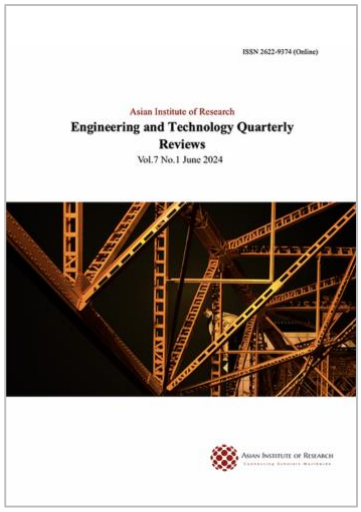

Engineering and Technology Quarterly Reviews

Ozgur, C., Fedor, K., Kois, A., & McFarland, E. (2024), The Effect of Supply Chain Disruptions on Business Post COVID-19. In: *Engineering and Technology Quarterly Reviews*, Vol.7, No.1, 10-23.

ISSN 2622-9374

The online version of this article can be found at:
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Published by:
The Asian Institute of Research

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The Asian Institute of Research
Engineering and Technology Quarterly Reviews
Vol.7, No.1, 2024: 10-23
ISSN 2622-9374

The Effect of Supply Chain Disruptions on Business Post COVID-19

Ceyhun Ozgur[1], Katia Fedor[2], Addy Kois[3], Ethan McFarland[4]

[1] College of Business Valparaiso University. Email: ceyhun.ozgur@valpo.edu
[2] College of Business Valparaiso University. Email: katia.fedor@valpo.edu
[3] College of Business Valparaiso University. Email: addy.kois@valpo.edu
[4] College of Business Valparaiso University. Email: ethan.mcfarland@valpo.edu

Abstract
There are many reasons for experiencing supply chain disruptions. The reasons could be miscommunication between the factory and the warehouse, miscommunication between the warehouse and the stores, or miscommunication between the stores and the customers. We investigated these possible disruptions throughout this paper with the help of a questionnaire. We further investigated the effect of various problems that may occur with the company stock which resulted in supply chain disruptions. There have been many papers written about the effect of the disruptions regarding these problems. With the goal of finding out the tactical approach from the company affects the value of the stock, we investigated this further. Additionally, this paper examined the nature of the tactical standings of the company and the effects on supply chain disruptions and the position of the company stock. Based on the responses to the questionnaire, we found how the tactical elements affect the supply chain disruptions. We also showed the effect of the supply chain disruptions on the company stock.

Keywords: Supply Chain Management, Supply Chain Disruptions, Disruptions due to Inventory, Disruptions due to Miscommunication between Factory and Warehouse, Disruptions due to Miscommunication between Warehouse and Store, Disruptions due to Miscommunication between Store and Customer

1. Introduction

This paper looks at the effects of how disruptions affect the firm and their position in the stock market. We will also discuss how the tactical elements of supply chain affects the wellbeing of the company in terms of their position in the stock market. “A Supply Chain Disruption is an unplanned and unanticipated event that disrupts the normal flow of goods and materials within an entire supply chain” (WGA Consulting, 2017). Because supply chain disruptions are occurring more frequently and with greater intensity, supply chain disruptions are on a continual increase. A supply chain disruption begins with one simple mistake or issue that continues to affect the product, its assembly, testing the product, and shipping the product (Gurman, M., Wu, D., & Bloomberg, 2020). In this part of the paper, we show how supply chain processes effect the cost, procurement, logistics, managing returns and risks, and creating an effective supply chain (Stevenson, 2017).

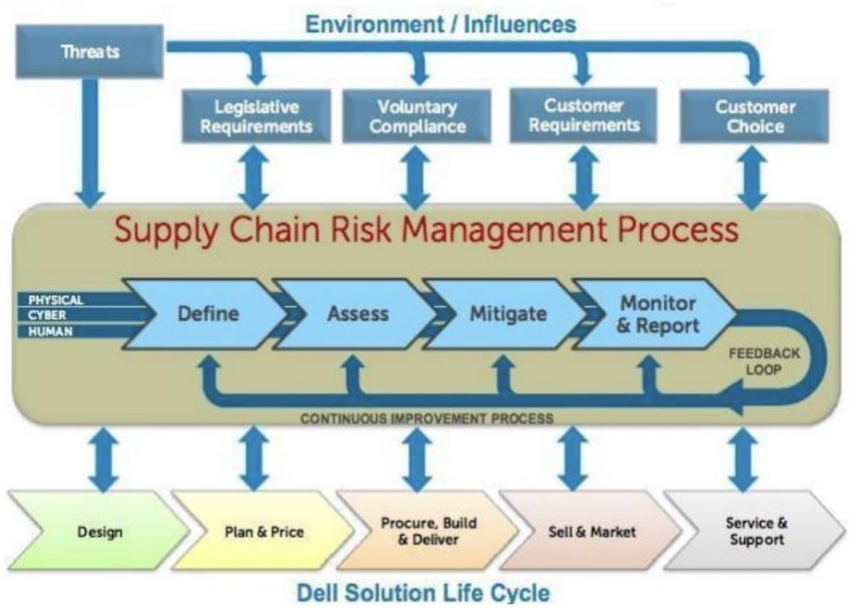

Figure 1: The map of Supply Chain Risk Management Program

There are many factors that weigh into how supply chain disruptions occur. Supply chain risk is shown above in figure 1. Some of these factors include timing, cost, product type, possible risk of a supply chain disruption because of excess inventory or lack of inventory (Luthy, J., 2018). Supply chain risk management is when trying to control risks by being able to legislate the proper requirements to comply voluntarily with the environmental risks while satisfying customers' requirements and choices.

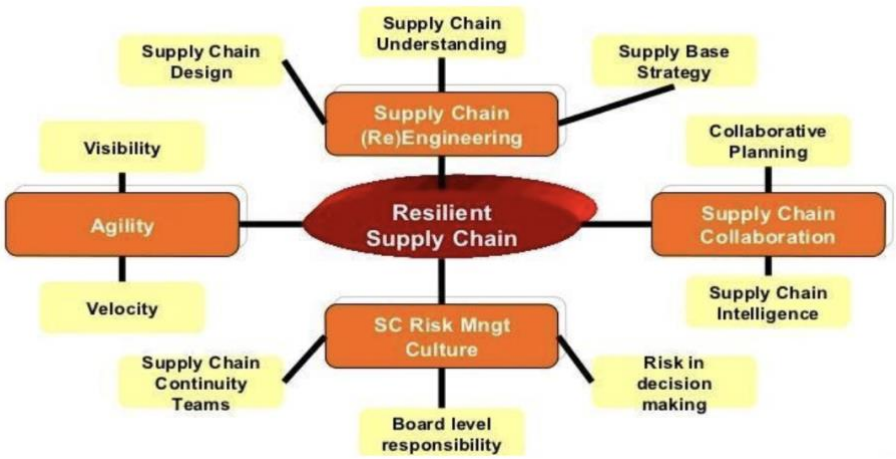

Figure 2: Supply Chain Risk Management Framework.

In figure 2, many aspects of supply chain are shown from understanding the supply chain to collaborative planning. Supply chain risk is shown toward the bottom of the figure. This figure shows how supply chains can be reengineered in an agile environment. We tried to show how supply chains can be planned collaboratively, with the help of a team. Supply chain can be further demonstrated with the team in the context of managing risk.

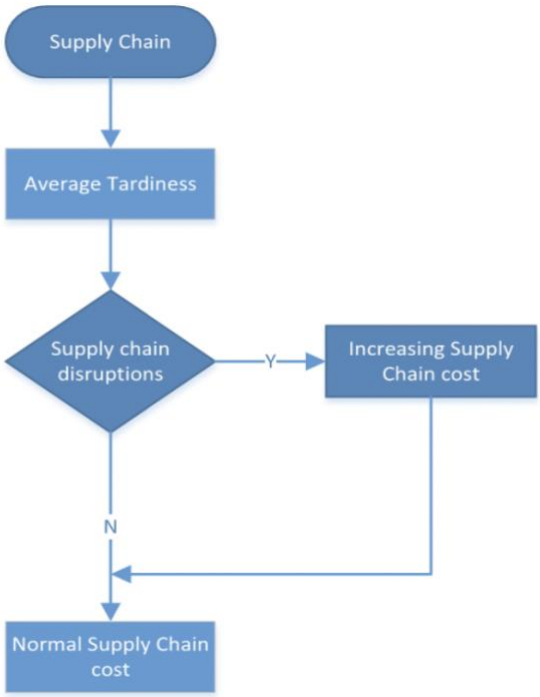

Figure 3: Effect of Average Tardiness on Supply Chain Disruptions and Cost.

In this paper, we also try to control how disruptions affect the position of the firm with respect to inventory. We will try to show how disruptions affect the position of the company with respect to the stock market. We also try to show how average tardiness affects the supply chain disruptions with respect to the cost of the supply chain. As shown in figure 3, we illustrate how average tardiness affects the supply chain disruptions and cost. For example, as illustrated in figure 3, if there is an increased cost the outcome of the supply chain may be affected by increasing the amount of time before the cost returns to normal for the supply chain. The average tardiness affects the supply chain cost due to shifting it from the normal supply chain cost, as shown in the example below.

A machine shop produces customized machinery for the aerospace industry. A particular machine has the following six jobs waiting to be processed.

Table 1: Original Machine Processing Time with Due Dates.

Job	Due Date	Processing Time (Days)
A	28	5
B	15	7
C	19	3
D	10	8
E	20	6
F	25	4

We should create a table according to the earliest due date sequence. This sequence is shown in the table below.

Table 2: Original Machine Processing Time with Due Dates according to earliest due date.

Job	Due Date	Processing Time (Days)
D	10	8
B	15	7
C	19	3
E	20	6
F	25	4
A	28	5

Table 3: Calculation of Lateness and Tardiness.

Job (EDD)	Flow Time	Due Date	Lateness	Tardiness
D	8	10	8-10=-2	0
B	8+7=15	15	15-15=0	0
C	15+3=18	19	18-19=-1	0
E	18+6=24	20	24-20=4	4
F	24+4=28	25	28-25=3	3
A	28+5=33	28	33-28=5	5
Total			-2+0+-1+4+3+5=9	4+3+5=12
Average			9/6=1.5	12/6=2

Lateness = flow time – due date
Tardiness = lateness if positive. Negative and zero values = zero

Table 1-3 elaborate of the Original Machine Processing Time with consideration of the Due Dates which include the earliest due date and the calculation of lateness and tardiness. If you look at table 3 it starts with 8 days. So, 8 days in addition to 7 days is 15 days of flow time. The Due date is in 15 days therefore for job B there is no tardiness. Tardiness measures how late the arrival will be in days. Tardiness is 0 if the items arrive early. For example, considering job E in table 3, we have a situation where item E comes after item C. Looking at the table and the due dates, we can see that a supply chain disruption occurs with item E because the flow time takes longer than the due date which results in a four-day tardiness of the job. The flow time for item E is 24 days. However, item E was due on day 20, which makes item E tardy by 4 days. Disruption occurs because item E is tardy by 4 days. This flow time situation lingers into the following items tardiness status. The disruption in item E affected the following items F and A.

Table 4: Medical Equipment used in Supply Chain

Number of Disruptions Occurring due to	Shortage/Surplus of Supplies (effect of number of units short)
Vaccines	44.4 Million Doses (USA)
N95 Face Masks	160 Million per month
Nitrate Gloves	800 Million per year
Hand Sanitizer	400 Million per year
Syringes	Low dead weight needles reported to become a shortage if demand exceeds supply. They account for 14% of syringes

Vaccines: 10x the effect of the shortage makes the vaccine more valuable due to the fact that there is such a limited supply of vaccines at the moment with an ever-increasing demand.
N95 Face Masks: Universal facemask wearing policy would put an enormous burden on the facemask supply.

Nitrate Gloves: The overall shortage in gloves is more valuable than the surplus. The world needs hundreds of billions of new pairs of gloves. Part of the reason for the glove shortage has to with the inherent manufacturing limitations that deal with a decreased availability of labor for these gloves and materials.
Hand Sanitizer: There are 400 million units of hand sanitize produced per year. Due to Covid-19 the demand of hand sanitizer increased substantially over a short period of time, therefore resulting in a shortage of hand sanitizers.
Syringes: A low dead space needle is a type of syringe that holds the maximum amount of fluid in the needle. The plunger pushes up against the needle and allows for even more vaccine doses to be given from the tiny glass bottles. These needles were never as important because we haven't had a product like this that has been so valuable and in such a small quantity.

Of the 286,000,000 syringes made by the largest manufacturer, Becton Dickinson. The federal government asked for this company to make 40M are low dead space syringes.

Table 5: Vaccine Types Available

Vaccine Brand	Capacity per Year	Dose Required per Patient	Efficacy	Dose per Vial
Moderna	20 million	2	94.5%	8-10
Johnson-Johnson	100 million	1	66.1%	15
Pfizer	20 million	2	95%	6

In this Covid environment there are various vaccines that have been developed the vaccines are summarized in the following table.

Table 6: Population's vs COVID-19 Cases and Deaths

Country	Population	# of Cases	# of Deaths	% of cases to Population	% of deaths to Population
United States	329,731,224	27,882,557	496,112	8.46%	0.150%
Mexico	126,577,691	2,041,380	180,107	1.61%	0.142%
Canada	38,037,578	845,652	21,674	2.22%	0.057%
Turkey	84,338,067	2,646,526	28,138	3.14%	0.033%
Australia	25,499,884	28,930	909	0.11%	0.004%
Italy	60,461,826	2,818,863	95,992	4.66%	0.159%
Argentina	45,195,774	2,064,334	51,198	4.57%	0.113%
Netherlands	17,134,872	1,060,801	15,249	6.19%	0.089%
United Kingdom	67,886,011	4,126,150	120,757	6.08%	0.178%
New Zealand	4,822,233	2,357	26	0.05%	0.001%
Brazil	212,559,417	10,168,174	246,560	4.78%	0.116%

Upon examination of table 5, it is easy to see that the most populated countries, United States, Brazil and Mexico also share the highest number of cases. With this noted, these three countries also share the highest number of deaths. In the table, the dark red and dark green represent the largest population and highest number of cases and deaths. Green specifically represents population. For example, the United Kingdom although their population is smaller than the USA, the United Kingdom has a higher death rate per population. New Zealand and Australia, with consideration that they do have active cases (not many when compared the rest of the countries) the death rate is very low for these two countries. Italy, (death rate .159%) having a population of over 60 million which is roughly 18% of the USA's overall population has a higher death rate than the USA (death rate .150%).

2. Methodology

Questionnaire
What is the current management structure?
A. Top down
B. Bottom up
C. Left right
D. Middle right

The nature of supply chain:

1. Warehouse to retail
2. Storetostore
3. Factorytostore
4. Warehouse to factory
5. Retail to store
6. Store to customer
7. Retail to customer

Possible supply chain disruptions due to problems between different parts of the business:
A. Problem with the shipment from warehouse to factory
B. Problem with shipment from factory to store
C. Problem with shipment from warehouse to customer
D. Problem with shipment from store to customer

Possible supply chain disruptions due to transportation:
A. Problems with transportation to customer
B. Problems with transportation to the warehouse
C. Problems with transportation to the store
D. Problems with transportation from the factory

Possible supply chain disruptions due to problems with communications among:
A. Factory and store
B. Factory and warehouse
C. Warehouse and customer
D. Warehouse and store

Possible supply chain disruption with inventory:

1. Too much inventory in the factory
2. Too little inventory in the factory
3. Communication problems between the factory and the warehouse
4. Communication problems between the warehouse and the stores
5. Communication problems between the stores and the customers
6. Too little inventory in the warehouse
7. Too much inventory in the warehouse

Scheduling:

1. Low volume systems effect on supply chain disruptions
2. Services effect on supply chain disruptions
3. Strategies effect on supply chain disruptions
4. Minimize average tardiness (Average tardiness = total tardy days/number of jobs)
5. Average lateness is always less than or equal to the
6. average tardiness

Management of waiting lines:

A. Managerial implications of waiting lines
B. Goal and strategy of how waiting lines are managed
C. The impact of waiting lines on supply chain disruptions
D. The impact of characteristics of waiting line on supply chain disruptions

In the future we want to run a survey comparing the supply chain disruptions per country using these questions. The questionnaire would explore the basic knowledge that business officials would have in regards to supply chain. For which we can then use to evaluate why certain countries/ business are having supply chain problems. For example, knowledge on possible disruptions involving inventory can allude to knowledge that is not acquired by potential inventory managers which can affect the supply chain and create a distribution. Therefore, there will be a shortage versus having an excess inventory of additional product. The questionnaire can also give valuable insights about the management of waiting lines. Waiting in line can cause a disruption in a supply chain so understanding how to effectively manage them is crucial to a successful supply chain. This ties into the idea of scheduling. Accurate and time-based deliveries of equipment result in less waiting time for the receiver of the equipment.

3. Discussions

In this paper we will discuss how disruptions affect the tactical nature or position of the company with respect to performance in the stock market. We will also discuss how a decline or increase in the inventory will affect the supply chain disruptions and ultimately how it will affect the position of the company on the stock market. We will try to show how average tardiness affects the supply chain disruptions, as shown in figure 2.

We can mitigate the effect of supply chain disruptions with the risk of understanding it (Gray, S., 2019). There is additional pressure put on the company when the supply chain disruption changes. When discussing possible risks for supply chain disruptions, having unreliable transportation and possibility of delays is a significant risk. To help avoid this risk, companies must have proper communication between each factory, warehouse, and stores transportation methods (Gray, S., 2019). We also learned that due to the COVID-19 pandemic, demands for a product or service can swing tremendously depending on what is happening in the world. For example, at the beginning of the pandemic the demand for air travel dropped tremendously due to the fact that everyone was in a lockdown. The lockdown then also caused the demand of supplies such as toilet paper and paper towels to skyrocket, leaving thousands of potential buyers emptyhanded when it came to supplies such as those (Montgomery, O., 2020).

The COVID-19 pandemic has shifted the business environment for organizations across the world. It has placed an emphasis on the importance of being able to react, adapt and set up crisis management mechanisms in order to weather situations of uncertainty. As restrictions and lockdowns began to create many dire situations that required immediate attention in the early stages of the pandemic, many companies are now beginning to move into "recovery mode" and began to plan for the long term. As companies seek to strengthen operations, the importance of supply chain resilience and risk management is more apparent than ever (Hedwall, M., 2020).

There are many negative effects of this pandemic that have affected many companies' supply chain such as airlines, shipping industries, food industries, the health care industry and so forth. However, one aspect that many people have looked over is the emergence of communication-based technology and sharing based technology. Applications such as Zoom and Microsoft teams were always around but were never as big as they are today due to COVID-19. The lockdown required people to go out and find new methods to see each other and communicate face-to-face and applications such as Zoom and Teams were able to do just that (Flynn, B., Cantor, D., Pagell, M., Dooley, K., Azadegan, A., 2021). However, we still have many supply chain disruptions related to this pandemic such as the shortages of healthcare supplies and food that must not be overlooked by the emergence of communication and sharing technologies.

How due supply chain disruptions effect the performance of the stock market? A company's ability to get product to the consumer efficiently displays a healthy well ran business. Therefore, if the business is not getting

the product to the consumer, it is because of a supply chain disrupting that has hindered efficient movement of the product. Therefore, customer satisfaction deceases.

From the supplier's perspective, issues that arise within the supply chain are usually those caused by outside issues. For example, Covid-19. Covid's impact on logistical services directly impacted the supplier's ability to continue to function as a healthy service.

Supply chain disruption affect each company differently. For example, shortages of inventory versus surplus of inventory have different impact on the company. Shortages of inventory result in various problems for the manufacturer for that when the customer demand is high for the product, shortages can arise. In an attempt to avoid supply chain disruptions that deal with shortages of inventory, many companies are creating alternative routes to distribution centers and also evaluating new sources for supplies. These alternative outbound routes will positively affect the company's ability to get products distributed to the customers. (Butt, A., 2021).

4. Introduction of the References for Each Article Cited:

Authors Saurabh Ambulkar, Jennifer Blackhurst, and Scott Grawe wrote an empirical examination of the resilience of the firm on the supply chain disruptions: Scale development and empirical examination Journal of Operations Management (Ambulkar S., Blackhurst J., Grawe S., 2015).

Authors Chia -Hsien Tang, Chih-Yu Chin, Yen-Hsien Lee wrote an empirical analysis titled *Coronavirus disease outbreak and supply chain disruption: Evidence from Taiwanese firms in China, Research in International Business and Finance.* The research shows a link between the COVID-19 outbreak and the disruption of logistics along with negative returns this had within Taiwanese firms (Chia -Hsien Tang, Chih-Yu Chin, Yen-Hsien Lee, 2021).

Authors Ceyhun Ozgur, Sanjay Kumar and Yiming Shen are responsible for writing the working paper titled the effect of supply chain disruption on average lateness and tardiness and lateness and how that affect can influence the supply chain disruption and also effect the firm. This paper explores how different tactical elements such as 'make to order' or 'make to stock firms' or 'level or chase' strategy of the firm affect the supply chain (Ozgur C., Kumar S., Shen Y., 2018).

Author Ceyhun Ozgur wrote the article titled Coronavirus supply chain disruption will affect those outside China: Sourcify CEO, elaborates on the many reasons for experiencing supply chain disruptions. Miscommunication between the factory and the warehouse or the warehouse and the stores, or the stores and the customers (Ozgur C., 2020).

Author Sinha Deepankar who wrote The Supply Chain Disruption Framework Post COVID-19: A System Dynamics Model. The authors capture the mathematical and operational relationships amongst the relevant factors and propose a System Dynamics model to carry out the simulations. The approach considers the impact of the force majeure condition, that is, COVID period on individuals' income, prices and demand of goods, cost of input and supply of finished goods (Deepankar S., 2020).

Authors M. A. C. Ekanayake, Geoffrey Q. P. Shen, Mohan M. Kumaraswamy responsible for writing Identifying supply chain capabilities of construction firms in industrialized construction. *Production Planning & Control*, elaborate on industrialized construction. This study examines how supply chain resilience can be boosted using clear focus of the relevant and appropriate supply chain capabilities (Ekanayake M. A. C., Shen G. Q. P., Kumaraswamy M. M. 2021).

Author Frederico F. Guilherme who wrote the article titled "Towards a Supply Chain 4.0 on the Post-COVID-19 Pandemic: a Conceptual and Strategic Discussion for More Resilient Supply Chains." This article basically goes into details about how supply chain disruptionsand failures in supply chain management often result in lost sales or financial losses and have a negative impact on shareholder and operating performance. Supply chain

management has been paid to improving the process of managing a disruption from its discovery through to complete recovery process (Guilherme F., 2021).

Authors Derek Friday, David Savage and Steven Melnyk, et.al. wrote the article titled, "A Collaborative Approach to Maintaining Optimal Inventory and Mitigating Stockout Risks during a Pandemic: Capabilities for Enabling Health-Care Supply Chain Resilience." the article goes into detail about how the COVID-19 pandemic presented unanticipated demand shocks due to stockpiling of medical supplies caused stockouts, and the stockouts triggered systematic supply chain disruptions. This created a risk for customers and put the managers working individually mitigating circumstances they had limited information about (Friday, D., Sqavage D., Melnyk S., 2021).

Authors Jiangxia Liu Sourish Sarkar Sanjay Kumar Zhenhu Jin, responsible for writing the analysis titles, *An Analysis of Stock Market Impact from Supply Chain Disruptions in Japan, International Journal of Productivity and Performance Management* elaborates on how supply chain disruptions effect the stock market (Liu J., Sarkar S., Kumar S., Jin Z., 2009).

Authors Harri Lorentz and Olli-Pekka Hilmola, responsible for writing the paper *titled Confidence and supply chain disruptions, Journal of Modelling in Management* speak about how managerial behavior is important t consider when supply chain disruptions are affecting the business performance. (Lorentz, H., Hilmola, O., 2012)
Authors Elena Revilla and Maria Saenz are the authors of the article *The Impact Of Risk Management On The Frequency Of Supply Chain Disruptions A Configurational Approach, International Journal Of Operations & Production Management,* speak about the frequency of supply change disruptions and how they affect the performance of the business. The paper also goes into detail about supply-chain / inter-organizational partners (Revilla, E., Saenz, MJ., 2017).

Authors Dmitry Ivanov, Alexandre Dolgui, Boris Sokolov & Marina Ivanova who wrote the *Literature Review on Disruption Recovery in the Supply Chain*, published in the International Journal of Production Research elaborate on recent research underlines the crucial role of disruption events and recovery policies in supply chains. The literature on supply chain design with disruption considerations, there is no survey on supply chain with disruptions and recovery considerations (Ivanov, D., Dolgui, A., Sokolov, B., Ivanova, M., 2017).

Authors Joseph B. Skipper, Joe B. Hanna. Who wrote, minimizing supply chain disruption risk through enhanced flexibility talks about how the use of a strategic approach will limit the risk of a supply chain disruptions. Their study show that flexibility has been shown to enhance the ability to minimize risk exposure (Skipper J. B., Hanna J. B., 2009).

Authors Konstantinos Nikolopoulos, Sushil Punia, Andreas Schäfers, Christos Tsinopoulos, Chrysovalantis Vasilakis who wrote the article *Forecasting and planning during a pandemic: COVID-19 growth rates, supply chain disruptions, and governmental decisions*, published in the European f Operational Research speak about how policymakers during COVID-19 operate in uncharted territory. This type of research plays a vital role in selling the supply chain distributions related to Covid-19 (Nikolopoulos, K., Punia, S., Schäfers, A., Tsinopoulos, C., Vasilakis, C., 2021).

Authors Kouvelis and Panos are in the Handbook *of Integrated Risk Management in Global Supply Chains, John Wiley & Sons, Incorporated* speak about the five key operational strategies, namely stockpile inventory, diversifying supply, backup supply, how to manage demand and strengthen supply chain. In addition, the value of deploying multiple strategies, and identifies some directions for future research to advance the knowledge and practice of supply chain disruption management (Kouvelis, P., 2011).

Author Maxamilian Kunovjanek and Christian Wankmüller wrote the article titled, "An Analysis of the Global Additive Manufacturing Response to the COVID-19 Pandemic." Published in the *Journal of Manufacturing Technology Management*. This paper elaborates on how the production of medical items, such as personal protective equipment during the pandemic was short of supply when in consideration for the demand. This

shortage caused global supply chain disruption and resulted in countries battling over these products that were desperately needed (Kunovjanek M., Wankmüller C., 2020).

Authors Rachel A. Dowty and William A. Wallace responsible for writing the article titled *Implications of organizational culture for supply chain disruption and restoration, International Journal of Production Economics* which is about how to manage supply chain disruptions while teamed up with diverse organizational cultures to work together in order to restore resiliency (Dowty, R., Wallace, W., 2010).

Authors Brian Tomlin wrote the article titled *On the Value of Mitigation and Contingency Strategies for Managing Supply Chain Disruption Risks*. The paper speaks about how suppliers are capacity-constrained, and reliable supplier may possess volume flexibility. The paper shows that in the special case in which the reliable supplier has no flexibility and the unreliable supplier has infinite capacity, a risk-neutral firm. (Tomlin, B., 2006) Authors Sanjay Kumar, Jiangxia Liu, Jess Scutella responsible for writing the paper titled *The impact of supply chain disruptions on stockholder wealth in India, International Journal of Physical Distribution & Logistics Management.* The paper speaks about supply chain structure, characteristics, and applicable policies differ between developing and developed countries. Supply chain management research is aimed at supply chains in developed countries, the authors of this paper look at the disruptions of supply chain and the financial impact the disruptions have in India and Turkey (Kumar. S., Jiangxia. L., Scutella, J., 2015).

Author Sanjay Kumar is responsible for writing the paper titled *Advance Warning of Supply Chain Disruption: A Behavioral Experiment, 11th Annual Behavioral Operations Management Conference, At University of Wisconsin-Madison, Madison* goes on to speak about how improving supply chain performance using predictive tools such as forecast accuracy and inventory management can help disruptions within a supply chain be avoided (Kumar, S., 2016).

Authors Sunil Chopra and Man Mohan S. Sodhi the authors of *Reducing the Risk of Supply Chain Disruptions, MIT Sloan Management Review* elaborates on how managers discuss solutions to reduce supply chain disruptions and if those solutions aren't implemented the disruption continues (Chopra S., Mohan, M., Sodhi, S., 2014).

Authors Shahed, K.S., Azeem, A., Ali, S.M. *et al.* who wrote "A supply chain disruption risk mitigation model to manage COVID-19 pandemic risk" speak about how the optimization model focuses on managing supply chain disruptions for a pandemic where disruptions can occur to both the supplier/ retailer. The idea of the inventory-policy using the Renewal Reward theory for maximizing profit for the manufacturer (Shahed K.S., Azeem A., Ali S.M., 2021).

Authors Katrin Schmitt, Ravi Kumar, Kathryn Stecke, Fred Glover, and M. Ehlen who wrote the paper titled *Mitigating Disruptions in a Multi-echelon Supply Chain Using Adaptive Ordering, Omega.* Go on to speak about impact of disruption based on facility location and the benefits of expediting the orders (Schmitt, T., Kumar, S., Stecke, F., Glover, F., Ehlen, M., 2017).

Author Tadeusz Sawik, titled Stochastic Mixed Integer Programming speaks about practical uses of stochastic approaches and how these approaches can deflect supply chain disruptions. The paper also elaborates on mixed (Sawik T., 2020).

Authors T. Wu, J. Blackhurst & P. O'grady wrote the article titled Methodology for supply chain disruption analysis, International Journal of Production Research speak about how the complexity of many supply chains, in order to understand the impact of disruptions on the operation of the system. network-based modelling methodology is used to determine how changes or disruptions propagate in supply chains and how those changes or disruptions affect the supply chain system (Wu T., Blackhurst J., O'grady P. 2007).

Author s Nick Wildgoose, Patrick Brennan, and Simon Thompson wrote the article Understanding your supply chain to reduce the risk of supply chain disruption. Journal of Business Continuity & Emergency Planning, elaborate on how the frequency of supply chain disruptions is high. Understanding this gives practical advice to

help reduce the cost associated. Understanding the frequency will help with the understanding of how to identify critical suppliers (Wildgoose N., Brennan P., Thompson S., 2012).

Author L. Veselovská has published the paper titled *Supply chain disruptions in the context of early stages of the global COVID-19 outbreak* which talks about how central European countries distributed food and supplies during the early stages of the pandemic to assess the long-term effects of it. This study found that nearly 20% of Slovak companies and 30% of Czech companies made little to no changes at all in their operations during the early stages of the pandemic. The study found that those companies were actually able to survive the supply chain disruptions brought among them during the pandemic and this had no effect on the businesses or the supply chain (Veselovská, L., 2020).

Author Atif Saleem Butt looked into the steps/countermeasures taken by buying and distributing firms to address supply chain disruptions caused by the COVID-19 pandemic. He found that buying firms are moving to supple production, focusing on the most important supplier risks, enhancing inbound material visibility and temporarily shutting down production facilities to answer to the challenges caused by COVID-19. He also found that distribution centers are changing their inventory policies, assessing substitute outbound routes and sources of supply to control the disruptions that have been caused to their businesses by COVID-19 pandemic (Butt, A., 2021).

5. Post-COVID-19 Implications for Supply Chains

COVID-19 has affected supply chains for businesses. Because of COVID-19 businesses experienced many supply chain disruptions. Some of these disruptions could include lack of inventory or lack of vaccine availability. These disruptions cause many difficulties for businesses including national lockdowns hat slow or temporarily stop the flow of goods coming into and going out of the business, this can lead to a disruption in manufacturing. These disruptions can also lead to a lack of workers due to not being vaccinated, this can lead to the greater use of technologies such as robotics or artificial intelligence.

6. Conclusion

Supply Chain disruptions are higher in advanced countries like the United States and United Kingdom. But they are low in countries like New Zealand and Australia. When you consider the supply chains in general the first thing we should look at is the availability and efficacy of vaccines. Considering the population of the world we need to consider the supply chain disruptions that can affect the entire world. For example, when we consider the vaccines we should look at the availability of syringes as well. We should also consider how affective the vaccines are. When you look at the number of deaths, we should consider how affective the vaccines are for different populations of people. For that different populations from different countries may not have the same type of health care that a country with a lower death rate has. Turkey has a death rate of .033% while the USA has a much more effective health care system but still has a higher death rate (.150%). Italy has a death rate of (.159%) while the USA has a death rate of (.150%) with Italy having a higher death rate than the USA. Another example shows us supply chain disruptions in the syringe manufacturing, production and distribution field are suspected to run low if worldly supply chains are prepared for the global demand of syringes.

Author Contributions: All authors contributed to this research.

Funding: Not applicable.

Conflict of Interest: The authors declare no conflict of interest.

Informed Consent Statement/Ethics Approval: Not applicable.

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