ISSN No:-2456-2165

Supply Chain Disruptions Due to Pandemic- A Case Study

Paper on the Recent Pandemic Covid 19

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Abstract:- Be it agriculture, manufacturing or production of energy, all are a part of supply and demand mechanics controlling freights and container ships, bringing the world's industry together leading to globalization of economy.

The world's food, products were transported by the shipping industry with supply chain as its core. 94% of the Fortune 500 companies are seeing covid 19 supply chain disruptions as per 2020 Forbes report.

Supply chains of today are very intricate and interconnected; disruption at one part can spread in an unpredicted manner.

This paper helps the reader analyze various supply chain models and the impact of disruptions caused by the pandemic. At first, it discusses supply chain management and its risks due to pandemics. It then, discusses a case study of Unilever restructuring its supply chain system.

The paper also suggests a methodology for supply chain management during pandemic. The outcomes and insights of this paper can be used by decision makers for risk management in supply chains and leads a step for future research.

Keywords:- *Supply chain management; consumer; distribution; Unilever; efficiency; disruptions; supply chain.*

I. INTRODUCTION

The pandemic has turned out to be a wakeup call for better supply chain management and has forced companies to rethink their global supply chain model. Supply chain is dealing with the progression of merchandise and enterprises which incorporates all the procedures that change crude materials into definite items. It includes the active streamlining of a business's supply-side activities to maximize customer value. A Supply chain disruption is an unplanned and unanticipated event that disrupts the normal flow of goods and materials within an entire supply chain. Supply chains have become very complex throughout the years. Furthermore, the frequency and intensity of supply chain disruptions is also increasing. Natural disasters, transportation failure, geopolitical instabilities, price hikes and cyber-attacks are some examples of disruption. Pandemics also cause a staggering amount of disruption.

A pandemic is an epidemic occurring on a large scale that transcends international boundaries, affecting people all over the world. Pandemic flare-ups speak to an uncommon instance of SC dangers which is particularly described by three segments, (I) long haul interruption presence and its erratic scaling, (ii) synchronous disturbance proliferation in the SC (the ripple effect) and pandemic engendering in the populace (pandemic propagation), and (iii) concurrent disruptions in supply, demand and logistics infrastructure, pandemic outbreaks start small but spread fast and disperse over many geographic regions.

Usually demand of the material needs such as food, beverages, clothing, medicines, medical equipment increase sharply. The implementation of logistics operations should be effective and efficient to reduce losses. Therefore, logistic operations management plays a very important role during the pandemic.

The purpose of this paper is to analyze the disruptions in the supply chain caused due to the pandemic and to suggest a methodology to control logistics in a supply chain.

II. LITERATURE REVIEW

A. Epidemics Control and Logistics operations.

Climate change and rapid urbanization of the world's population could lead to accelerated epidemic outbreaks. This can lead to a pandemic of unprecedented proportion where available resources could be strained to their limits. Thomas K. Dasaklis, Costas P. Pappis and Nikolaos P. Rachaniotis, in their paper have inter-correlated the logistics operations taking place during the containment of an epidemic. They have tried to use methodologies applied in business logistics problems to the context of epidemics control logistics. Stockpiling of medical supplies and triage operations are two methods suggested. Inventory, in the case of epidemics, deals with managing specific medical supplies like vaccines, antiviral drugs or antibiotics and ancillary medical resources like Personal Protective Equipment (PPE). In

some cases, joint inventory stockpiling is also done for groups of hospitals, that have mutual aid agreements for inventory sharing. A mathematical framework by Duintjer Tebbens et, having several logistical constraints like capacity, production and filling delays, risks associated with the stockpile is used for optimally managing the vaccine stockpile. Simulation models have been discussed for the evaluation of candidate PODs, alternative dispensing processes and staffing plans. A mathematical model by Wein et al has been suggested to compare various emergency responses to airborne anthrax. A discrete event simulation queuing theory model for the clinic planning of public-health services by Aaby et al is also given. The paper also suggests few integrated quantitative and qualitative methods. It concludes by suggesting a few areas for future research.

B. Predicting the impacts of Epidemic outbreak

Epidemic outbreaks create a lot of uncertainty and companies need to develop plans for their Supply Chains. Dmitry Ivanov, in his paper, discusses the impact of COVID-19 on the global SCs. The supply chain risks due to epidemic outbreaks were identified. These supply chain risks start small but propagate fast and spread over many geographic regions creating a lot of unknowns which makes it difficult to fully determine the impact of the epidemic outbreak on the SC and the right measures to take. They have used anyLogistix simulation and optimization software to predict short term and long-term impacts on SCs and develop pandemic SC plans. The major observation from the simulation experiments were the timing of closing and opening of the facilities, lead time, speed of epidemic propagation, and the upstream and downstream are factors in the disruption of the SC. The paper concludes by proposing pandemic plans such as different risk mitigation inventory level. The complexity of the pandemic plans can be easily increased by including other elements such as reserved capacities, backup suppliers, lead time reservations and regional subcontracting.

C. Challenges and solutions for addressing critical shortage in supply chain

Managing supply chain disruptions can be very challenging. N.J. Rowan and J.G. Laffey, in their paper on Challenges and solutions for addressing critical shortage of supply chain for PPE arising from the COVID19 pandemic, have provided two solutions for the shortages in supply chain for one-time use PPE. The first step would be to improve communication lines for better stock management of PPE that exploits webpage and mobile phone app development. The next step suggested is the dual bespoke production of PPE using medical grade materials and contingency planning is required for times when there are unexpected demands. During such times, one solution given by them is the reprocessing of PPE. This requires the manufacturer to closely follow the advice from original manufacturer of PPE on material composition and design features. This also includes adhering to close advice provided by regulators, such as the FDA.

D. Managing Supply Disruption for Remanufacturer of Reverse Supply Chain

Supply chain disruptions are a major threat to business. In their paper on “Managing Supply Disruption for Remanufacturer of Reverse Supply Chain”, Gu Qiaolun and Gao Tiegang have suggested two effective approaches to mitigate supply disruptions. The first approach suggested by them is to split orders among multiple suppliers and the second one is sourcing from regular suppliers initially and then from specified backup suppliers when supply disruption occurs. Their main focus is to increase the remanufacturer's profit in a reverse supply chain. They have presented a system dynamics model to ensure that the remanufacturer gets his profit even when the supply disruption lasts for a long time. After simulation they found that the remanufacturer should purchase parts from the contingent supplier from the period at which his profit is approximate to zero to manage supply chain disruptions in a closed loop. The paper concludes by suggesting future research directions in the area of supply disruption of closed-loop supply chain.

E. One-supplier One-retailer Supply Chain Model-Certainty Model

LEI Dong, WENG Ming in 2006, the authors discuss about the one-supplier one retailer supply chain model, where the retailer is led by the supplier as a Stackelberg game. The disruption factors such as demand and price factors are considered along with the production plans to check for ambiguity. The authors proposed a Certainty model with the demand and price factors influencing the supply chain disruption simultaneously. This model explains the features of real market demand being a linear function of market price along with unit production cost. The authors proposed this model by considering few models which were based on a single factor causing disruption which led the supplier to conclude with a change in production plan in order to have equal profitability along the supply chain. Wherein after the study of simultaneous disruption factors the authors concluded that there need not be a change in production plan in order to have profits to both retailer and supplier, but can be achieved within the supply chain by altering the price factor according to demand. This study concludes that the profit to supply chain is the sum of profit of supplier and the retailer mathematically, hence also justifies the supplier is the leader of Stackelberg game.

F. Disruptions in Modern Supply chain systems

C.S.Tan, P. S. Tan, S.S. G.Lee in 2015, their study related the modern SCs which were in high risk to disruption because of the prominence on efficiency where lower buffer is available to reduce the disruption impact. They proposed models for both qualitative and quantitative risk assessment techniques, the qualitative approach focused on interviews, historical data and expert rating whereas the quantitative techniques included the System Dynamic, Petri Net, Discrete Event and Mathematical modeling. These techniques had few limitations such as, a) Tuff to analyze the impact as the time passes b) Does not study the generation of disruptions through SC c) These techniques wouldn’t consider demand-side disruption d)

The techniques do not calculate the magnitude and time of the disruption impact for every SC node. Hence the authors presented a Time - based model where an external disruption was compared to a water droplet which disturbs a pool of still water, generating ripples across the water surface which is called as the Ripple Effect in which the disturbance start to generate across the pool of water or the SC network, both up and downstream. Moreover, partnerships and outsourcing improved their interdependencies among distinct SC networks where disruption was prominently explained based on its time and intensity. The intensity and time of propagation among disrupted node and its trading partners are designed based on the lead time, transaction records and inventory parameters. The results showed that the suggested time - based model would have the ability to predict the quantitative impact of disruption which will be happening at different nodes, thereby affording more effective management action.

G. Multiple sourcing strategies in supply chain management

ZHOU Xiaoqiang and FANG Huijiang in 2009 started their work based on the fact in 1997, the fire broke at a supplier's factory where brakes for Toyota were manufactured this incident resulted two weeks of closure for 18 assembly plants and the direct losses amounted to $195 million. Later that incident, frequent emergencies, such as natural disasters, terrorist attacks, public health events, strikes, fires, etc had brought many difficult challenges to supply chain globally. To analyze the situation, they considered a two-echelon supply chain comprised of two homogeneous suppliers and one purchaser, the purchaser could synchronously order from two suppliers, but the suppliers couldn't complete the orders because of different emergencies. Hence considering the supply disruption risk of each supplier they proposed a procurement process in which the purchaser selected the primary procurement strategy and the supplier ordered from the suppliers when times of normal situation and also during stochastic demand, then a SC network was built using a Decision Tree with the probability of disruption and service fulfillment. This study has three major conclusions, they are: Primarily, multiple sourcing order quantities will be averagely allocated to two homogeneous suppliers. Secondly, multiple sourcing will have less single sourcing than total order quantity, so it will provide with insurance function and inventory reserve to the whole supply chain and purchaser in order to protect against emergencies. Thirdly, if the demand follows the uniform distribution, the expected income of single sourcing will be lesser than that of multiple sourcing, that is where, the optimal policy for enterprise's supply disruption management will be the optimal policy.

H. Disruptions caused due to pandemic COVID-19 on health care supply chain system

Abid Haleem, Mohd Javaid and Raju Vaishya these authors discuss about the pandemic situation caused due to COVID-19 (Corona virus) has been the main cause for slowing down the global economy thereby affecting day to day life. This being a new viral disease spreading exponentially region wise is affecting humans for the first time, vaccines are not yet available so the emphasis is on taking extensive precautions such as extensive hygiene protocol (e.g., regularly washing of hands, avoidance of face to face interaction etc.), social distancing, and wearing of masks, and so on. Most of the countries have slowed down their manufacturing of the products, various industries and sectors are affected by the cause of this disease; these include the pharmaceuticals industry, solar power sector, tourism, Information and electronics industry. This virus creates significant knock-on effects on the daily life of citizens, presently the impacts of COVID-19 in daily life can be divided into various categories: healthcare, economic and social. Focusing on the health care category it starts with the personal hygiene essentials to the isolation ward essentials according to the protocol mentioned above, the virus has disrupted the supply chain of the health care causing shortage in the total number required. This being an global issue the supply of raw materials or the hygiene protocol are given high priority to overcome the situations such as challenges in the diagnosis, quarantine and treatment of suspected or confirmed cases, high burden of the functioning of the existing medical system, Patients with other disease and health problems are getting neglected, overloading of medical shops and requirement for high protection of medical supply chain.

I. Health care supply chain disruption during natural disasters

Irwan Syahrir, Suparno, Iwan Vanany in 2015, presented a preliminary report on the healthcare supply chain during natural disaster. Social insurance flexibly chain incorporates the accessibility of clinical needs, for example, clinical gear, medications, hostile to infection, immunization and so on which must be satisfied to the catastrophe casualties. At the point when a cataclysmic event happens, ordinarily the measure of interest for clinical requirements will increment pointedly, so a urgent issue which frequently discovered are deficiencies of medications, an unevenness between the measure of the accessibility of prescriptions in emergency clinics and the quantity of patients in case of calamitous like pestilence flare-up. Human services flexibly chain the board ought to be working viably and productively in a fiasco relief activities, in this manner quick reaction and addressing the requirements of meds during the pestilence advances gets fundamental. Another methodology was led to concentrate on controlling a pandemic assault through calculated activity for drugs at the hour of the debacle. Medicinal services SC in a fiasco the board tasks has a significant job that isn't just to accomplish a help quality, yet in addition the wellbeing of the patient henceforth close to home and defensive hardware was on a significant core interest. This paper recommends building stock models that can take care of issues of gracefully chain in co-ordinations procedure on the emergency clinic, to be considered as a key anticipating stock limit and coordination between capacity systems in a debacle aid projects with utilizing stochastic program approach. The utilization of data innovation in social insurance alongside the utilization of RFID innovation in

the medicinal services framework becomes research pattern which is drifting even today. Along these lines, a casing work for fiasco alleviation gracefully fasten that can adapt to the issues that emerge in case of outrageous conditions and loaded with vulnerability stays a test.

J. COVID-19 impact on transportation and health

Charles Musselwhite, in his journal on transport and health has discussed the implications of COVID-19 on transport and health. First, the various ways by which the COVID-19 disease is transmitted, its spread via droplets, contaminated hands or surfaces are explained. The journal then discusses how hypermobility of the societies across the world spreads such a disease very quickly. Studies show that, COVID-19 has spread more rapidly due to increased globalization and the first epicenter's (Wuhan) accessibility and the abundance of connecting flights, the timing of the outbreak during the Chinese New Year, has enabled the virus to spread throughout the country, and eventually, globally, in a very short time. This has caused countries all over the world to introduce lockdowns which curtail mobility and this has had significant repercussions for work and also for fulfilling everyday duties. The paper then goes on to discuss how public transport also contributes to the spread of the disease. Analysis shows that virus can live for hours or even days on hard surfaces. These vehicles can become a significant source of microorganisms when passengers do not close their mouths when coughing and sneezing. Handrails, ticket machines, smart-card machines, doors, handles, windows, panels, floors, elevators and seats are areas that can host infectious microorganisms. It suggests Virtual mobility as a solution to keep people active and connected when mobility ceases. The paper concludes by stating the positive advantages for transport and health such as reduction in pollution, fewer road traffic injuries and reduced community severance.

A Case study being the contextual analyzer, on organization techniques are utilized to examine the business issues of a firm systematically by recognizing either research-oriented issues and breaking down them to make new information or to become familiar with a superior method of solving problems related with such issues. In like manner, contextual investigations are considered as a subjective examination technique in business management research. Contextual analyses mostly center around to examine and break down an association and its business to see new data to give answers for guaranteed or distinguished issue. Now and then, the contextual analysis may concentrate on talking about a solitary issue or numerous issues of an association. These issues may identify with different parts of the associations business and its condition. A contextual investigation dependent on organization examination gives proposals or suggestions to improve the exhibition of the association. Organization investigation can be considered as the most incredible asset to learn new aptitudes required distinguishing, comprehension, and taking care of the issues to oversee and lead the orgabizations.

III. METHODOLOGY

In this section, we have chosen a case study of Hindustan Unilever Limited, a home-grown brand that has become a multinational company. The strategies adopted by this corporate leaves no stone unturned in cashing in on the tiniest niche markets available. Lot of exploratory and case studies have been made in this field. The strategies developed by Hindustan Unilever Limited which has been one of the most successful companies to foray into the emerging markets in South East Asia and successfully tapped the base of the pyramid in India. The critical aspect here is developing connection through the supply chain which should translate to a cooperative spirit which will leverage the strengths and overcome the weaknesses

A. Existing Method.

This method involved 3 phases in which the manufacturers, storage/warehousing, retailers/distributors reaching the end customers was designed as shown in figure 1.

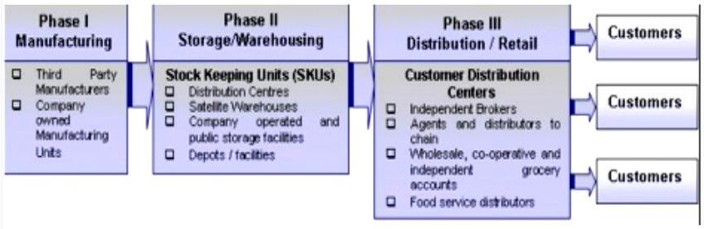

Fig 1:- Depiction of Hindustan Unilever Supply chain

This supply chain involving the three phases was adversely affected due to pandemic. Implementation of strategies such as multiple sourcing or ripple effect model would lead us to achieve the objectives of individual phases but not leading to a solution to overcome supply chain inefficiency.

B. Suggested Method

The disruptions due to pandemic across the supply chain are causing immense effects to the organizations. Based on the Literature review, this paper suggests a model that concentrates on the phases involved in the supply chain that suits pandemic situation like Covid 19. The three level strategic steps as shown in figure 2 can be implemented by the organizations to overcome the supply chain disruptions.

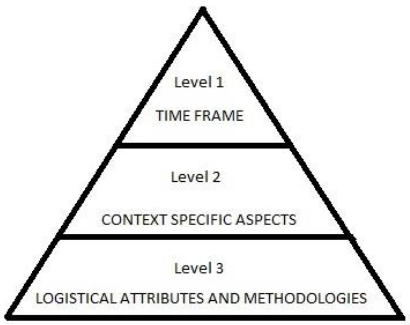

Fig 2:- Three level Strategic steps for pandemic.

These levels involving the time frame would focus on the details of demand and supply constraints over period, this level also focuses on the plans to be implemented strategically based on pre-pandemic and post-pandemic logistics. The LEVEL 2 and LEVEL 3 are well explained in the literature review considering various pandemic situations, affecting the supply chain in various sectors. The logical attributes and methodologies are to be implemented at the ground level in order to increase the efficiency and meeting the objectives of the organizations.

Further, this paper suggests a model which satisfies all the levels and constraints caused due to the pandemic for the effective work strategy in order to have maximum supply and demand fulfillment which leads to situations such as ripple effect.

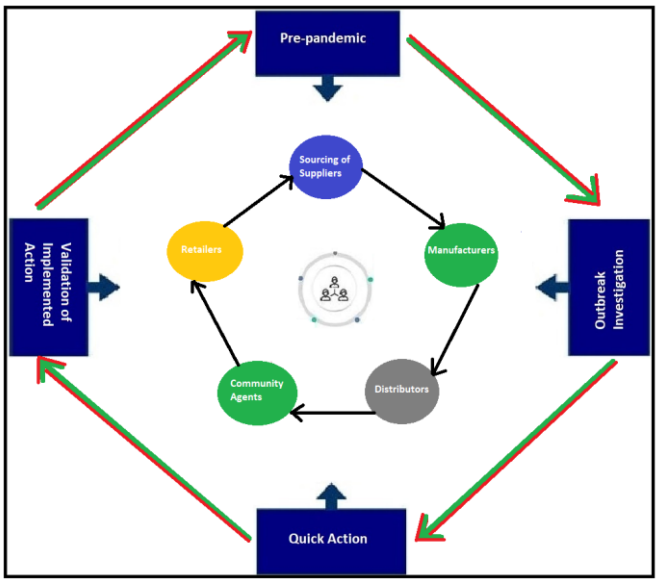

Fig 3

The figure 3 shows the stages as follows,

- Pre-pandemic conditions analysis- History proves that organizations are better prepared for the pandemic, emerge stronger and build long lasting competitive strength. Fast recovery requires preserving capabilities and capacity, making targeted investments and flexing up with agility.
  - Proactively sense the demand and identify opportunities and risks
  - Shift to shorter and more responsive planning cycles
  - Invest in advanced analytics capabilities to improve insight, visibility and speed.
  - Freeze, control and eliminate costs that aren't critical and redeploy to profit- and cash-favorable activities.
  - Invest in multiple sourcing to reduce shortage of supplies and to maximize profit

- Outbreak Investigation- Outbreak investigation involves the detection of any suspected outbreak and its confirmation by testing in labs. Logistics activities that support the detection and confirmation mechanisms of a suspected outbreak are (U.S. Agency for International Development, 2009; World Health Organization, 2005):
  - The provision of, emergency medical services and that will be used for analyzing the initial cases
  - The training of hospital staff to recognize unexpected patterns of the occurrence of specific diseases and to promptly identify and report suspected cases.
  - The provision of all the necessary resources for the hospitals and the medical centers.
  - The collection of specimens and their labeling
  - The secure transportation of specimens to the appropriate laboratory using cold storage.
  - The appropriate storage of specimens in the laboratory within a specific temperature range.
  - The procurement, handling, storing and distribution of laboratory commodities, their classification, their quality assurance and quality control etc.

- Quick Action- Covid-19 has taught organisations that future supply chain must include new performance measures such as resilience, responsiveness and reconfigurability designs, apart from cost, quality and delivery. Companies would also seek to diversify supply chains from a geographic perspective to reduce supply-side risk from one country. Multiple sources of key commodities or strategic components would be identified and protocols will be in place to activate alternative sources of supply in short notice. Many organisations would want to shift a part of their supply chains locally. This would lead to increased investment in India's local industries and would make the country better prepared for an economic crisis.

For instance, in the pharma industry, the Government of India has decided to promote domestic manufacturing of critical Key Starting Materials (KSMs)/Intermediates and Active Pharmaceutical Ingredients (APIs) in the country. This is an urgent wake-up call for Indian industry to realise the need to develop its own local sourcing units and adopt alternative strategies for reducing the dependency on other countries.

During the pandemics, it is important that the resources and commodities are delivered on time. In the existing method, it was noticed that stockpiling increased the lead time and made the process less efficient. In order to make the supply chain more effective and time efficient, it is suggested that this step must be eliminated. Authorised community agents can be employed to help deliver goods and services during a crisis. This would make the supply chain time efficient and would also act as a shot in the arm for an economic crisis as it provides employment and utilizes the country's resources, making it more self-reliant.

- Validation of implemented action- This phase is very useful as it provides strong insights which can be used to make necessary modifications to increase the resilience of supply chains, making it prepared for future pandemic outbreaks.

- bottlenecks or delays in the supply chain must be identified
- development of indicators regarding the performance of the logistics control operations
- assessment of coordination issues risen among the parties involved
- establishment and operation of rehabilitation procedures for pandemics.

IV. CONCLUSION

Pandemic outbreaks like Covid 19 have significantly impacted the supply chains all over the world. When the country is looking to become self-reliant, it is important to develop local sourcing units and adopt alternative strategies. These points highlighted in the paper. This paper discusses the case study of Unilever handling the supply chain well during the pandemic. It also discusses the existing framework of supply chain and its discrepancies. Th paper has attempted to suggest a methodology which makes the supply chain more efficient by eliminating stockpiling and having authorized and licensed community agents to deliver the commodities on time. The paper provides dynamic model addressing the unemployment during a pandemic situation by suggesting, having community agents. The model is illustrative and further research has to be conducted to observe the outcomes.

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