun & Zhao, 2018; Tortorella et al., 2021)
CC	(Ali et al., 2021; Ali & Govindan, 2021; Chaouni Benabdellah et al., 2021; Dev et al., 2021; Haleem et al., 2022; Martinelli et al., 2021; Menon & Shah, 2020; Reyes et al., 2021; Tortorella et al., 2021)
DP	(Irfan et al., 2022; Ivanov, 2021; Moretto & Caniato, 2021)
SM	(Hu, 2022; Sun & Zhao, 2018)
CPS	(Chaouni Benabdellah et al., 2021; Cozmiuc & Petrisor, 2018a; Tortorella et al., 2021)
MT	(Chatterjee et al., 2021; Martinelli et al., 2021)

The emergence of technologies, based on the literature review, is shown in Figure 2. The figure shows that there are leading technologies in the supply chain, namely the Internet of Things, Blockchain, Big Data Analytics, Artificial Intelligence, as well as Robotics and Autonomous Technology. The remaining technologies, such as Cloud Computing, Virtual and Augmented Reality, Digital Twin, Digital Platforms, Cyber Physical System, Mobile Technology and Social Media, appear less often in the analysed literature, which does not necessarily mean that they are not used to a greater extent, and their lower representation may be the result of the research query posed in the research.

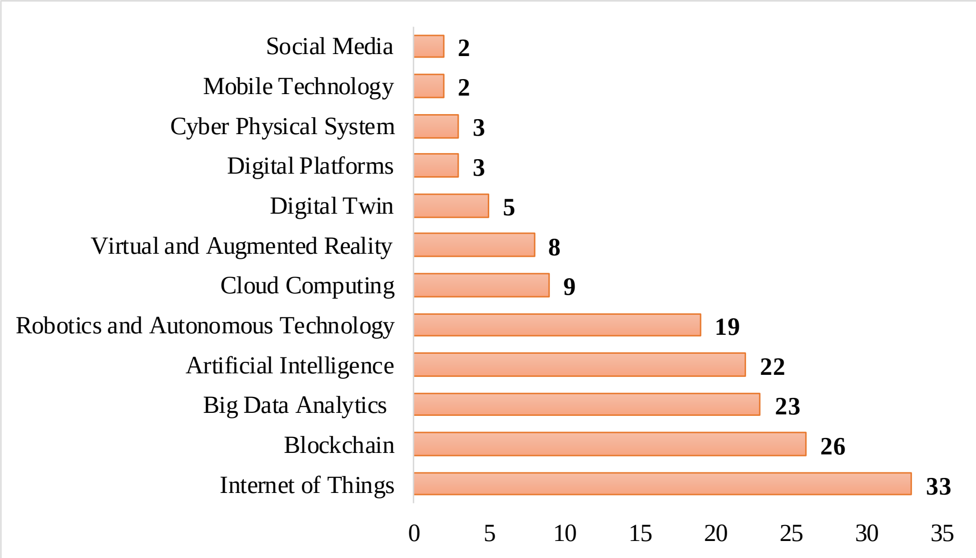

Figure 2. Emergence of technologies in the supply chain

Table two presents the answer to the third research question (RQ3) How can technologies strengthen the supply chains' resilience to disruptions? The table shows how each technology contributes to supply chain management and to which disruptions technologies can provide an adequate response and enable supply chain resilience. Also, it provides a connection between technologies and their impact on mitigating risk elements (RE) such as hazard (H), exposure (E) and vulnerability (V) (Cardona et al., 2012).

Table 2. Technologies' impact on disruptions in the supply chain

TECH	CONTRIBUTION IN SCM	DISR (RE)
SM	LinkedIn, Facebook, Instagram and YouTube are used to share information about products, services and for spreading electronic word-of-mouth communication. They strengthen cooperation between organizations in SC, focusing on information sharing and joint problem solving (Hu, 2022; Sun & Zhao, 2018).	DD (E); SD (E); PD (H); D&TD (V); L&TD (E/V); C&PD (V)
MT	Ease of installation and the ubiquity of mobile technology leads to the constant availability of information in the SC. The aforementioned technology is integrated with other systems within organizations in SC, which leads to monitoring, updating, comparison and access to information in SC from anywhere at any time (Chatterjee et al., 2021; Martinelli et al., 2021).	DD (E); SD (E); PD (H); D&TD (V); L&TD (E/V); C&PD (V)
CPS	They represent a system that unites computing entities with the physical world that are in an intensive relationship with its ongoing processes, providing and using, at the same time, data access and data processing. In the SC, such systems rely on digital technology integrated with production machinery, storage systems and transportation technology, and the characteristic of the relationship is the autonomous and intelligent exchange of information (Cozmiuc & Petrisor, 2018a; Ivanov et al., 2019; Tortorella et al., 2021).	DD (E); SD (E); ID (V); D&TD (V); L&TD (E/V); C&PD (V)
DP	The platforms represent a base for cooperation and connection of organizations with business partners in the SC. Such technology enables the SC to respond quickly to market changes and fluctuations, thus ensuring the long-term success of the SC. Optimizing the planning of production activities, the exchange of important business data that enables monitoring of current conditions, but also the simulation of future demand, support of business processes and transparency of operations, are the key advantages obtained from the use of such technologies (Das et al., 2019). Essentially, SC visibility is enabled by digital platforms (Ivanov et al., 2019), and they are crucial for the speed of data collection, analysis and knowledge creation (Irfan et al., 2022; Ivanov, 2021).	DD (E); SD (E); PD (H); ID (V); D&TD (V); L&TD (E/V); C&PD (V)

DT	A model that represents the network state of any moment in time and allows complete end-to-end SC visibility to improve resilience. It is used for complex analysis of SC risks, the development of contingency plans and efficient operational management. It supports the decision making process on the basis of data by mirroring the physical SC: transportation, inventory, demand and capacity data. Also, the simulation of the DT helps to forecast possible disruption propagation and quantify its impact and it can be transferred to the ERP system of business intelligence tool to analyse the performance impact of the disruption (Ivanov et al., 2019). DT can enable simulation and optimization methods in combination with Machine Learning, promote faster actions to reduce lead times, improve forecast accuracy, as well as promote demand forecasting, aggregate and inventory planning of the SC to be more reliable, efficient and quick (Serrano et al., 2021).	DD (E); PD (H); L&TD (E/V); C&PD (V)
VR& AR	VR enables interaction in the environment with a realistic effect in three-dimensional situations, using equipment with sensors that help to better understand the situation and make decisions, by providing a visual experience. AR describes the ability to integrate virtual 3D objects into the real environment, which helps to realize a real experience. SC recognizes the potential of this technology in training/education, product visualization and improved inventory management, while research and development are focused on the ability to create virtual work environments that enable meaningful interactions between colleagues, partners and customers, regardless of their physical location (Hopkins, 2021; Pyun & Rha, 2021).	ND (H); E&FD (H); LD (E); SD (E); ID (V); TD (E)
CC	CC refers to the use of a common master server to which all devices are connected, which allows the collection and creation of a common set of data for further processing. The joint application of technologies and CC enables connectivity of devices, data and information sharing, which requires minimal effort and limited investment. It offers optimization, predictive maintenance, real-time monitoring and customer profile data to support process adaptation sales and services (Ali et al., 2021; Ali & Govindan, 2021).	DD (E); SD (E); ID (V); TD (E); C&PD (V)
R& AT	Collaborative robots read product information from sensors and flexibly decide where to forward the identified product. The development of robots is focused on their independent learning, automatic execution of various actions and optimization of commoditized tasks, while the collected data gives the possibility of creating an ideal strategy for implementing the process (Ivanov et al., 2018; Sun & Zhao, 2018).	SD (E); ID (V); TD (E); C&PD (V)
AI	AI exploits data, expands it and enables research and analysis of it. It leads to the generation of new ideas within SC, evaluates innovative solutions, supports organizations in problem analysis and leads to rapid prototyping. SC, using the aforementioned technology, can easily process information, recognize key data for uninterrupted SC operations, and can learn from data with the aim of mitigating uncertain market conditions and ensuring SC resilience (Belhadi et al., 2021). Furthermore, AI improves SC efficiency by clearly understanding the interaction and contribution of each SC participant (Chaouni Benabdellah et al., 2021). In this way, AI provides greater precision, accuracy and speed of data collection (Sun & Zhao, 2018).	PD (H); ID (V); TD (E); C&PD (V)
BDA	It is based on the extraction of knowledge from a huge amount of data which facilitates data-driven decision-making, and in SCM it covers a wide scope of processes such as the formation of price optimization models, routing optimization, real-time traffic monitoring and proactive security management. Highlighted areas where BDA can contribute to the development of SC in the near future, include quality control in manufacturing, dynamic vehicle routing, in-transit inventory management in logistics/transportation, order picking and warehouse inventory control systems (Das et al., 2019; Haleem et al., 2022; Ivanov et al., 2018).	DD (E); SD (E); ID (V); TD (E); L&TD (E/V); C&PD (V)
BC	BC allows new solutions and creates rules to make the SC more intelligent, automated and efficient. BC is used to reduce delivery times, fasten the monitoring of goods and reduce of potential losses due to human error and unnecessary bureaucratic activities. It can improve productivity, reduce the time spent controlling processes and increase competitiveness in B2B organizations.	E&FD (H); DD (E); SD (E); ID (V); TD (E); D&TD (V)

	A BC based SC includes traceability (locates real-time movements of goods in the SC), immutability (enables secure transaction validation, purity verification, and authenticity), compliance (used to create applications that address compliance and responsibility) and sustainability (reduces product retraction, charges carbon tax, cultivates behaviour and improves the efficiency of emission trading blueprint) (Zhang, 2021). BC enhances transparency and visibility through the network, providing a secure connection between various databases and systems (Varriale et al., 2021).	
IoT	Additive manufacturing is the process of making three-dimensional products. Its application in SC is visible in the production of spare parts in logistics, which contributes to increased production flexibility, shorter delivery times, increased product individualization and reduced inventory. The tracking and tracing systems aim at the timely identification of disruptions, the analysis of deviations and the danger of disruptions that have occurred or may be caused, as well as the elaboration of control actions for recovery in the SC. Combined with radio-frequency identification and mobile devices, they are used to provide up-to-date information on process performance (Das et al., 2019; Ivanov et al., 2018).	ND (H); DD (E); SD (E); ID (V); L&TD (E/V); C&PD (V)

In the continuation of the paper, the most represented technologies and their impact on mitigating disruptions will be presented. The Internet of Things can be an adequate response to natural disruption, demand disruption, supply disruption, information disruption, logistics and transportation disruption, as well as capacity and process disruption. Economic and financial disruption, demand disruption, supply disruption, information disruption, time disruption, digital and technological disruption can be managed by Blockchain. Big Data Analytics finds a functional application in solving the following disruptions – demand disruption, supply disruption, information disruption, logistics and transportation disruption, as well as capacity and process disruption. Furthermore, the application of Artificial Intelligence mitigates the effects of pandemic disruption, information disruption, time disruption, capacity and process disruption. Also, supply disruption, information disruption, time disruption, capacity and process disruption, are covered through Robotics and Autonomous Technology.

In the next chapter, a case study of Ever Given, the largest overseas container vessel, will be presented, with an emphasis on technologies that could have prevented or mitigated the consequences of the incident known as the Suez Canal Blockade.

5 Case Study of the Suez Canal Blockade

World waterways play an important role in the global trade and shipping industry. One of the biggest and most important artificially dug waterways is the Suez Canal in Egypt, which divides the African from the Asian continent and connects the Mediterranean Sea with the Red Sea. The Canal itself is about 120 miles long and 105 meters wide, with a usage capacity of up to 19.000 ships with a net tonnage of 1.17 billion tons. All this indicates that the Suez Canal plays a crucial role in connecting the eastern and western world, as well as enabling the transport of natural gas, cargo and oil (Lee & Wong, 2021).

On the 23rd March 2021, a large container vessel named Ever Given sailed from Malaysia to the Netherlands through the Canal. The 400 meters long, weighing 20.000 tons and capable to carry around 20.000 containers, the Ever Given is one of the largest cargo vessels in the world. Although it has crossed the Suez Canal many times before, the huge vessel got stuck at the southern end of it, causing a blockade, as well as major and critical disruptions in the global supply chains.

Some of the problems that have arisen are the sudden stops of maritime transport for other vessels, which then had to find alternate routes to deliver the cargo. One of the alternative routes was the Cape of Good Hope in Africa which added several days of travel and millions of dollars in costs for services. Also, delays, congestions at terminal berths and shipyards increased the bottleneck effect in the logistics chain (How Ever Given Has Shaped the Future for Shipping Canals - Ship Technology Global, 2021). Over 300 ships, container vessels and bulk carriers were unable to use the Canal for six to seven days and the cost of disturbing the global markets was around billions of dollars (Coles, 2021). Regarding other consequences, the producers in China faced a shortage of empty containers to ship their goods, manufacturers around Europe and USA did not receive goods, components and materials for their production processes (Smet, 2021), the insurance companies suffered losses since they had to compensate victims (companies, customers, vessels) and law firms were dealing with expensive lawsuits regarding cargo interests (Lee & Wong, 2021).

Over the past months, many opinions have arisen about the reasons for the incident. One of the most likely reasons for the blockade is the weather conditions, e.g. wind and sand storms because sudden changes in the wind speed and direction make it difficult to manoeuvre vessels (Nikkanen, 2021).

Another reason for the crisis is the size of the container vessels because they are hard to shift once stuck (McLoughlin, 2021). Authors have also considered human errors, cyberattacks and lack of appropriate digital technology as possible causes of the blockade (Lee & Wong, 2021; Moulds, 2021). From the above, the authors identified three disruptions: natural, capacity and process, as well as digital and technology.

The use of outdated digital technologies could have had a significant impact on the incident. Standard used technologies in today's vessels are divided into four groups: IT bridge systems (radars, GPS, VDRs, ECDIS, AIS), communication systems (RF communication, satellite communication, integrated communication system, WLANs, voice over Internet Protocol), cargo systems (water ingress alarm, level indication, CCTV network, container- sensing system, on-board loading computers) and operational tech systems (power management, engine governor, emergency response) (Chan et al., 2021). Also, modern technologies such as Machine Learning (which is used for scheduling at ports and optimization of shipping patterns) and Blockchain (Coles, 2021) are used to control and manage the shipping process.

Although those technologies provide adequate support during the transportation process, they are still insufficient when crossing critical points such as the Suez Canal. In those situations, the use of modern, detailed and precise technologies would assure a secure and efficient passage of the vessels. Regarding the mentioned, some of the technologies which should be integrated into the logistics process are Artificial Intelligence (with wider use of Machine Learning), Digital Twins and Big Data Analytics. These technologies were already identified in Table 2, and can support functionalities such as weather quality measurement, simulation modelling, lean manufacturing and product optimization, container automation, as well as diagnostic tools and risk-based scheduling.

6 Discussion

Although IoT, BC, BDA, AI, and R&AT are recognized as the most represented, it is evident from the results that the remaining technologies for which less representation was determined, in accordance with the research query (SM, MT, DP, etc.), reduce the impact of the disruption on the SC. The use of specific technologies is related to the digital maturity of organizations, which implies their focus on the ability to apply technologies in a collaborative network, while dealing with disruptions. Problems caused by disruptions are reflected on all SC stakeholders through a ripple effect, and in order to keep it under control, it is necessary to transfer the digital culture to the entire supply chain. Finally, if digital technologies were more prevalent in maritime transport, incidents such as the blockade of the Suez Canal could be prevented on time.

7 Conclusion

Unpredictable disasters, such as health crises or wars, cause disruptions in supply chain management, and disruptions need to be responded to as early as possible. Organizations react differently to disruptions in supply chains, and digital technologies are of great help in this. Research results show that the opportunity to respond to disruptions is recognized in different digital technologies such as the Internet of Things, Blockchain, Big Data Analytics, Artificial Intelligence, Robotics and Autonomous Technology. Each of the mentioned technologies can provide resistance to disruptions based on their functionalities.

The importance of technologies is recognized in the analysed case study of the Ever Given vessel, but also in the pandemic crisis. In such cases, digital technology can help to predict the possible negative outcomes and reduce, as well as prevent their impact on the organization's business and the resilience of the SC.

This article provides several practical implications. First, a list of disruptions was identified and shows the organizations' possible threats for which they have to be prepared. Second, the authors identified which technologies can mitigate the negative impacts of the disruptions. Third, and last, the case study of the Ever Given vessel shows that the transport process of every supply chain is exposed to critical points such as the Suez Canal and digital technologies might be useful support in maritime transport.

In the very end, the authors agree there are some limitations of this research. Such defined research query has maybe excluded some relevant papers, whereby the frequency of technologies used in SC could be differently distributed. Also, the authors' recommendations are limited only to maritime transport since it was the main subject of this paper. Finally, there could be a different technology classification than the one mentioned in this paper, so the final results could be different from the ones the authors recognized.

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