

The Effect of Supply Chain Disruptions on Business

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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.

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).

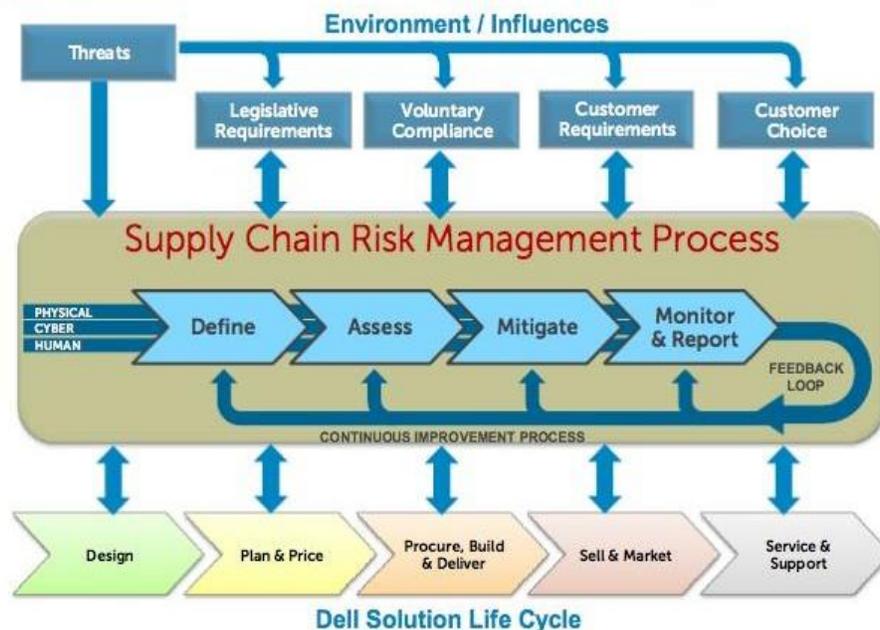


Figure 1. The map of Supply Chain Risk Management Program

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.

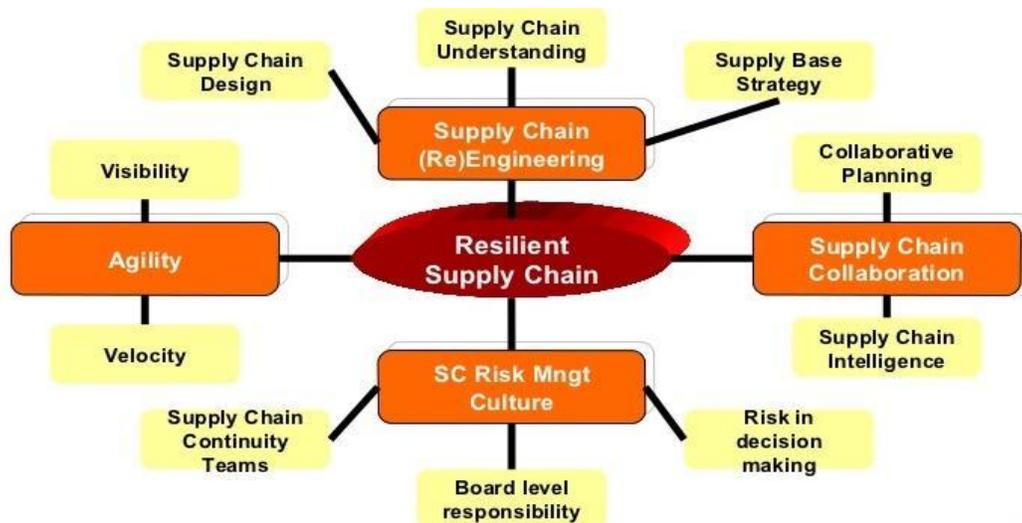


Figure 2. Supply Chain Risk Management Framework.

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.

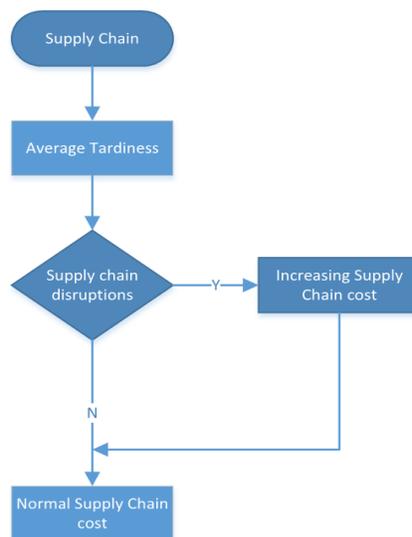


Figure 3. Effect of Average Tardiness on Supply Chain Disruptions and Cost.

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

Formulas:

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 a 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.

Table 4. Medical Equipment used in Supply Chain

Number of Disruptions Occurring due to	Shortage of Supplies (effect of number of units short)	Surplus of Supplies (effect of number of units of over supplied)
Vaccines	44.4 Million Doses (USA)	44.4 Million Doses (USA)
N95 Face Masks	160 Million per month	160 Million per month
Nitrate Gloves	800 Million per year	800 Million per year
Hand Sanitizer	400 Million per year	400 Million per year
Syringes	Low dead weight needles reported to become a shortage if demand exceeds supply.	Low dead weight needles account for 14% of all 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 do 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 sanitizer 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. Populations vs COVID-19 Cases and Deaths

Country	Population	# of Cases	# of deaths	% of cases to pop.	% of deaths to pop.
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	84,339,067	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%).

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:

- A. Warehouse to retail
- B. Store to store
- C. Factory to store
- D. Warehouse to factory
- E. Retail to store
- F. Store to customer
- G. 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:

- A. Too much inventory in the factory
- B. Too little inventory in the factory
- C. Communication problems between the factory and the warehouse
- D. Communication problems between the warehouse and the stores
- E. Communication problems between the stores and the customers

- F. Too little inventory in the warehouse
- G. Too much inventory in the warehouse

Scheduling:

- A. Low volume systems effect on supply chain disruptions
- B. Services effect on supply chain disruptions
- C. Strategies effect on supply chain disruptions
- D. Minimize average tardiness (Average tardiness = total tardy days/number of jobs)
- E. Average lateness is always less than or equal to the
- F. 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 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 excess inventory of additional product. The questionnaire can also give valuable insights about management of waiting lines. Waiting in line can cause a distribution in a supply chain so understand 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.

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).

How do supply chain disruptions affect 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 decreases.

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.

Author Ceyhun Ozgur. Sanjay Kumar. Yiming Shen, responsible for writing the working paper titled *the effect of supply chain disruption on average lateness and tardiness the effect of average tardiness on supply chain disruptions speak about the tardiness and lateness that affect the supply chain disruptions also effect the effectiveness of the firm.*

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.

Authors Lorentz, Harri; Hilmola, Olli-Pekka, responsible for writing the paper titled *Confidence and supply chain disruptions, Journal of Modelling in Management* speak about how managerial behavior is important to consider when supply chain disruptions are affecting the business performance.

Revilla, E; Saenz, and MJ 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.

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.

Author Sanjay Kumar, 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.

Sunil Chopra and ManMohan 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.

T. Schmitt, S. Kumar, K. Stecke, F. 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.

Conclusion

Supply Chain disruptions are higher in advanced countries like the United States and United Kingdom. But there 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.

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