The Ripple Effect of COVID-19
on the 2021 Global Supply Chain

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Abstract

Supply chains have a long history of resiliency, mostly with minor issues. The pandemic of 2020-21 and a series of other events during 2021 have opened the eyes of many supply chain managers, to the point where they are rethinking their supply chains. It started in early 2020 with COVID shutting down factories and shipping organizations world-wide. We saw, for example, issues with active pharmaceutical ingredients (APIs) used to make drugs in the United States, finding that over 80% come from China and India and 97 percent of all antibiotics in the United States come from China. With this shut down for a period of time in 2020, the US came close to disaster in the drug industry. But 2021 saw even more problems with the ship Even Given stuck in the Suez Canal for over a week, blocking all ship traffic and causing major supply chain disruptions around the world. And now, in late 2021 with the rise of the Delta variant, ports world-wide are having issues importing and exporting, mostly because they can't get enough workers to handle the load. As of this writing, the southern ports of California, Los Angeles and Long Beach have 88 ships waiting offshore to unload. In contrast, prior to 2020 there would be one ship at most waiting offshore. And now, Costco and Home Depot have made dramatic changes in their supply chain, renting multiple cargo ships to have tighter control over the goods they import from China. With all of these issues and more, this paper provides and in-depth look at what is happening to world-wide shipping today.

Keywords *COVID-19, Supply-chain management, Ship Backlog, Dynamic capabilities, Sustainability, Environmental uncertainty, Suez Canal, Ever Given, Delta variant, Supply chain capabilities.*

1. Introduction

Thousands of professors, including myself have taught supply chain classes for years. We cover all the basics like big data and how we can use analysis to better our supply chain. We also talk about things like Data-Driven supply chains, transforming supply chains, integrated and intelligent supply chains, and overall supply chain frameworks. Often, we will get into supply chain levers and the impact on Sell, Make, Move and Buy. We can also look at roadmaps and what-if scenarios, for example as gas prices rise should we re-open a previously closed well? All of these (and more) considerations form our supply chain strategy and may ultimately lead organizational change. We can even look at some new trends such as predictive supply chains. Amazon for example is working on a plan to ship products to customers even before they purchase them! Having recently gained a patent for "anticipatory shipping", Amazon is using big data and predictive analytics to pre-ship to customers. Finally, we often touch on supply chain bottlenecks and how we might avoid them, but rarely do we go in-depth in this area.

In our 2019 study (Lindoo & Deranek) we demonstrated that supply chains have become the most critical piece of modern-day business. We also explained that in the past two decades, many businesses especially the Fortune 1000 have outsourced elements of their supply chain to overseas interests. And, because of the COVID-19 pandemic these companies now have a realization that their supply chains are quite vulnerable. For example, Amaro (2018) explained that some 10,000 trucks cross the English Channel to and from Calais France to Dover England every day. This is basically the lifeline of the UK island. But when COVID-19 swept through countries during 2020, traffic across the English Channel came to a halt when both Brittan and France closed the ports just before Christmas to prevent the spread of COVID. This stranded some 8-10 thousand truckers on both sides of the channel for several days. While the blockade lasted just a few days, it could have been much worse, and did prompt fears of food shortages in the U.K.

Image 1. Airial view shows lines of freight truckers waiting near Dover England as the port is closed. William Edwards/AFP/Getty Images

And much like the trucking situation in the UK, Chinese restrictions to control a spike in COVID infections have severely curtailed cargo operations at several airports, reducing crew availability while forcing airlines to cancel hundreds of flights. Kulisch (2021a) found that for the fall rush of 2021, long-haul aircraft rates will be near $20 per kilogram, making air transportation five or six time more expensive that normal. This can have a major impact on one's supply chain because, depending on your product you may have to double, triple or more the price to make up for the cost of air freight. And with that come the potential loss of customers, to the point that it could put some companies out of business.

According to Kulisch (2021a), the most current data shows that 531 flights or 43% of the daily total were canceled from Beijing and that airlines cut 408 flights at the Shanghai International Airport, or about 43% of their daily total. But it didn't stop there as two-thirds of flights from Xiamen were cancelled, and at this time Sunan Shuofang International Airport is not accepting import cargo. Because the airport serves the cities of Wuxi and Suzhou in the southern Jiangsu province, this is having a major impact on the supply chains of businesses in those cities and throughout the region.

As Kulisch (2021a) pointed out, the mass cancellation of cargo flights in China is the just the latest in a series of supply chain disruptions this year that include a large container ship getting stuck in the Suez Canal for six days, a partial COVID lockdown of the Yantian terminal in the Port of Shenzhen for nearly a month which caused shipping delays around the world, and wildfires in British Columbia that halted intermodal rail traffic to and from the Port of Vancouver, a devastating hurricane in the Gulf of Mexico that halted oil production, and now an outbreak of the Delta variant of COVID which has severely backed up the Port of Los Angeles. And if all this wasn't enough. Another constraint was placed trade this fall when the U.S. Department of Transportation on Aug. 1 reinstated a 150-flight annual quota on charter flights from China's two primary economic zones.

Image 2. A three-week shutdown of Shenzhen's Yantian Port ended a month ago, but now there's a massive backlog of goods awaiting export. Photo: Martin Chan, scmp.com

Global Port Congestion

Regarding the Port of Los Angeles, which is one of the world's busiest container ports, there is now a heightened concern that the rapid spread of the delta variant will bring on a repeat of last year's shipping issues. As Deaux et al. (2021) pointed out the port, which saw its volumes dip in June because of a COVID outbreak at the Yantian port in China, is now looking at another potential decline because of the most recent closing of the Ningbo-Zhoushan port in China. The shutdown at Ningbo-Zhoushan has raised fears that ports around the world will soon face the same kind of outbreaks and Covid restrictions that all but shut down everything from perishable food to electronics last year as the pandemic took hold. Infections are threatening to spread at docks just as the world's shipping system is struggling to handle unprecedented demand with economies reopening and manufacturing picking up.

As of August 12, 2021, there were 28 container ships anchored outside the Ningbo-Zhoushan port, waiting for berth space, according to Deaux et al. (2021). And this is on top of the fact that port calls to Ningbo have dropped to less than 60 ships per week, which is a 70% decline for their usual 200 container vessels. While all of this is obviously affecting

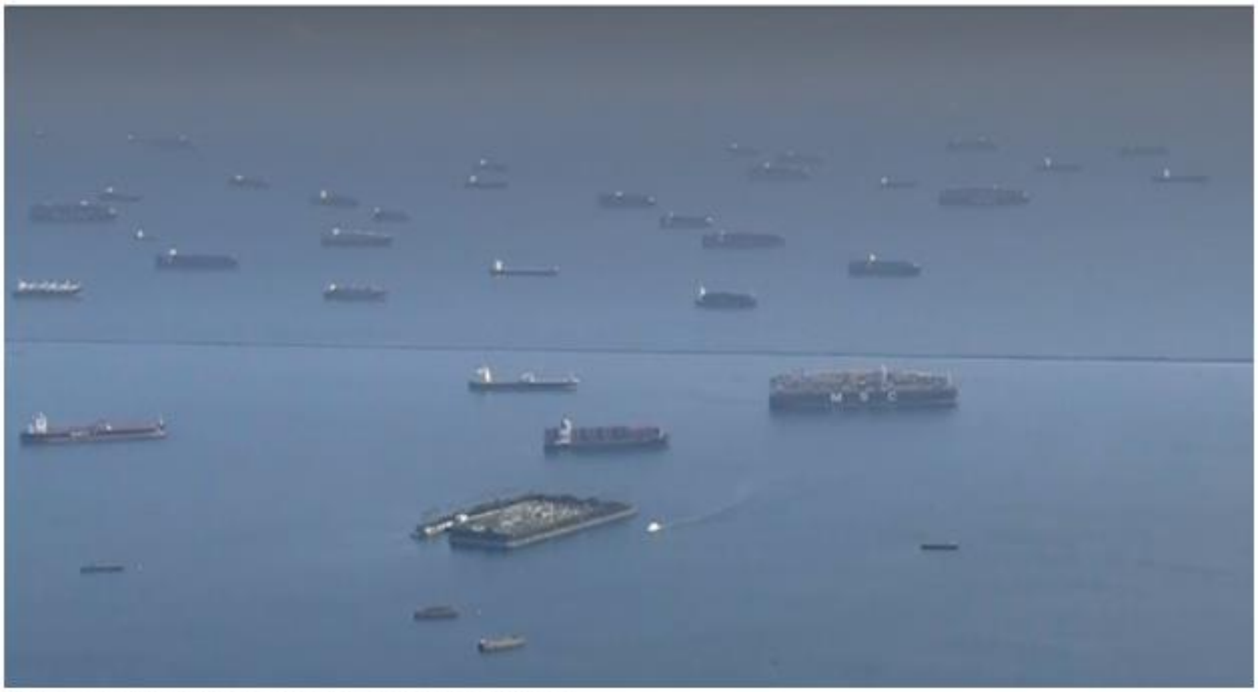

Image 3. 88 ships waiting offshore of Los Angeles

business around the world, it also has an impact on countries, like Peru which is one of China largest trading partners in crops. Pundits do agree, however that the China port shutdown may further fuel increases in freight rates, which have been rising as the shipping industry grapples with bottlenecks during the virus pandemic.

Shipping has become so volatile that many companies chartering ships are now adding COVID contract clauses as insurance so that they won't have to pay for stranded ships.

While the backup of 28 ships at the Ningbo port seems high, as of August 30th, 44 freight ships were stuck awaiting entry into California's two largest ports, according to Business Insider (2021a). But just a month later, that count had risen to 88 (Olsen, 2021), ships carrying over 500,000 (CBSLA, 2021) containers waiting offshore and as of October 1, 2021 there were 154 ships waiting to load export cargo off Shanghai and Ningbo in China, with a total of 242 waiting nationwide (Miller, 2021b). While this is certainly bad news for U.S. importers, it could temporarily lighten the pressure on the California ports. The backup is a result of the labor shortage, COVID-19-related disruptions, and holiday-buying surges (Tayeb, 2021). Port of Los Angeles data indicated that the ships' average wait time had increased to 7.6 days. But to paint a picture of the severity of this, the normal number of container ships anchored offshore at these ports is between zero and one! And because the ports in Los Angeles and LongBeach account for about one-third of US imports, they are the primary source of imports from China. While writing this paper, the author was personally on flight from Mexico to San Francisco and flew right over this backlog, witnessing firsthand the pile of ships dotting the waters off the coast of California. With little margin for error, ports have been unable to handle the sudden deluge of containers, and a big part of the problem, as pointed out by Business triple the size of what they were 10 or 15 years ago, and so they take longer to unload. But it's not only the unloading process as you now need more trucks, more trains, and more warehouses to put the cargo. And of course, while the container ships are forced to anchor and await berth space, companies importing and exporting goods to and from Asia expect additional shipping delays. This comes during one of the busiest months for US-China trade relations, as retailers buy ahead in anticipation of US holidays and China's Golden Week in October, according to Business Insider (2021a). As a real-life example of the kinds of challenges shipping companies are facing, one was recently denied entry into China because a crew member tested positive for COVID, forcing the vessel to return to Indonesia and change the entire crew before continuing. Overall, the voyage was delayed by two months.

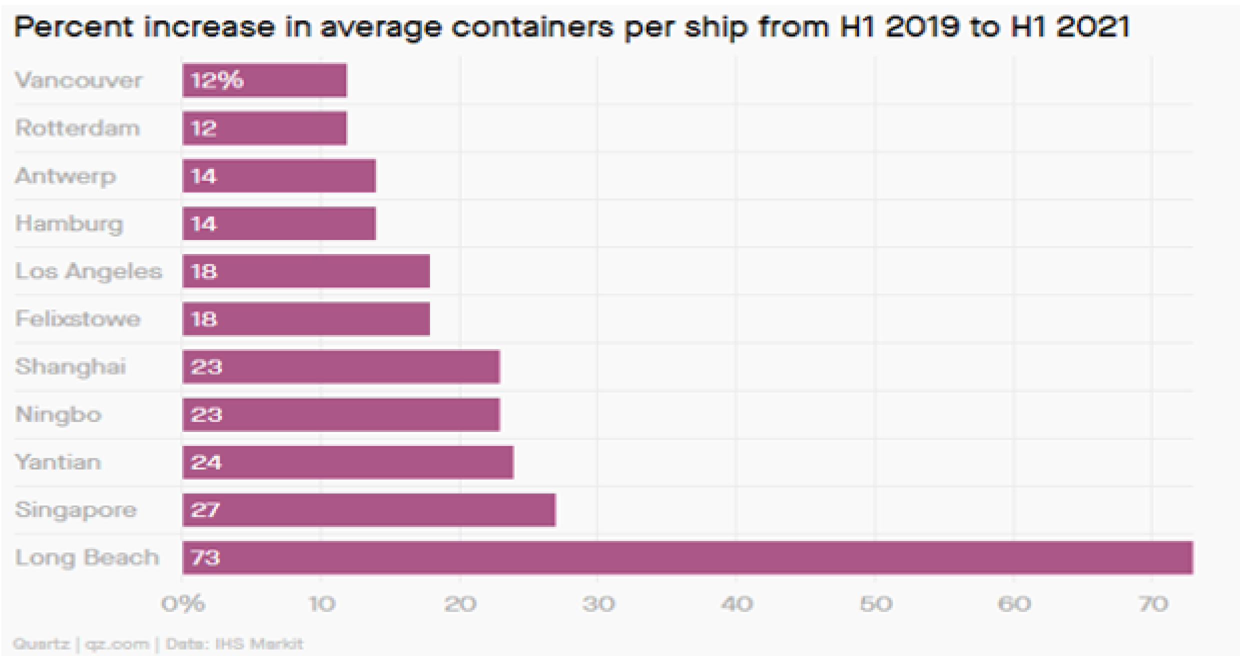

Figure 1. Rivero, 2021

But the reality of port congestion is that transit times from Shanghai to Chicago has more than doubled to 73 days from 35 days. In most all cases voyages are now taking 30 days longer than in previous years due to port congestion, container handling delays, and other factors, as Business Insider (2021a) reported. Despite record levels of ships in port and at anchor, while not being as efficient as it should be due to COVID protocols in these uncertain and unsettled times, and record levels of cargo, the Marine Transportation System in Los Angeles and Long Beach remains safe, secure, reliable, and environmentally sound, according to the Marine Exchange of Southern California.

Suez Canal Blockage

While no one could have predicted the COVID-19 pandemic, likewise no one could have predicted the Suez Canal shutdown by the Super cargo ship Ever Given. The 400-meter-long Ever Given became stuck diagonally across the canal in Egypt on March 23rd, shutting down all north and southbound traffic. This blocked more than 400 ships that had planned to transverse the canal (Chellel et al., 2021). While the Ever Given was finally freed almost a week later, on March 29th, it certainly was not free from the Egyptian government. It turns out that the canal carries more than 10% of the world's trade, and the closure was estimated at $10 billion a day in global costs (Bacon, 2021). Egypt charges a hefty fee for ships going through the canal and estimated that the blockage cost them roughly one billion dollars in revenues. As a result, once the Ever Given was freed Egypt impounded it and basically held it for ransom. With roughly 18,000 containers sitting on the Ever Given, Egypt obviously had a good bargaining chip and after three months of negotiations they settled for $550 million dollars (Associated Press, 2021a).

Image 4. Photographer Ahmed Gomaa/Xinhua/Zuma Press

Imagine, however, having your merchandise, part of your supply chain, sitting on the Ever Given for all that time. What kind of damage would that do to your business? One can only imagine all the car parts, beer, electronics, machinery, household goods, furniture, footwear and more on this ship. Now multiply this by the contents of the 64,887 containers that were stuck on other ships because of the blockage (Streeter, 2021). Some of these ships even had livestock such as sheep and cows that are crammed onto ships, forced to endure long, grueling journeys halfway around the world, only to be slaughtered for meat and leather upon arrival. Sullivan (2021) explained that not only do we not know, nor can we get manifests that would show just how many containers contained livestock, we'll probably never know how many died.

One would think that the issues with the Ever Given would prompt change, and as Nabil (2021) pointed out; it has. The Suez Canal Authority head, Osama Rabie, held a news conference in which he stated that the authority would not change its rules about the passage of ships in bad weather. He did however, go on to say that the grounding had accelerated plans for the canal's expansion. The plan, according to the AP News (2021b) includes widening the canal's southernmost length by about 40 meters to the east, on the side of the Sinai Peninsula, and be deepened from the current 66 feet to 72 feet in depth. That part of the canal is 30 kilometers (18 miles) long. The plan also includes a 10-kilometer-long extension of a second lane of the waterway that opened in 2015. That would bring the double-lane stretch of the canal to 82 kilometers, or 60 miles, allowing more vessels to pass through the canal. This is of course good news for future shipping, but it didn't help those that were stuck for over a week. While many vessels remained stuck, some opted to take the long route around Africa, not know how long the Even Given might tie things up.

Figure 2. An illustration of a sea route from the Red Sea to east Mediterranean without using the Suez Canal. Google Maps/Insider

As can be seen in figure 2, a total detour of the canal would be around 15,000 miles, but of course most ships would not be doing this. Instead, those in the Indian ocean are typically headed to European ports in England, France, Belgium or Germany, or even off the United States. Likewise, many ships are headed in the opposite of this, and so the actual additional mileage is more in the 5,000-8,000 range. Even so, the extra costs of sailing via the Cape of Good Hope are large. Anoop Singh, Singapore-based head of tanker analysis at Braemar ACM, told The Wall Street Journal that the detour can add $450,000 in costs to a typical journey Jankowicz (2021).

The Panama Canal

Not to be outdone, the Panama Canal is also having issues. Hurricanes and COVID-19 have had a significant impact on Canal shipping. In fact, according to Miller (2021a), transit demand for the larger locks for container ships, liquified natural gas and liquefied petroleum gas has surged the past year. As a result of the issues and surge not only for the bigger locks, but the original locks as well, pre-booking has been put in place, with most ships needing to book 10 to 15 days ahead of time. If they don't, they sit offshore and wait. With all this, lock maintenance is needed at the Miraflores locks during September 2021 and according to Alsguth (2021), ships should plan on booking 25-30 days in advance. Bottlenecks at the Panama Canal also produce bottlenecks at ports around the world as planned shipping changes.

It's interesting to note the dramatic increase in mid-September. This is due to the planned Miraflores maintenance in early September. We can also safely say that most ships do not want the alternative, sailing approximately an additional 8,000 nautical miles around Cape Horn, which is considered the most dangerous area to sail on earth, according to Wade (2021). And it's not just the 8,000 miles, it's an additional 12-15 days added on to the journey.

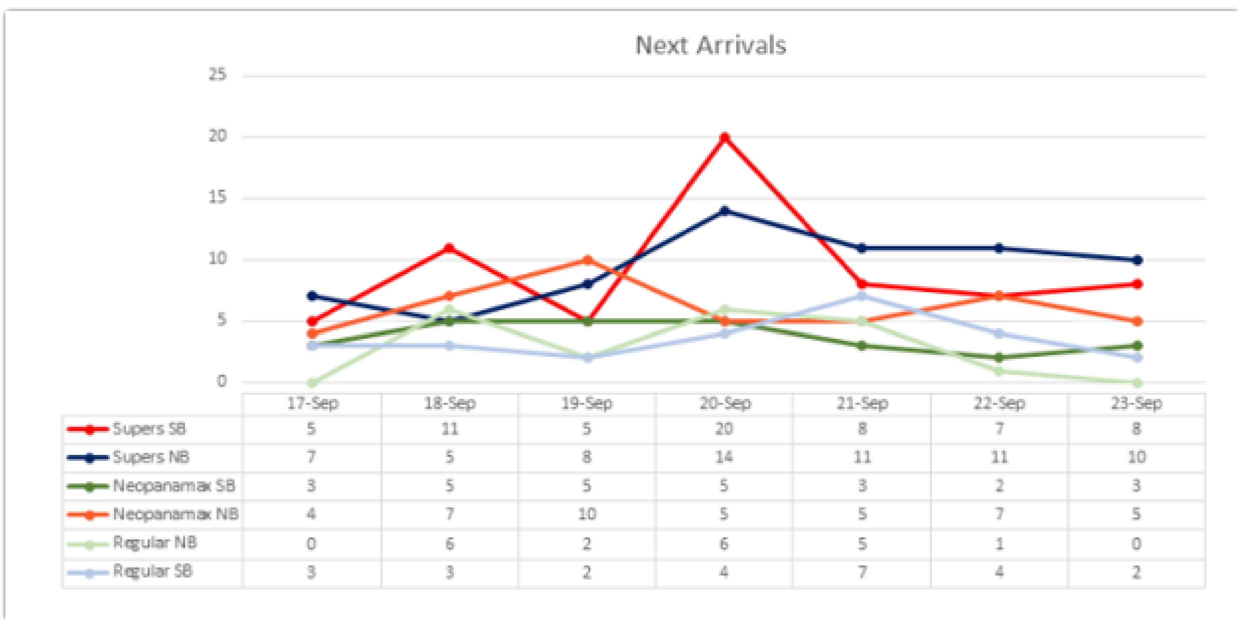

Figure 3. Waypointports.com. September traffic info,

To understand the importance of the Panama Canal we only have to think of the consequences for the shipping industry if, all of a sudden, it would not be available. There are currently 144 routes, connecting shipping ports from 160 countries (Vega, 2020). With an average of 14,000 transits made every year through the Panama Canal, it's obvious that the world depends highly upon this shipping route. In fact, one of the biggest institutions that depends on the Canal is the US Navy, with their need to be able to quickly move ships from the Atlantic to the Pacific and vice versa. From the day the Panama Canal opened in 1914, the American Navy has relied upon the Canal to quickly move military vessels from one coast to the other. But the Canal also imposed constraints on U.S. naval vessel design. Because Naval ships had to fit through the canal, they were built to comply with the canal's original 320-meter length, 33.53-meter width, and 12.56-meter depth limitations, as well as meet a height constraint imposed by the Bridge of the Americas at Balboa. Imagine if war broke out between the U.S. and another major power. Chances are the Panama Canal would become a major target.

Environmental Uncertainty

Shifting to other sources of supply chain disruption, most recently we saw hurricane Ida hit the Louisiana coast as a cat4 hurricane. That shutdown the Port of New Orleans, and others including the Port of South Louisiana, and Port Fourchon (Business Insider, 2021b).

Image 5. Hurricane Ida destruction at Port Fourchon, shown Thursday, Sept. 2, 2021, four days after the Category 4 storm made landfall there. Photo Scott Clause/Lafayette Daily Advertise

While most ports reopened within 4-5 days, Fourchon remained closed a few extra days because it was hardest hit and sustained the most damage, as can be seen in image 5 above. Chris Tomas, the Lead Intelligence Analyst at BSI, explained to Business Insider that port delays could impact grain and oil shipments, though the ports are only responsible for a fraction of US imports" (Business Insider, 2021b). But the damage and temporary closures in Louisiana come at the same time as key ports in Southern California are facing record backlogs.

The storm's 150 miles-per-hour winds in the Gulf of Mexico halted offshore oil and gas production for over a week, while also damaging onshore support facilities. Oil losses from the damage ranked among the worst in 16 years, and the aftermath of the storm cut US oil production by 12% through most all of September 2021. This of course means higher gasoline prices at the pump for consumers and supply goes down while at the same time summer demand is up. But it's not just consumers of gasoline that will feel the impact. As Business Insider (2021b) pointed out, "Constraints on one raw material compound themselves across the industry". This disruption of oil will have a huge impact on many US industries such as paint, raw material, electronics, toys, and furniture and food.

This past year has seen the global supply chain of goods stressed in numerous ways, and here's one more. The shipping industry is seeing the biggest spike in cargo containers going overboard in nearly a decade. In just two months this past winter, cargo ships lost twice as many shipping containers than the annual average. Between November 30 and January 30, more than 2,675 containers—containing furniture, fitness products, electronics, and more—were lost in five separate incidents, according to Gregory (2021).

Increasingly larger container ships, bad winter weather, and a surge in pandemic related demand have combined to make cargo ship travel more treacherous. The sheer size of the ship that blocked the Suez Canal this year, the Ever Given, and the number of containers it carried have been previously discussed as contributing factors to its predicament. But besides loss of profit and inconvenience, losing containers can have a disastrous impact on the environment. Because plastic does not decompose, but lives on as tiny fragments of microplastic, it will wreak havoc on marine ecosystems. And plastic can last for hundreds if not thousands of years in the ocean Gregory (2021). As an example, a recent study tracked ink cartridges that spilled from a cargo ship in the North Atlantic Ocean in 2014. The team of research used oceanographic modeling and social media to track down over 1500 ink cartridges which were littered on beaches from Florida to Norway.

Image 6. Getty Images Gregory, M. 2021

But shipping concerns are minor compared to the impact on ground transportation. The trucking industry has two major issues right now, long port delays as well as labor shortage. And now there is a third constraint, requirement them to get into areas that are difficult to access. As a result, Business Insider (2021b) pointed out that supply chain issues will continue to be felt by consumers, both through a lack of supply as well as imported items, and one more disruption could send the global supply chain into complete chaos. It is also expected that this supply chain crisis will last well into 2023.

But just when we thought we had seen it all, port backups, Suez Canal issue, environmental disruptions such as hurricanes, and containers going overboard, along comes tighter energy consumption policies in China, shutting down Tesla, Apple and other manufacturing plants for days, while electricity is rationed (Paul, 2021). This of course poses additional threats to global supply chains as China provides over 28% of global manufacturing.

Conclusion

Global supply chains are starting to buckle as seen with the backlog of ships in China, California and other areas of the world. All transportation sectors are seeing a shortage of workers as a result of poor treatment during the past two years of pandemic (Walters, 2021). Representing 65 million workers and 80 percent of world's merchant shipping fleet, the International Chamber of Shipping issued a warning in an open letter to the United Nations general assembly on September 29, 2021. In that letter they predict a "global transport system collapse if world Governments failed to restore pre-pandemic levels of travel movement or give priority vaccine notices to transport workers." (Walters, 2021)

Mario Cordero, the executive director of the Port of Long Beach, one of the busiest ports in the country warned that people should start buying for the holidays now (October 1, 2021) because there will be a supply chain shortage very soon. Everything from raw materials to durable goods, electronics, furniture, and auto parts have been hit with shortages and delays, and soon consumers will feel the effects of this. As an example, Kay (2021) pointed out that on September 26, 2021, Nike stated that it doesn't have enough sneakers to sell for the holidays and the week before, Costco announced a limit on the amount of toilet paper and packages of water shoppers could purchase.

Two long-term trends have been increasing the number of containers loaded or unloaded on the average ship. This is known as the ship's "call size" and these increases were happening even before the pandemic. The first trend is that container ships are getting bigger, and this has dramatically increased their maximum capacity. The second is that the shipping industry has consolidated to just 10 companies that now control 80% of all shipping.

Having become more profitable, these shipping giants are using their market power to make their shipping routes as efficient as possible, which means filling their ships to capacity to maximize profits. As the pandemic matured, demand for consumer goods rose dramatically, especially via e-commerce. This put even more strain on supply chains while at the same time space onboard container ships became scarce and expensive.

To combat supply chain shortages, both Home Depot and Costco charted entire container ships to move their products. Following the lead of Home Depot, Walmart and Ikea, Costco rented three ships during September 2021 to have better control over their merchandise. Although each vessel can carry approximately 1,000 containers, it remains to be seen if they'll be able to get these offloaded any sooner than the current backup in California (Kulisch, 2021b). One could assume, however, that these large companies will contract with smaller ports to get these shipments offloaded, thereby bypassing the larger congested ports.

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