

Operations and Supply Chain Optimization – The New Era Model

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Abstract— The Covid-19 pandemic has demonstrated to the world that supply chain is the true lifeline of any business operation. The manufacturers had been hitherto concentrating on long-term planning to decide their future course of action and the organizational strategy. The Covid-19 pandemic exposed the futility and vulnerability of long-term planning and the need for short-term ad-hoc decision-making ability. This article is an investigative study of optimization of supply chain and hence operations in the new era of digitization and identifies scope for future studies and further development of ways to achieve operational excellence. The research shows that it is necessary to optimize supply chain and operations to build in resilience and flexibility to ensure faster response to unforeseen disruptions. Short term responsiveness is gaining popularity and building resilience must overtake forecasting to ensure shocks such as Covid do not throw businesses completely out of gear.

Keywords: Operation, optimization, supply chain, resilience, automation, digitization, transformation, operation management, supply chain optimization, operation and supply chain optimization.

1. Introduction

In the present world, businesses are highly competitive and dynamic, thanks to innovation, globalization, and the everchanging nature of technology and consumers' tastes and preferences. It is essential to streamline operations and supply chain to ensure efficient functioning of the organization. Supply chain has been identified by organizations as one of the key focus areas for developing and maintaining competitive advantage in business [1].

An efficiently managed supply chain can significantly curtail organizational operating expenses, thus boosting earnings [2].

A wide range of activities including procurement, management of materials, planning of operations, logistics, product dispersal and delivery, retailing, forecasting of demand and execution and completion of order, comes under the purview of Operations and Supply Chain Management (OSCM) and spans across both the manufacturing and service sectors [3]. In general, supply chain includes procurement and movement of not only raw materials but also finished products, whereas

operations management concerns itself with the creation of product from the raw materials and in case of smaller organizations the two can overlap [4]. This article scrutinizes models for optimization of supply chain and hence operations in the new era of digitization and identifies scope for future studies and further development of models for achieving operational excellence.

2. Literature Review

The origin of operations management lies in the need to resolve management issues arising within a factory, but since the middle of the 20th century scholars, teachers and practitioners started adapting the related knowledge to brace service operations as well [5]. Operations management is crucial to every business. Irrespective of the obstacles faced by an organization, having a strategic operations management plan ready ensures smooth and unmovable workflow and production. [6].

Opportunities in information management and communications have emerged on the back of scientific advancement and modern technologies for the fabrication and development of activities that affect operations and supply chain management. Optimization of operations and supply chain reinforces the entrepreneurial orientation of a business and augments the performance level. Operations management can help to design the finest ways to enhance the competence of entrepreneurs using supply chain management practices. Supply chain covers a wide array of disciplines, making the definition of supply chain somewhat ambiguous [7]. Essentially, supply chain refers to a grid or linkage that a company builds with its suppliers for producing and distributing a specific product or service [8]. Generally, supply chain is considered to be a sequence of activities (as shown in Figure 1) involving raw material suppliers, manufacturing facilities, finished product distribution services and last but not the least, customers; and flows of goods and information connecting them. In its most elementary form, a supply chain involves the activities that must be undertaken by an organization in order to produce products or services and deliver them to the consumer.

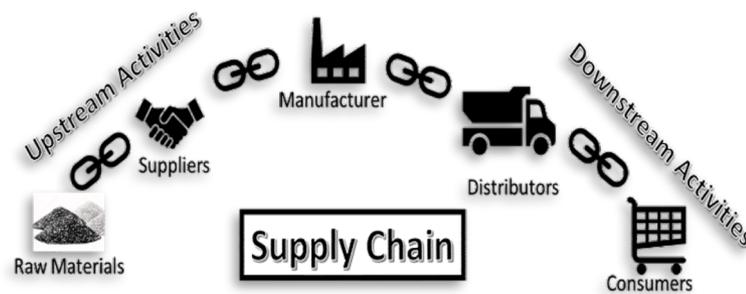


Figure 1. A Supply Chain

A supply chain, therefore, focuses on the fundamental activities within an organization that are necessary for the conversion of raw materials or constituent parts into finished products or services to be used by the end consumers [9]. In today's business scenario, an optimal supply chain design is all the more important for the success of an industrial concern.

2.2 Operation Enhancement Through Supply Chain Optimization (SCO)

Firms require operational competence, including teamwork, collaboration and reconfiguration [10]. It is imperative that they develop capabilities for handling uncertainties and acquiring competitive advantages reinforced by flexible supply chain. Researches in strategic management argue that competences can be deliberately developed using complex collaborations between resources.

Network resource optimization including network designing and the decisions regarding the location and the number of facilities, generally form part of an organization's strategic operations and supply chain management [11]. Optimization of operations and supply chain results in optimum utilization of both technology and resources such as blockchain, artificial intelligence (AI) and internet of things (IoT) for the improvement of efficiency and performance within a supply network.

The system or procedure of mixing the resources for removing bottlenecks and reducing other operational glitches that inhibit the manufacturing process helps the organization function in a cost-effective, smoother and a timelier fashion and is referred to as Supply Chain Optimization. It aims to guarantee the best maneuver and control of an organization's manufacturing and distribution activities. Being an important part of operations, SCO involves the optimal positioning of inventory within the supply chain, operating cost minimization which includes cost of manufacturing, transportation and distribution of products [12]. It plays an important role in optimizing operations.

2.3 Importance of Operation Management and Supply Chain Optimization

Supply chain management (SCM) and operational capabilities are crucial to a company's competitive prowess. Several studies have looked across supply chains, beyond their immediate area of research, to ascertain the connection between operations and SCM, intending to create a continuous flow of commodities, services and information from producers to the consumers. Despite their growing importance, the associations between SCM and operational competence are yet to receive any explicit focus [13]. International manufacturing and supply chain systems have been mostly disrupted because of the Covid-19 pandemic. Majority of policymakers and industry managers are seeking appropriate policies and approaches to overhaul production designs and satisfy customer demand [14].

Supply chain is a critical success factor for providing superior customer experience [15]. A supply chain that displays high performance, empowers a business by making it efficient and responsive to customer needs – helping to provide customers with what they want, at the time and place that they want thus helping to boost the organization's profitability and contributing to sustainability of the supply chain [16].

In order to ensure superior performance, not only the internal operations but also the different supply chain constituents need to be designed in the correct manner, and the apportionment of resources over the resultant infrastructure needs efficient execution. An optimally designed supply chain should, through a single or a variety of parameters, be able to reflect the finest organization, operation and management of all the elements involved. Hence, it is in the best interest of all industries to optimize their supply chains and operations, in some way. Resilient and sustainable practices are likely to play the key role during this period when the Covid-19 pandemic has wreaked havoc on international supply chains.

2.4 Challenges to Operation and Supply Chain Optimization

Competitiveness comes with consistent, comprehensive, and systematic optimization of operations across the entire enterprise. Globalization and state-of-the-art communications technologies have made numerous prospects available for operation enhancement. Nevertheless, the same progressions also result in stiffer universal competition, increasing pressure on both emerging industries and established firms for planning their operations, building and operating their supply chains in an efficient and as cost-effective manner.

Operations and supply chain optimization, in all probabilities, is likely to be a technologically challenging mission to accomplish, particularly where the dimensions are huge; especially for companies with global operations with supply chains spanning across the globe similar to Figure 2. Such supply chains are extensive and complicated system encompassing diverse supply, manufacturing, and distribution services. A variety of transportation options such as trucks, trains, planes and ships, with various lead times, connect these constituents, establishing a cohesive network called the supply chain. It is usually prone to various uncertainties, which includes but is not limited to alterations of prices of commodities at the global level and supply disruptions.



Figure 1. A Global Supply Chain

OSCM appears to be a long-drawn process because of various complexities involved [17]. One key challenge in the new era is increasing emphasis on green production which makes it imperative for businesses to increasingly adopt technology and inputs that will help to reduce carbon footprint. The necessary change will have to be implemented not just at one single point but throughout the entire supply chain. Operations and supply chain configuration need to improve to suit changes in the business environment. The current configuration that may appear to be the best combination of service and cost is most likely to change, gradually, in accordance with the changes in the business scenario such as instabilities in material costs, alterations in carriers, demographics of the customer or other issues that usually need constant monitoring and control [17].

Almost every corporate has to handle the impacts of globalization, its opportunities and challenges. A significant economic potential exists alongside the practical need for optimally designing and coordinating all activities undertaken by companies and supply chain entities. This will help to attain continuous and smooth operation of a large-scale and intricate supply chains in uncertain conditions. Over the last 2 years operations and supply chain management has been adversely affected by the new and specific issues of streamlining operations amidst turbulence, which made it challenging for corporates

to control businesses while everything seemed chaotic [18]. The Covid-19 pandemic considerably improved most organizations' environmental sustainability, despite cutting back the consumer economy and presenting industrial workforce management issues [14].

2.5 Method & Models of Operation & Supply Chain Optimization

A major reason behind the increase in importance of OSCM is ever-changing consumers' demand, tastes and preferences. An increasing number of customers have grown used to e-commerce and express delivery services that provide instant gratification. With the internet providing them a snowballing range of goods and services as also a significantly large number of vendors to choose from, businesses have no choice but to adapt by boosting speed and efficiency of delivering the right product to the right buyer. Decision-makers cannot avoid facing such operations management uncertainties as unexpected machine breakdowns and unpredictable or erratic vehicle travelling times, making resilience one of the key criteria for optimization, in recent years [19]. Information flow too is important.

Along a supply chain, information flows in the same direction as the goods it pertains to. However, additionally it may and should move in the direction that is opposite to the goods flow. The former case

supports the feedforward goods flow while the latter supports distribution of information on position and status of their products to the suppliers. Wasteful transactions, pilferage, swindling and futile supply chains performance, are some of the causes behind greater lack of trust, which gives rise to need for improved information distribution and verifiability [20].

Optimization often entails the application of techniques of mathematical modelling through the use of computer software and is considered to form a part of operation management, despite the latter's primary focus on mathematical modelling techniques, and the fact that operation and supply chain optimization can be done using management-centric qualitative techniques. By and large, operation and supply chain optimization typically commences with the use of advanced planning and scheduling (APS) technology that helps in detailed analysis of anticipated demand, and gradually progresses through the development of production, inventory design and logistics for meeting the said forecast, providing an opportunity for examining better e-commerce integration potentials using an omnichannel strategy and includes inbound raw materials or inputs, production, transportation and distribution [17].

The APS technology uses a variety of methods to investigate operation and supply chain data and design simulations that can help SC planners for making decisions that help to successfully achieve their targets. Generally, businesses engage consultants and avail their services for managing the optimization procedure and implementation of technological and company-wide transformations necessary for ensuring that the outcomes of the procedure survive in reality [17]. The modern era has seen the application of the following models for supply chain and hence operation optimization.

2.5.1. *Blockchain Technology*

The concept of blockchain technology (BT) first appeared in 1991 [21] and the term was first objectified by Nakamoto as Bitcoin for money exchange among peers. Blockchain makes use of blocks for data storage and implementation of individual cryptography strategies in order to maintain data privacy [22].

Being a peer-to-peer network of information technology (IT), the blockchain keeps records of transactions in digital asset employing distributed ledger technology (DLT) with no intervention from such intermediaries as governments and financial institutions [21]. Thus, BT can reduce the risks associated with interventions of intermediaries, including hacking, contractual quarrels, negotiated privacy, susceptibility to political instability, expensive compliance with government rules and regulation, and uncertainties associated with financial institutions [23].

The blockchain technology presents significant possibility to promote and nurture several sectors [24] with its inimitable combination of decentralization, security, immutability, traceability and transparency [21]. Blockchain technology is disruptive in nature – its introduction led to critical disruptions in traditional business processes as it led to the decentralization of the applications and transactions, which required centralized architectures or reliable third parties for their verifications, with equal level of certainty [25].

2.5.2. *Artificial Intelligence (AI) Operations & Supply Chain*

AI refers to the capabilities of machines to both communicate with and imitate human skills. It can be used to solve problems having higher quantity of inputs, with greater precision and speed [26].

Usage of AI is spreading across operations and SCM. Operation management support tools, such as the ones that process historical data for demand forecasting, ERP systems that automate ordering, management systems for warehousing and transportation that improve storage and transportation operations, can be carried out as a siloed application, or in cohesion with several of the corporate operations, including financial accounting or management of supplier relationship and this integration helps to share data with a shared platform for data [27].

Large-scale and extensive accessibility of data, along with continuous improvements in computational prowess, has opened up novel opportunities for the enhancement of operation and supply chain decision-making [28]. Data is likely to originate from application of digital logistics, or the association of assets through another technology called the Internet of Things. AI also has the capability to ease the automation of definite workflows [27]. AI energizes and enhances human competences. Despite the fact that AI is able to accomplish several tasks with greater accuracy, speed and agility, we believe that the job of the operation planner will still remain very much in vogue [27]. Many companies in Asia used simulation employing artificial intelligence to predict how the corona pandemic could take shape which helped them to be better prepared for the ensuing disruption [29].

2.5.3. *Internet of Things based Operations & Supply Chain*

In the context of operations and SCM, Internet of Things or IoT refers to linking different data points, assets, processes, systems and people for achieving goals such as superior operational competence or high-quality demand forecasting for finished products and the practice is growing even for minor enterprises [30]. The system of IoT employs

connections between to devices to attain the same final goal of supplying commodities or services to the consumers, albeit with higher efficiency [31]. Implementation of IoT platforms and enabled devices will lead to quicker assimilation and application development [32].

In the IoT supply chain, devices are capable of effectively tracking and authenticating products as also shipments through the efficient use of GPS and additional technologies also monitoring product storage conditions thus enhancing the quality of management across the supply chain [33]. IoT presents innovative breaks for mitigation of risks, management of difficulties thus providing concrete commercial benefits on the back of growing transparency and better resilience throughout the supply chain [31]. The intricacies of logistics can be exhibited, examined, visualized, and enhanced using dedicated simulation software [34].

2.5.4. *Lean Operations & Supply Chain*

This is the era of globalization. Operations have transpired into extended enterprises that link companies across locations and enables partners to acquire and augment competitive advantage. Firms have understood that efficient operation and SCM is imperative for effective management of daily operations [35].

A key initiative adopted by major commercial enterprises across the world for remaining competitive in an increasingly aggressive global market, is the lean philosophy [52]. Implementing lean operation principles commences with detailed analysis of organizational processes and identifying alternatives ways with higher efficiencies to attain business targets [36]. The lean approach focuses on cost reduction through the elimination of non-value-added (NVA) activities and putting to use lean tools for the purpose of being sustainable and for the optimization of supply. Lean organization appreciate customer value by focusing its vital processes on incessantly increasing it.

For a lean supply chain, the principal focus is on the creation of a modern, rational and highly efficient system that manufactures finished goods at a frequency that is in consonance with the consumers' demand with minimal waste. Several supply chains, especially the ones targeting performance improvement through waste reduction, apply the lean philosophy [35].

2.6 Present Scenario

Present-day business enterprises are witnessing significant modifications in operational and supply chain complexities [37]. Highly competitive business environment has resulted in the rising popularity of lean practices [38] resulting in the need for uninterrupted processing of flows without high volumes of inventory, smooth and just-in-time (JIT)

manufacturing and perfect transport scheduling for cross-docking operations making better cost-effective and supply chains that react faster [38]. In addition to this, the mounting pressure for reducing costs has resulted in both outsourcing and offshoring of several manufacturing as well as research and development (R&D) activities, specifically the sourcing from countries that offer these services at significantly lower costs. All these trends put tremendous pressure on corporates to present focused operations and steady environments, but at the same time increase their susceptibility to disruptions which in turn enlarges both operational and financial outcome of disruptions of supply chain [39].

Several challenges have been faced by supply chain networks across the world due to such factors as highly volatile demand, short product lifespans, and dissimilar expectations and requirements forthcoming from consumers. Supply chains have adjusted, altered and modified themselves in accordance with these challenges which has enhanced their complexities thereby resulting in higher uncertainty and greater volatility. Along with handling its fundamental functions, such as ordering and receiving goods or services, management of physical cargos [40], supply chains central to business operations and are responsible for management of movement of information and sustaining and maintaining core activities of a business such as planning and estimating, purchasing, customer service and measuring performance [41]. Information acts the pivotal element around which every supply chain function [42].

Novel talent and technology combinations enhancing competitive edge, customer experience, and operational effectiveness. Positive outcomes of digital transformation include streamlining processes, data harnessing or novel business methods, uniting fragments of the enterprise with a shared objective [43]. Information flow is the key element in the supply chain that is needed by stakeholders to initiate novel processes or envisage their present status. Additionally, every movement of products is recorded at both entry and exit points and records are maintained of their locations and their legal documentations and various other processes that are intrinsically required at individual stages are also handled which makes it easier for interested parties to acquire information regarding their products and services all through the process [22].

The evolution of supply chain continues at a rapid space, matching the rapid advancements in modern technology [44]. Today one of the most critical business functions in supply chains is SCM. Modern corporations are focusing strongly on radical improvement of their supply chain operations for several reasons such as timely identifying and

subsequently gaining from demand volatility, forecasting supply constraints, overcoming supply shortages or restricting the effects of cost escalations [45].

2.6.1. *Emphasis on Sustainability & Green Supply Chain*

Owing to the growing concern for global warming companies are taking several measures and trying to reduce their carbon footprints. One such endeavor is the implementation of sustainable operations through green supply chain. Sustainability refers to companies' efforts to consider the environmental and human impact of their products' journey through the supply chain, from raw materials sourcing to production, storage, delivery and every transportation link in between [46].

For majority of corporations, the efforts concentrate on development of sustainability analysis systems and measures as well as incorporating them within the operation and supply chain strategy. Towards this end, the initial steps included mechanisms that integrated the models of reverse logistics or reverse flows within supply chain strategy, which includes concepts of materials recycling and resource systems sustainability [47]. From a wider perspective, globally the sustainability concept has played an important role in influencing socio-economic and environmental policies. Economic, environmental, and social sustainability are essential features of a really sustainable supply chain [48, 49]. Corporates across the world have endeavored to diminish their carbon emissions, reduce waste generation and better labor conditions. Pursuing sustainability metrics in SCM systems, allows them to monitor complex programs such as, prioritization of renewable energy, products and materials recycling or urging greater suppliers to demonstrate higher social responsibility [46].

2.6.2. *Emphasis on Automation*

Automation of operation refers to the application of digital technologies such as Robotic Process Automation (RPA), Artificial Intelligence (AI), Optical Character Recognition (OCR), and robotics for cutting a product's operational costs, improve productivities, associate applications and rationalize processes involved in supply chain operations [50, 51]. It has the potential to prepare systems which can react to hostile conditions with the least delay [52]. The Covid crisis has displayed the deficiencies of operations and supply chains. Large commercial entities could neither match the rhythm of sales nor satisfy the market needs leading to undersupply of finished products [53].

Supply chain automation involves processes such as selection and packing that use up valuable time of employees that could otherwise be spent more productively on higher-level jobs that need human

intervention [52]. Partial or complete automation of operations and supply chain has the potential to confer several benefits upon a business including manual labor reduction and at the same time increase output, efficacy, and precision [54]. The primary management concentrates on the sourcing, optimization, management of orders of the stockrooms to handle the demand, and at the end makes sure optimal consumption of transportation services – proving beneficial in the medium to long run [53].

2.6.3. *Disruptions*

Supply chain disruptions are events that result in disruptions in the manufacturing, selling, or distribution of goods and are likely to have crucial impacts on industries and companies [55]. Besides creating price escalations and scarcities among expensive and sophisticate consumer goods, such as vehicles, supply chain disruptions also disturb more essential commodities including generic drugs and energy, raising cost of living for the general population and making provision of basic needs more difficult [56].

The causes behind disruptions fall into one of the following categories

- I. Natural disasters
- II. Transport disruption
- III. Geopolitical instability
- IV. Price increases
- V. Technological disruptions

[57, 58]

Various parts of the world have time and gain witnessed supply chain problems that grew worse due to various reasons, such as, Chinese power shortages have adversely impacted country-wide production recently, Brexit has been a key factor causing shortage of truck drivers in the U.K., thanks to Covid-19 pandemic the U.S. too is struggling with scarcity of truckers while Germany has been experiencing serious backlogs at its ports [59].

Given the growing occurrence of catastrophic events over the last few years especially over the last couple of years, it has become imperative for corporations to modify operations and adopt risk planning services to ensure flexibility and resilience [55]. The disruptions are happening rapidly, forcing the supply chain leaders to challenge the past orthodoxies to address strategic issues arising at present and develop robust supply chains for future [60]. This article concentrates particularly on the disruption caused by the Covid-19 pandemic.

(a) *Covid disruption*

Covid-19 pressurized and disrupted operations and supply chains [61, 62]. The pandemic was unique in the sense that it has transpired as the first long-term crisis witnessed by companies across industries and borders amongst all the crisis occurring in the last

decade which were typified by shifting of manufacturing to outsourcing from insourcing, from regional to international, and from superfluous to lean [18]. For several industries and companies, hitherto farfetched disruptions became a stark reality as businesses struggled to handle sourcing problems to avoid the shortages looming at large, especially in case of crucial medical supplies, edibles, and other essential items [57].

Additionally, years of relatively stable business environment had made the managers and managements get used to a steady demand-supply scenario thus creating a mindset that was fit for crisis-free management and not disruption management. Most believed that they had risks and uncertainty under control and concentrated on long-term planning, building lean network structures that were inelastic. All of these led to chaos and disarray when Covid-19 struck. The pandemic confronted SCM from angles both novel and distinct. It made them change their logistics approach to one which was dynamic and adaptable, flipping between fixed and flexible processes while discovering new modes to ensure certainty while being in the throes of uncertainty [18].

Managers realized that the need for making short-term decisions and the important role played by technology in reducing the decision-making time while improving decisions quality [63]. However, greater technology dependence for operation management makes the companies vulnerable to IT-related risks that need to be alleviated as also monitored by the administrating body [64].

Covid-19 exposed the inherent vulnerabilities and structural weaknesses of global supply chains. Through perseverance and determination, several companies have been successfully able to modify their operations and transform their global supply chains to be able to deliver against the odds, which has made it even more essential for executives to leverage their recent experience and the consequent knowledge to better prepare for the future [60].

Another key challenge is coping with a situation where consumer demand is soaring along with their expectations; while supply still remains highly challenged by the labor scarcities, raw material shortages and accessibility restrictions reeling under the influence of lopsided global supplies resulting from the global pandemic [60]. Lack of awareness of after-shock risks among inventory and capacity management teams can cause significant destabilization by disrupting the production–inventory equation thus leading to inferior performance in the period following the Covid disruption [18]. Inadequate productions and cost escalations are the obvious outcomes. Supply chains facing demand deferment and capacity shutdown during this pandemic are specifically susceptible to disruption tails [65].

3. Research Methodology & Research Contribution

3.1. Methodology

This research uses literature review and case studies to highlight the evolution of supply chain in the present era. The focus is on operational modifications the took place following the disruptions caused by such factors as technological innovations and global pandemic.

3.1.1. Literature Review

A literature review studies and reviews books, news articles, magazines, scholarly articles, and any other resources that are pertinent to the subject matter or area of research and in the process, presents an explanation, a portrayal, a synopsis, and a critical appraisal of those literary works that relate to the research problem that is under investigation [66].

The relevance of literature review has gradually soared in the view of the rapid development in business research leading to proliferation of knowledge which makes it harder for researchers to stay abreast of all the up-to-date and relevant information pertaining to any faction of business research or scrutinize the available evidence. Moreover, this knowledge is associative, multifaceted and disintegrated [67]

3.1.2. Case Study

This study combines case study with literature review to gain a detailed understanding of the developments in supply chains in the Covid and post-Covid situations. The aim is to understand how a few organizations such as Amazon and Tesla are moving ahead of the curve to remain viable even in disruptive situations.

As a research approach case study helps to produce an all-round understanding of various aspects of a complicated issue in a realistic background. This is a recognized research methodology that is applied extensively across disciplines, especially in case of social sciences. Case studies are also used to elucidate or explore occurrences or phenomena in the day-to-day contexts in which they take place.

We have selected Amazon, Tesla, Unilever, Walmart and Pizza Hut from 5 different industries – online retail, automobile, fast moving consumer goods and or FMCG, off-line retail and restaurant, respectively, which are some of the industries that are worst affected by the global pandemic [68].

3.2. Research Contribution

Operation and supply chain optimization is maturing as a subject and the rising significance of energy and sustainability issues provide ample opportunities for research in operation streamlining and supply chain design. Logistics and SCM are important areas of

research. However, literature reviews on the topic are very limited. Optimization plays a key role to effective operations management especially during challenging times. This article takes a specific look at how optimization played a key role in building resilience that has helped large companies, with global operations, to survive the Covid disruption and creates further scope for research on the topic.

4. Case Study

4.1 Companies that are getting ahead of the curve

An extremely destructive economic issue that surfaced during Covid-19 was disruption of global supply chains. With the lifting of lockdowns, demand soared. Supply chains got disrupted and are still confronting significant challenges in recuperation. This outcome has been chaotic for product manufacturers and distributors. They failed to deliver pre-pandemic volumes of products due to reasons such as shortage of labor and dearth of raw materials and component parts. [59].

Lockdowns during the earlier days of the pandemic resulted in forced shut down of stores, overnight, leading to such incidents as hoarding of grocery and apparel overstock, along with changes in consumer behaviors and business practices that are likely to have a permanent impact on industry dynamics, urging the retailers to shift hurriedly to e-commerce [69]. In the areas affected by Covid-19, consumers had been hoarding dry groceries, cleaning supplies and paper products [70].

With the easing of the pandemic situation, the retail space appears redesigned, as several players have been devastated by the disruption while several others received significant bounce in performance [71]. Retail stores are re-opening leading to accelerated application of digital technology for transforming both online and in-store engagement and experience of the customers [72].

4.1.1 Amazon

Amazon has been an outstanding performer even amidst this global pandemic, playing an important part in making daily essential supplies available to consumers. Its focus has been on projects that match the ways in which Covid-19 has restructured economies, industries and shopping habits, across countries [73]. Amazon accounted for about 4% of pre-pandemic retail sales in the U.S.A. [74]. Its Corona-disruption-fueled surge in revenues facilitated the growth in its e-commerce market share [75]. At present Amazon accounts for 43.5% of e-commerce in the USA [76, 79].

During the first half of 2020 Amazon was losing share in total e-commerce market in the U.S., despite rising sales [77, 78]. Amazon lost market share to Walmart (4.2% to 5%) and Target (2.2% to 3.5%),

who benefitted mainly from sizeable bricks-and-mortar store networks, enabling speedy delivery and pick-up by consumers [69]. However, fresh bolts of the pandemic disruptions exposed weaknesses in these channels. As consumer demand continued to build up markets became undersupplied.

Speeding the adoption of e-commerce boosted Amazon's other business areas, keeping it on track to turn into one of U.S.A.'s biggest delivery companies. Of late, Amazon has created its own shipping operations that competes with FedEx and the U.S. Postal Service [80]. The company possesses an ever-expanding network of "warehouses" and "last-mile delivery stations", and an extensive logistics operation including vans, trucks and planes [75]. This helps Amazon deliver almost 66% of its own packages which has been particularly during the COVID-19 pandemic when the company had to handle the pressure of increased demand for online orders [81]. With the easing of the COVID situation shoppers are returning to the conventional bricks-and-mortar stores. However, buying tendencies have not gone back to the pre-COVID state and that is expected to sustain [82].

In a further step to optimize operations and SC, Amazon has started manufacturing its own containers which helps to bypass SC disarray using chartered ships and long-distance aircrafts [83]. This has facilitated avoidance of exorbitant price rise. The pandemic caused shortages of shipping containers globally leading to huge rise in freight rates from China to the US which multiplied by almost 10 times from around \$2,000 previous to the pandemic, in a little over a year [84]. Nevertheless, according to CommerceIQ, that provides platform for e-commerce management, during 2021 Amazon witnessed 14% increase in out-of-stock items and 25% rise in average price [83].

Amazon is also investing heavily in autonomous self-driving truck systems and electricity powered trucks that will help it be ahead of the curve and beat the problem of driver shortage [51]. Amazon is buying 100,000 electrical vehicles for product delivery and over 1000 autonomous truck-driving systems called Plus Retrofit, from the self-driving trucking startup Plus, that produces software for trucks using AI technology [85]. Amazon's collaboration the autonomous driving technology developer for long-distance trucking [86], has the potential to eliminate the need for human drivers. Amazon is exploring a future in which companies would completely do away with the reliance on humans for driving delivery vehicles [85]. Through the application of the technology used by Plus, Amazon could find a solution to problems such as the national labor unavailability that seriously affected the trucking industry especially during the pandemic, causing transport-cost escalations and delays delivery of even essential goods [85].

4.1.2 *Tesla Inc.*

Austin-based electric vehicle (EV) and clean energy firm Tesla Inc., has better managed supply chain issues compared to most automakers through the use of chips that are less scant and quick re-writing of software resulting in handing over its highest ever number of automobiles to clients in spite of supply chain disruptions due to the global pandemic [87]. In 2021 Tesla's factory output was constricted by directing its resources towards vehicles modification and manufacturing with a view to coping with chip shortage and other supply-chain issues that will continue even in 2022 and has also prevented Tesla from rolling out new vehicle models in the present year [88].

Hitherto, the company could cleverly circumnavigate most supply chain crises and had successfully overcome even the U.S.–China trade conflicts that constrained manufacturers worldwide [89]. Tesla's employees, unlike other automakers, do not belong to any union, making it easier for Tesla to modify its operations meaningfully, especially to circumvent COVID disruptions [90].

Tesla is facing difficulties in acquiring certain raw material for an in-house battery cell development, that is available only in China, pointing at continuation of supply chain crisis. The resultant logistical delays and the associated problems are gradually becoming substantial obstacles, slowing down progress and production [89].

Global automobile industry has been rocked by shortage of semiconductor chips along with port delays that delayed manufacturing goals got aggravated due to COVID restrictions in China [85]. The pandemic made it difficult for Tesla to scale up production in China, since these restrictions deterred Tesla from getting engineers for its factories [91]. Worldwide container-ship shortage and port delays have impacted Tesla's industrial supplies in the US [85] and its delivery volumes adversely [91].

Tesla provided its customers the option to take vehicle delivery with some parts, such as Bluetooth chips and USB ports, missing [92]. Tesla also eliminated certain features such as front-seat passengers' lumbar support and radar sensors, thus removing a lot of manufacturing complexities; and also removed 1 among 2 electronic control units that the steering racks had, in some China-built models [93, 94, 95].

Tesla also raised vehicle prices to tackle higher costs, including "expedite costs" for parts and an American consumer ordering for a Model Y version would have to pay 18% and wait for 7 months [92]. Integration of global operation help to continue production in China when the Texas factory was reeling under the pandemic thus balancing performance [96].

In a bid to clear production backlog, Tesla substituted alternative chips where there was short

supply. Its ability to designs hardware and write software provides it a competitive edge. To optimize operations, majority of the sophisticated software that controls Tesla vehicles are designed internally. It also fabricates the chips implanted in its driver assistant systems and internally manufactures components ranging from seats to battery cells. In terms of optimizing supply chain, Tesla maintains specific direct sales, service and charging networks resulting in superior customer experience [97]. 2020 witnessed several automakers reducing chip orders with the pandemic caused lockdowns hitting demand. Tesla, however, neither cut down production nor its estimates with suppliers, thanks to rapid growth anticipation, thus surviving the chip shortage [97].

4.1.3 *Unilever*

With the rapid spread of pandemic in 2020, Unilever had to develop its workforce strategy quickly to protect employees. With products being supplied to 190 countries and a headcount of 149,000 Unilever is present almost all over the globe supplying products to 2.5 billion consumers [98]. The pandemic and lockdowns and resultant store and factory closures threw many businesses out of gear as none could predict such a situation or estimate its impact. It called for an agile supply chain capable of being dynamically managed to accommodate external fluctuations. Moreover, it highlighted the need for businesses to collaborate, or strike partnerships and alliances for remaining responsive and flexible [99].

Unilever partnered with PA Consulting for coping with the challenge, and built state-of-the-art predictive tool, COVID-19 Awareness and Situational Intelligence (CASI) [100]. Its Indian arm, Hindustan Unilever (HUL), was able to recover its operations speedily using strategic alliances. Its collaborations with manufacturers and other industries helped to cater to the growing demand for certain products. During the pandemic consumer needs evolved fast which made product innovation imperative for Unilever as also develop more sophisticated communication and marketing channels to stay relevant as much of the consumers shifted to online mode [99].

In order to respond to record levels of fall in certain countries and categories simultaneously, Unilever unraveled new levels of agility [101]. Its "supply chain has shown that it can switch off, switch on and adapt at pace" [102]. For Unilever the pandemic hastened digitization, and enhancement of agility, resilience, and sustainability leading to enormous business agility as well as immense personal agility all across the organization [103].

The Group's robust sales and earnings performances in 2020 and 2021 testify Unilever's agility at adapting crucial components of its product portfolio for meeting new customer demands whilst fine-

tuning its supply chain and employee workflow for handling the pandemic-triggered disruption [104, 105].

Prior to COVID-19, Lifebuoy hand gel - was a product that comprised only a small portion of Unilever's global business. Today, however, the brand is a €1 billion brand [106]. For optimizing operations, during 2020, Unilever vigorously shifted resources from the worst-affected business segments such as Unilever Food Solutions as restaurants pulled down shutters, to businesses that continued to grow, such as sanitizers [103]. The company is reorganizing its human resource (HR) in order to increase its responsiveness to both customer and channel trends, while having transparent delivery accountability [107].

The pandemic revealed the actual strength of Unilever's competence in technology and data-driven decision-making that helped to ease several challenges faced due to COVID restrictions. For instance, Shikhar, HUL's B2B (business-to-business) ordering app, enables large number of retailers to safely place contactless orders while offering them visibility into order fulfilment through logistic associations and interactive interfaces [99]. Unilever leveraged agility to adapt its business to COVID-19 by modifying its supply chain and manufacturing operations [108] which allowed it to emerge triumphant even amidst trying situation.

4.1.4 Walmart

Organized retailers have been hit hard by mall shutdowns and shop closures while the impact on retailers of essential goods remained minimum [109]. While demand remained strong, deliveries got affected due to restrictions on transport movement, both national and international, leading to huge built up of stock of undelivered products. Besides general explosion in online sales, Walmart saw a huge uptick in demand for delivery and pickup services [110]. It offers wide variety of products including groceries, pharmacy and financial services.

Walmart took few actions in order to be best able to serve its customers. The company diverted shipments via less jammed ports using chartered ships which expedited delivery and helped to circumvent supply chain disruptions [111]. Walmart also rerouted domestic shipments, using less orthodox methods of transportation to avoid delays caused by shipping through rail [112].

In terms of automation, Walmart is expanding its automation capabilities in existing facilities using technology that is set to transform the supply chain by facilitating and expediting product deliveries to stores from distribution centers [113]. The company has also expanded storage capacity of its fulfillment and distribution network through addition of new stores that will also operate as market fulfillment centers [114].

Walmart also invested in its supply associates through wage investments throughout the year and continues to do so for acknowledging their extraordinary efforts, as also to meet growing consumer demand [115]. Walmart has already hired over 3,000 truck drivers and over 30,000 supply chain employees while promoting and training many more and more hiring is underway [116]. About 20,000 permanent supply chain positions were created to ease and quicken product movements through Walmart facilities [117]. The expansion of Walmart's delivery capabilities is being given effect by routing online orders straight from stores using present local delivery capacities thus lessening delivery times to customers [118]. In a bid to ensure that the company has adequate number of associates available to help customers and fill online orders, Walmart continues to hire aggressively [115]. It has hired 150,000 associates across the country to ensure that it is in position to serve its customers irrespective of whether they decide to shop online or in stores [119].

4.1.5 Pizza Hut

COVID-19 disruption has been noteworthy for the restaurant industry. While it has led to significant decline in conventional food deliveries, contactless delivery and distant dining are rapidly growing and are set to become the new normal [120]. Despite restaurants remaining shut and customer collection remaining unavailable during lockdowns, pizza ordering and delivery remained robust. Therefore, all transactions had to occur online, and were being distributed using contact-free delivery, and not customer collection [121].

Rivals such as Papa John and Dominos had already started offering contactless delivery [120]. Pizza Hut commenced making use of advanced analytics in order to optimize its online sales throughout the pandemic situation, especially when the restaurants remained shut by government order [121].

Pizza Hut, which has been combatting sliding sales over the last few years due to closure of outlets and grinding competition [122], witnessed its best time in sales in 8 years – both delivery and carry-out, amidst the pandemic [123]. Pizza sales grew phenomenally with focus on contactless delivery.

Several Pizza Hut restaurants, most of which are at dine-in locations and are not well suited for either carryout or delivery are being shut down, as a substantial number of customers are preferring to eat at home. Shutting down these stores will make it possible for Pizza Hut to divert resources towards more productive investments such as smaller stores that can better handle orders placed online for optimizing operations. After closing down 1,745 restaurants globally, while opening 682, the brand saw its lowest number of venues in 2020, making it imperative for the system to evolve from predominantly a dine-in format to one that allows

greater number of carry-out giving rise to a host of “delco” stores that are delivery friendly [124]. “The Hut Lane” unveiled in March 2021 is a window dedicated for digital order pickup – a feature accessible by customers through the Pizza Hut’s app or online, followed by a drive to the dedicated window [124]. These were developed to cater to the transformation in the consumer behavior during the pandemic as the company expanded ways for customers to collect their pizzas while limiting human contact at the same time [125]. It offers both convenience and speed without ever needing vehicle parking, eliminating the need for order board and ensured zero friction, allowing pizza pickup without even opening the car door at the speed of conventional quick-service restaurant drive-thru. Pizza Hut implemented this in 1,500 locations, almost overnight by powering its restaurants to become digitally enabled making it possible for users to easily access this feature using their preferred devices. Pizza Hut was quick to understand the changing consumer preference and modify their operations and supply chains accordingly. It saw the opportunity in its once contactless curbside drive-thru windows and used its app to digitally enable these drive-thru windows and turned them into Hut Lanes [124].

The reconceived window constitutes Pizza Hut's long-term strategy of modernizing through digital ordering thus improving consumer experiences. It is the pioneer in offering contactless curbside pickup and delivery that will remain available even at locations that do not have the new lane [125]. Its digitization drive that came into force in 2019, continued throughout 2020 and 2021. Along with digitization and automation of hitherto manual tasks it is also speeding up execution.

In another attempt to optimize operations Pizza Hut adopted closed-user groups to serve local communities that were at the fore-front of corona-fight, including its own employees, into its partner program that allowed Pizza Hut Delivery to essentially kill 2 birds with 1 stone - gaining employee loyalty by offering discounts and enhancing their product mix; and increase revenue indirectly due to sky rocketing sales. This in turn helped Pizza Hut to improve business dynamics and make it more reactive to changes in consumer preferences. When an organization’s employees become its customers, feedback on product mix, offers and packaging are immediate and in-house which improves operational effectiveness. Any new offering introduced, which was selling out quickly, then became a top offering across all branches. Branding and customer delight were also being addressed using the same channel with customer feedback being provided by their own workers. Product promotions and pricing decisions were also able to be fine-tuned with very little turnaround time to suit this unique audience [126]. A judicious mix

of automation, scale of operation and an outcome-based model, effectively delivered the much-needed operating leverage to Pizza Hut.

5 Research Outcome: Emerging Trends & What the Future Looks Like

Several changes in consumer behavior as a result of Covid-19, that is impacting every generation presently alive, is indeed affecting the world of ecommerce as well [127, 128, 129]. This is a world designed by the “new normal” as the people have come to terms with the fact that Covid-19 is not disappearing any time soon. Instead, it will, as of now, continue to be a part of our life and we need to alter our behaviors to co-exist. The pandemic resulted in a significant shift in consumer behavior, that was the outcome of such dire needs, that drastic changes were observable within record time [154]. As stated in a study by McKinsey [130], during the peak of the Covid-19 pandemic, 10 years of e-commerce growth occurred in just 3 months [154], as shown in Figure 4 below.

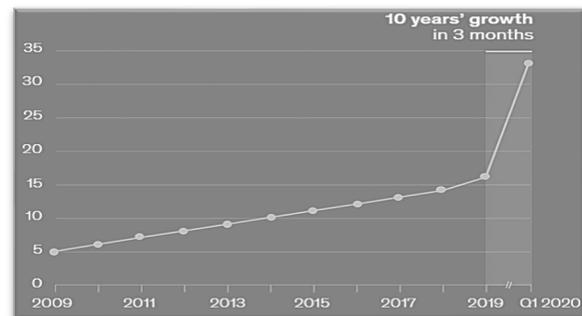


Figure 3: Penetration (%) of Ecommerce in the US [130]

Ecommerce businesses, especially retail, have started seeing novel changes behavior when it comes to shopping, and these changes over the past couple of years are showing signs of permanence or at least persistence over a considerably long period [128, 131].

According to a study by McKinsey [132], several countries have seen decline in net consumer optimism caused by the COVID-19 pandemic [133]. However, the pandemic has demanded larger adoption of ecommerce across businesses, specifically in case of essential items [132]. According to a survey by UNCTAD, consumers belonging to developing countries have adopted online shopping mostly [134]. The availability of a wide range of commodities to choose from made it possible for the firms to operate in spite of restrictions on interaction. In several countries, e-commerce transactions have been evolving from predominantly articles of luxury and services to run-of-the-mill products including necessities. Taking

into consideration the possibility of arrival of new waves of COVID-19 pandemic, easier adoption of and transition to novel purchasing behaviors, low cost of picking up the new habits and ways of shopping, and businesses aspiration for making profit out of innovative sales channels, it can be said that there are high chances of long-term survival and even perpetuation of several of these e-commerce changes [133].

The pressure to transform that had been building for years reached its zenith during the pandemic [135]. While the corporate leaders are taking meaningful initiatives to revive their employees and hence the organizations, the most optimistic ones perceive much bigger opportunity - the possibility of further developing whatever was achieved during the period in which the pandemic was in full swing and reassess or even reconceive the identity of the organization, the ways it operates, and its growth trajectory [136]. The coronavirus outbreak is expected to be closely followed by the next disruption wave, in the form of economic shock, as a fallout of the “extended public- and employee-isolation measures”, that is believed to be the largest till date after the World War II. Experts expect it to be not just an economic shock but a serious jolt to customer activities, habits and business models as well [137].

The pandemic has exposed the futility of long-term planning. Despite use of tons of predictive software trying to forecast future trends in demand with alleged high levels of accuracy and having several policies and plans in place to handle various predictable risks and situations that might appear in the future, none of the organization were prepared for the chaos and disruption that the coronavirus brought with it. None was prepared for the supply chain shock that struck the companies [45].

Consumer behavior has been changing in a very unpredictable and weird manner. For instance, hoarding toilet paper or purchasing bottled water and stocking up at a time when no proven threat to supply has been apparent [45]. Such instances made the retailers grasp for data that could prove helpful in predicting demand, since the COVID-19 pandemic resulted in historical data becoming practically immaterial [70]. Modification of customer behavior in the present time is a likely indication of an emergent trend that is most likely to remain strong, at least in the near future, but it is extremely difficult to predict whether such trend will remain persistent over the long run [121].

Typically supply chains function quietly in the background. However, this pandemic has demonstrated to the world that supply chain is the true lifeline of any business operation and the human factor in industries such as retail, food and delivery services have proven to be the key factor in extending that lifeline to every one of us, on a daily basis [138]. Supply chain models are likely to undergo change in order to factor in the influence of

the pandemic even following its passage. An interesting impact of the COVID-19 pandemic on the business enterprises is that rise in the importance of short-term planning rather than putting more resources in demand forecasting which is essentially a long-run phenomenon [139].

6 Research Limitations & Scope for Future Research

This research highlights the need for building flexibility in to operations in order to be able to respond quickly to short term shocks or changes of phenomenal stature. The research lays the foundation for further study on building quick response operation models and supply chains.

The research doesn't concentrate on the importance of communication lines in optimizing operations and supply chains. Communication devices such as mobile phones and other mobile communication equipment are greatly exposed to a range of shocks including trade disputes and disruptions caused by such instances as pandemic and cybersecurity risks since they are vulnerable for being high-tech value chains having a significant amount of value at stake and possessing intellectual property [140].

7 Conclusion & Recommendations

World is an uncertain place. Organizations adopt a plethora of planning tools and policies to prepare themselves for unforeseen eventualities. Despite so much effort at forecasting and planning for the future, no organization remained unaffected by the global pandemic which presented challenges that remained hitherto unpredicted. Forecasting for the short-run – from 30 days up to a year, is now gaining importance. The companies need to be able to respond to situations developing in the short run. Ad-hoc decision making is necessary in a situation where no one has any idea about how thing will look in future.

The key challenges associated with the new disruption are expected to be of magnitude that are much greater than the magnitude that contemporary businesses are used to handling. In order to cope with such a situation, it is imperative for businesses to implement a model that has the capacity to operate even under extreme levels of uncertainty. While the stress should be on optimization of operation and supply chain in order to build a robust and resilient system, there should also be focus on planning for the future, both near and distant ones, and not forecasting, because there is no possible way to forecast a situation like this.

Business organizations should not be just concentrating on the menacing events such as natural calamities, cyberattacks, global pandemic, or any other unforeseen events but should actually be focusing on detecting on their vulnerabilities. The

vulnerabilities are the elements that result in inability to cope with dire situations. Even supply chain professionals need to contemplate on ways to make their planning systems more flexible.

The outcomes of the global pandemic, however, in no way indicates that planning has lost its significance or relevance. It only means that more data and transparency are necessary. Transparency and speed of data movement can help businesses withstand turmoil such as the one that has been caused by the coronavirus. It is necessary to build on transparency of the supply chain to optimize operations.

Risk doesn't lie in buying from one supplier but is hidden behind the ways in which the supplier sources the inputs and how risky are those channels. This is the cue for organizations to build or enhance transparency in their supply chains. Information should move smoothly and swiftly across the length and breadth of the supply chain making it possible to detect even the slightest change in normalcy. Transparency offers visibility into the future and hence is essential for detecting any challenging situating that may be developing in the near future and help to circumvent disruption.

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