

Effectiveness of Digitalized Supply Chain During 2020 COVID-19 Pandemic: Case Studies

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Abstract: Competition in the global market calls for organizations to install digital technologies and frameworks within their existing physical supply chain. In such a fast-paced economy, digitizing the supply chain methods will optimize an organization to the latest consumer trends and ensure that they remain successful. Various digital technologies such as AI and robotics, cloud computing, 3D printing, advanced analytics, blockchain, AR, RFID, IoT, and cloud computing are enabled within supply chains. The purpose of this paper is to present a theoretical model along with case studies that suggests the essential components shaping the new digital supply chains (DSCs). The supply chain disruptions caused due to the 2020 COVID-19 pandemic are highlighted and methods to improve the resilience of organisations and ensure continuity in business while providing high visibility of inventory levels, and order tracking are presented.

Keywords: advance tracking and tracing, big data analytics, digital enablers, digital supply chain, e-commerce, digitalization.

1. Introduction

Digitalisation has evolved as a new phenomenon that has altered numerous elements of life around the world. This new era is marked by a complex, dynamic environment and a competitive economic marketplace. A Digital Supply Chain (DSC) is a smart, value-driven, and efficient mechanism enabling enterprises to generate new kinds of revenue and business value by leveraging innovative techniques with novel technologies. Global market and growth of business has given rise to tight competition where the aim of every business is customer satisfaction and fulfilling supply and demand constraints. The way activities are accomplished is changing because of digital technologies. Adaptation is required of industries and organisations, otherwise they risk being left behind. Digitisation is changing the way businesses operate and opening up new worldwide prospects for value creation across industries.

Consumer behaviour is shifting as a result of digital transformation, as are expectations for products and services. To achieve these expectations, firms must typically supplement traditional business models with web-based sales channels such as direct delivery to customers or click-and-collect, which allows customers to make purchases online and pick them up

later in a store. While individual digital enablers (e.g., robots, sensors, RFID – radio frequency identification, agents, modular factories, etc.) are not new, they are becoming more feasible, and businesses are more willing to use them to stay competitive [1]. Furthermore, in fact, an attempt to connect these local solutions using advances in data processing technology may be seen.

Prakash Agrawal and Rakesh Narain in their paper discuss digital transformation enablers, namely, robotics, sensors and geolocation, advanced tracking a tracing ability, big data, cloud services, unique identification and display innovation, nanotech, 3D printing. Electronic Data Interchange (EDI), Enterprise Resource Planning (ERP) and Radio Frequency and Identification (RFID) are not sufficient technologies in today's global requirements in terms of staying ahead of the curve [1].

The 5Vs are often used to describe big data in literary works: volume, variety, velocity, veracity, and value. Since statistical analysis reveals the true worth of enormous data, veracity and value are especially significant. BDA is based on extracting knowledge from large amounts of data, allowing for data-driven decision-making. Industry 4.0 is a smart manufacturing networking concept in which machines and goods connect with one another without the need for manual operations. Industry 4.0 technology enables new production strategies with the use of cyber-physical system principles based on highly customised assembly systems with flexible manufacturing process design. Cyber-physical systems that incorporate elements from both information and material subsystems are to be considered [2].

Decision-making is concerned with control and adaptation in various uncertainty environments where response and recovery are required to determine the best allocation of scarce resources to rebuild/reconnect supply chains and thus ensure process continuity and viability. For supply chain response, recovery planning and sharing, real-time data collection and exchange is critical which is addressed by advanced tracking and tracing technologies.

The term "blockchain" refers to a distributed digital ledger in which all transactions are collaborated inside a secured network and cannot be altered. The blockchain is revolutionising product traceability and anti-counterfeiting methods. Smart

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contracts are another blockchain use. Supply networks can be more agile, responsive and economical using smart contracts [3]. Cloud computing is a broad term that refers to a variety of methods for delivering computing services over the Internet on a pay-as-you-go basis. SaaS is the most well-known Cloud model, with Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) following closely after (IaaS). Customers, suppliers, and trading partners expect immediate information and that the correct products arrive at the correct location at the appropriate time. Cloud Applications are the ideal place to do this. In place of manually oriented supply chains, SaaS technologies can be used to convert supply chain operations into an automated, progressive demand-supply network, providing detailed insights, control, and collaboration.

Disruptive technologies like digitalisation and Industry 4.0 drive the creation of new supply chain management paradigms, ideas, and models. In this paper we understand and report the business processes of two companies during the COVID-19 pandemic, the challenges they faced, their strategies to overcome uncertainties and how digitisation of their supply chain allowed quick adaptation and mitigation of the disruptions caused. All observations and reports are with respect to the pandemic situation in the year 2020.

2. Literature Review

This section contains a detailed literature review of 20 papers covering topics related to Industry 4.0, Retail digital supply chain, structure and competence required to maintain a digital supply chain, conceptual framework for the relationship between digitisation and disruption risks. The following paragraphs explain each paper in detail.

They report that Electronic Data Interchange (EDI), Enterprise Resource Planning (ERP) and Radio Frequency and Identification (RFID) are not sufficient technologies in today's global requirements in terms of staying ahead of the curve. They define digital supply chain management as "powerful innovative technologies that are capable of changing the traditional way of doing various processes of supply chain like supply chain planning, task execution, interacting with all the participants of supply chain, achieving integration among the members of supply chain and enabling new business models" [1].

D. Ivanov and team suggest a conceptual framework for research on relationships between digitisation and disruption risks and a framework for Supply Chain risk analytics. In their paper, the author aims to answer questions regarding the relationship between digital tools and disruption risks, digitalisation's effect on improving ripple effect control and the technology based additional tools that can prompt advancement towards supply chain risk analytics [2].

The authors Knut Aliche, Daniel Rexhausen and Andreas Seyfert discuss changing times and the disruption digitization causes in supply chain and the exceeding customer expectations which leads to Supply chain 4.0 which makes it faster, more flexible, granular and accurate and efficient. The improvements of Supply chain 4.0 can mainly be seen in Physical Flow, performance and order management as well as strategies

observed in supply chain. It also talks about how transformation into a digital supply chain needs a suitable environment as well as perfect definition and capabilities [3].

Rita Azzia, Rima Kilany Chamouna and Maria Sokhn discuss the need to decentralize the management of information systems which requires transparency, better traceability, precise and accurate data collection and safe storage. The authors discuss how a blockchain gives an untampered and unaltered record of all the information and transactions. It also mentions how the introduction of blockchain has reduced risk caused by tracking systems and data management as there more accurate end-to-end tracking with the introduction of blockchain. [4]

K. Liere-Netheler et.al, discuss the effect of transformation into a digital supply chain from the traditional one and the drivers that push for adoption of these technologies in the field of manufacturing. They identify drivers process improvement, workplace improvement, vertical integration, management support, horizontal integration, and cost reduction as organisational drivers and customer demands, supply chain, innovation push, market pressure and government as external drivers all bound by employee support [5].

R. Patnayakuni and team discuss a framework for digital supply chain integration and express that triumph is regulated by the management of the supply chain by the organisation. The authors argue that the spotlight is being removed from monitoring good flows and logistics and placed on integration of physical, financial and information flows on an extended enterprise that includes supply chain partners. They also identify a rift in sociotechnical perception investigations especially on observation and exposition of adoption influences [6].

This report discusses growing levels of order visibility and personalisation as an immediate effect of introduction of internet e-commerce. An urge is placed that organisations should convert their logistic activities into quick paced, e-business fulfillment networks by using key converging tools to increase efficiencies and satisfy ever growing customer demands. It is discussed that by integrating internet based processes, it reduces the cycle time for an order by a huge margin wherein online tools and cloud services can be used in the front end process [7].

Blandine Ageron and team in their paper elaborate on the Structure, competence required to maintain a digital supply chain and also provide an evaluation of its performance. Digital supply chain ensures better visibility and reduces bull-whip effect by providing accurate real time information that will help in decision making. The authors also elaborate on the technological innovation of digital supply chain such as Cloud computing, IOT, Big data etc. The paper highlights the organizational, strategic and HR aspect of Digital supply chain. A detailed literature review on recent developments in digital supply chain is also provided. [8]

Poorya Farahani, Christoph Meier, and Jeorg Wilke apply digital supply chain to automotive industries. This paper talks about the methodology that can be followed by automotive supply chain managers to bring in new technical innovations to their organizations. The methodology presented in this paper is

based on 17 digital supply chain management case studies along with expert interviews. The case studies are evaluated using a value-maturity-portfolio model and then transferred to a digital agenda. Finally, a six step process is given to develop a digital Supply chain by evaluating, prioritizing and arranging the case studies on the roadmap [9].

The purpose of this paper was to present a theoretical model that determines the vital components of the new Digital Supply Chains (DSCs) through the incorporation of Industry 4.0. This work presents the transmogrification of the constructs in logistics and Supply Chain along with investigating different theoretical models and a review of Industry 4.0's components, with the aim of digitizing supply chain (SC) processes. The fundamental components of Industry 4.0 and their impact on DSCs are discussed, and a new conceptual model is offered that addresses a future perception of correlation between different DSCs, organised in clusters, in order to generate value through cooperation and digital integration [10].

This research proposes a digital supply chain (SC) twin, which is a computerised model that depicts network states in real time. The interrelationships between risk data, disruption modelling, and performance assessment can be discovered using a mixture of model-based and data-driven methodologies. The Supply chain disruptions and modifications during the COVID-19 pandemic provide irrefutable evidence of the critical necessity for digital twins to map supply networks and ensure business continuity and visibility. The findings of this study add to supply chain risk management research by improving reactive and predictive judgments, historical analysis data disruption, and real-time disruption data to enable end-to-end visibility in businesses [11].

3. Case Study

A. Case Study 1

Company XYZ (identity not revealed due to confidentiality reasons) is a national distribution platform facilitating retailers and businesses to source merchandise from manufacturers, brands, white labels, importers etc. on a single platform. By utilizing the competency of technology in terms of big data, cloud services, advanced tracking and tracing, and automated sortation and quality checking, this Business-to-Business (B2B) e-commerce platform has improved the effectiveness and efficiency of their Supply Chain. Designed to solve core trade problems for small, medium and large businesses, their convenient online application and website allows users to buy and sell, grow their network, discover customers, products and suppliers and connect directly with interested parties to discuss trade.

Company XYZ deals with both essentials (groceries, meat, staples, pharmacy) and non-essentials (electronics, apparel, home and kitchen appliances) and due to the COVID-19 nationwide lockdown during months of April and May 2020 mandated the closure of the non-essentials supply chain. Since the original supply chain structure for Company XYZ comprises separate warehouses for essentials and non-essentials, the essentials supply chain continued to function as

always. They received orders continually at normal rates throughout the national lockdown period.

However, Company XYZ faced numerous disruptions during the COVID-19 pandemic. Following the nationwide lockdown announcement, all operations and activities came to an immediate halt proving licences acquisition and authorisation details a tough and challenging affair. An added disadvantage of the situation was absence of labour even after procuring required official documents and licences, due to health concerns and general apprehensiveness of the staff. To mitigate the disturbance, employees whose work could be performed from home were assigned work-from-home (WFH) status while the absolutely necessary staffing were required to be physically present at the facilities while maintaining minimum crowd and a safe distance. The employees were provided with hardship compensation to improve morale and willingness to attend to their duties.

Additional health precautions and sanitization became a need of the hour during the COVID-19 pandemic. Within their facilities, further precautions required to maintain hygiene resulted in decline of productivity and an increase in throughput time. Regular hourly sanitation escalated delays and gave rise to a need for additional activities and labour strength, especially for inbound and outbound products and essentials. Time spent daily on thermal scanning of employees' temperature checks also consumed a significant portion of the working hours. Management made an executive decision to absorb the losses into the company.

Another major disruption to operations was a logistics driver, transport. Inbound logistics proved to be an obstacle due to significant delays in receiving products and essentials which in turn resulted in higher probabilities of losses and damages, especially for perishable goods like vegetables, fruits and milk. Systems were drawn to ensure greater tracking visibility to continually check the progress of incoming products. Problems with outbound logistics were mainly unavailability of drivers and trucks due to the COVID-19 pandemic which was alleviated by outsourcing the transport operations to third-party organisations.

During the lockdown, the non-essential warehouses shut down were rented/ leased to other parties that contributed to a positive cash flow. Once the lockdown began to lift in India gradually after May 8th 2020, many retail stores that are customers to Company XYZ, re-opened and order frequency returned to a state of semi-normalcy. This saw a sudden increase in customer orders, 2-3 times higher than before. Company XYZ forecasted such an increase in orders. To accommodate the increase in demand, they expanded their capacity by building larger facilities.

Some specific products showed an exorbitant demand during the COVID -19 pandemic. The demand for sanitizers, masks, disinfectants rose enormously and to accommodate the demand Company XYZ identified new sources, vendors and manufacturers to obtain these products. Panic buying by the mass public for these products as well as groceries and household items was assuaged by obtaining more suppliers and the situation was adequately managed. Company XYZ's

priority was retaining and maintaining their customer base and hence delivery charges were maintained at the same rate and losses were absorbed into the company's finances. However, to cut major losses, the discounts on products were reduced. Most of the cash handling occurred through digital payments to prevent petty thefts, reduce contact and improve payment tracking.

A pre-existing e-commerce company, Company XYZ's excellent Information technology, websites and apps provided a competitive edge during challenging and disruptive times like the COVID-19 pandemic 2020. Although the company's contingency plans were rudimentary, their well-established supply chain, information sharing and order visibility and well devised predictive and analytical algorithms proved to be highly beneficial under such strained and uncertain situation.

B. Case Study 2

Company ABC (identity not revealed due to confidentiality reasons) is a grocery retail store chain present in many cities across India aiming to provide services in a sustainable and responsible manner while accommodating growing customer requirements. Company ABC's vision is to assure quality of products and services to its customers on a timely basis. Company ABC actively conducts business with more than 6000 vendors across various categories of products and has a full-fledged multi-faceted quality evaluation system to check, maintain, assure and continuously improve quality and customer service. Company ABC contains products ranging from fresh produce to groceries and household items. Their 'everyday lowest price guaranteed' is a vantage point to enhance their customer base.

Their supply chain consists of vendors, consolidation centers, warehouses (facilitated with cross-docking and shipping) and sortation centers at many different levels. Company ABC has numerous channels through which orders can be placed, namely:

- Online applications and websites, through an integration with e-commerce company.
- Directly from the store (where customers pick up their own products).
- Placing orders through messaging application such as WhatsApp (which is delivered by the store employees) or
- Via phone calls.

Company ABC had extensive predictive models in use for forecasting the demand for each day through tools like descriptive and predictive analytics and statistics. By partnering with an e-commerce company, they expanded their customer base and added another channel of business which was monitored through inventory levels and order tracking and visibility.

With the onset of the COVID-19 pandemic in 2020, Company ABC encountered supply chain disruptions with respect to supply of labour and transportation of goods. Procurement of licenses and authorisations shut down operations in the beginning of the nationwide lockdown in India causing losses in business and delays in resuming business

activities. Additional challenges were faced on the grounds of logistics and labour wherein truck drivers, delivery personnel and staff refused services due to various reasons such as fear against the newly rising pandemic, lack of public transport to reach work and no movement from red zones (areas with high density of COVID-19 cases).

A lack of preparation against such an unexpected uncertainty caused a setback for Company ABC. However, as the demand for essentials products grew rapidly and orders being placed online increased two fold, the company's integration with e-commerce proved to be a fruitful endeavor to keep operations running under the circumstances. To ensure smooth activity, the management increased compensation for their employees as an incentive and in cases of extreme situations; additional labour was outsourced from third parties. To overcome shortage in means of transportation, supplementary trucks and transport vehicles were hired at the risk of increased transportation cost

Company ABC maintained previous delivery rates, however it did not add additional capacity. Since the retail store sold mostly perishable goods such as fruits, vegetables etc., the demand was high throughout the pandemic. The management however reduced the number of delivery slots, to facilitate more deliveries on each trip and to manage the shortage in labour. Online orders were also accepted on the basis of inventory levels and attendance of staff to their duties. Although many orders were cancelled in the beginning of the disruption period, the operations and activities were steadily regularised and a smooth system was established while making certain social distancing rules and daily temperature checks were followed, despite the added costs. During this period, the online sales for Company ABC doubled from the previous year's suggesting a positive trend towards online operations substantiating the effectiveness of the digital supply chain.

4. Conclusion

The supply chain's digitization is a strategic initiative. It a topic of interest to academics and professionals all across the globe. To ensure the DSC's success, a number of technological, organisational, and strategic difficulties must be solved. It is critical to further enhance the emerging research on technology adoption and its effects on the supply chain. The digital supply chain of the future will be dependent on the integration of cyber physical systems, cloud and mobile computing, data analytics, additive manufacturing, blockchain, etc., into traditional supply chain models. This study adds to the literature and benefits practitioners by providing insights into the decision-making process through the case studies to raise awareness among all parties involved in the corporate digitalisation phenomenon. In our case studies, Company XYZ and Company ABC both rose above the disruptions caused by the 2020 COVID-19 pandemic by leveraging important digital tools and technologies.

An already existing e-commerce organisation, Company XYZ utilised order tracking and inventory visibility to ensure timely delivery of supplies and maintaining constant contact with vendors. A large amount of data (Big Data) is generated during the supply chain processes which were used to gain key insights about the business' profitabilities and functioning.

Company XYZ forecasted sales and customer demand through predictive analytics and algorithms to support big data. Similarly, Company ABC's e-commerce channel proved to be a profitable venture as all other channels were shut down due pandemic lockdown restrictions. Time series analysis using prediction models and big data were digital enablers applied to their already existing physical supply chain. Order tracking and real time inventory management and tracking ensured customer satisfaction and fulfilment of demand. In both case studies, we observe productivity, profitability and efficiency maintained and managed during a disruption such as the COVID-19 pandemic. As the world moves into a more digital domain, organisations will profit significantly from digitalisation of their already existing traditional supply chains.

References

- [1] Prakash Agrawal and Rakesh Narain, "Digital Supply Chain Management: An Overview", IOP Conf. Ser.: Mater. Sci. Eng., 2018.
- [2] Rutkowsky, S., I. Peteresen, and F. Klötzke. "Digital Supply Chains: Increasingly Critical for Competitive Edge." European AT Kearney/WHU Logistics Study, 2015.
- [3] Ivanov D, Dolgui A, Sokolov B, "The impact of digital technology and Industry 4.0 on the ripple effect and supply chain risk analytics", Int. J. Prod. Res., 2018.
- [4] Knut Alicke, Daniel Rexhausen and Andreas Seyfert, "Supply Chain 4.0 in consumer goods", April 2017.
- [5] Ling Xue, Cheng Zhang, Hong Ling & Xia Zhao, "The power of a blockchain-based supply chain."
- [6] K. Liere-Netheler, S. Packmohr, K. Vogelsang, "Drivers of Digital Transformation in Manufacturing", HICSS 2018.
- [7] Ravi Patnayakuni, Nainika Patnayakuni, V, Arun Rai, "Towards a Theoretical Framework of Digital Supply Chain Integration", ECIS 2002.
- [8] B. Enslow, "Internet Fulfillment: The Next Supply Chain Frontier," ASCET, 2000.
- [9] Blandine Ageron, Omar Bentahar, and Angappa Gunasekaran, "Digital supply chain: challenges and future directions," in *Supply Chain Forum: An International Journal*, vol. 21, no. 3, pp. 133-138, 2020.