UiT The Arctic University of Norway

Faculty of Engineering Science and Technology

The Impact of COVID-19 on Supply Chains and E-commerce Logistics

Shiqi Gu

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Shiqi Gu

Abstract

As a result of the COVID-19 pandemic, supply, demand, and logistics have all been affected. Due to its unpredictable severity, the pandemic has highlighted the need to modify the existing supply chain model, the consumer structure model, and the digitization of markets. At the same time, the situation under COVID-19 offers increasing opportunities for e-commerce, including new business models and online commercial activities.

This master's thesis aims to analyze how COVID-19 will affect global supply chains and e-commerce. Moreover, it will try to analyze the practices of major e-commerce platforms during the pandemic to determine whether there are opportunities for innovation and development in the future. The study will examine how retailers adapted to supply chain disruptions caused by the pandemic from a practical perspective and highlight the critical role of technology in these processes. The research provides insights into how companies are coping with long-term disruptions.

The study we conducted used a qualitative approach, which included a case study and a SWOT analysis. In addition, we analyzed quantitative operational data from public financial reports released by JD.com.Our study examines the effects of a pandemic on supply chains. It also summarises the challenges faced by the retail sector and the strategies used by JD.com during the challenging period. During the pandemic, JD.com was able to handle the various aspects of its supply chain management through an integrated supply chain and intelligence platform. As a result of the unpredictable demand and logistics disruptions caused by the pandemic, JD.com adapted its delivery processes and effectively utilised its intelligent platform to cope with the supply chain disruptions.

This study presents a supply chain resilience analysis by using actual operational data. It suggests that companies should consider operational flexibility and collaboration outside the supply chain to adapt to significant supply chain disruptions like COVID-19.

1 Introduction

Natural disasters or manmade disasters are the most common causes of disruptions to the supply chain. In December 2019, cases of the virus were identified in the wet markets of Wuhan City, in Hubei Province, China, but it was reported as pneumonia symptoms(Rothan & Byrareddy, 2020). The COVID-19 virus was not named until later and was declared a pandemic only after that. Consumers' purchasing behaviours have been profoundly affected by COVID-19, as traditional supply chains have been challenged and disrupted. Consumer behaviour has also been drastically impacted due to the epidemic and the consequent measures(Sheth, 2020). Due to panic buying, there was a significant increase in the need for medicines and foodstuffs during the pandemic, while other commodities and manufactured products experienced significant decreases(Gereffi, 2020). Due to this new circumstance, new needs have arisen. For instance, due to social spacing policies, the need for collection and delivery services has significantly increased(Gray, 2020). Additionally, throughout this unprecedented pandemic, the market has changed drastically (Donthu & Gustafsson, 2020), which compelling enterprises to take unique survival tactics.

Digital technology has been extensively used and advocated for corporate sustainability. Schools are embracing digital education(Sheth, 2020), and employers such as Google encourage workers to "work from home"(Coolidge, 2020). The business models of several enterprises have also been reformed utilising innovative technologies. In Hong Kong, a private music school leased a big vehicle and repaired and converted the vehicle into a portable workshop to bring services directly to clients' homes (Choi & Review, 2020). With the help of Terra Drone (a Japanese startup) in New York, Unilever used drones to deliver ice cream to customers in the last-mile delivery(Singh, Kumar, Panchal, & Tiwari, 2021).

Supply, demand, and logistical infrastructure have all been impacted due to the COVID-19 pandemic. Because of its unforeseen magnitude, the pandemic underlines the need to modify existing SC patterns, consumer structure patterns, and market digitisation (Kilpatrick & Barter, 2020). It is unclear what the long-term implications of this will be (D. J. T. R. P. E. L. Ivanov & Review, 2020). It is essential to investigate the numerous causes of uncertainty in this setting and determine the appropriate reaction tactics for operating in such a fast-paced environment.

The situation under COVID-19 presents a growing opportunity for E-commerce with new business models encompassing online commercial activities. Increasing numbers of businesses are engaging in e-commerce, which will result in significant changes in the logistics sector. Although the COVID-19 outbreak has caused world commerce to undergo a crisis, it has also brought new opportunities for global trade development.

1.1 Thesis Purpose

The purpose of this Master's thesis is to analyse the effects of COVID-19 on global supply chains and e-commerce and analyse the practices of major e-commerce platforms during the epidemic to determine if there are opportunities for innovation and development in the future. A key focus of the literature review is global supply chains, COVID-19 impact on global supply chains, supply chain resilience, and e-commerce. Several studies have suggested that the supply chain needs to be strengthened and more resilient. Due to their excessive emphasis on efficiency and lack of attention to risk management, global supply chains are prone to disruption(Taleb,2012). Several authors have proposed mechanisms to mitigate the effects of some of the COVID-19-related risks. However, many suggestions lack scientific evidence supporting them(Miroudot, 2020). We will examine the ways in which retailers have responded to supply chain disruptions associated with pandemics from a practical standpoint in this article, emphasising the vital role of technology in these processes. The study provides insight into how companies may respond to long-term disruptions.

1.2 Research Question

The pandemic has caused economic instability worldwide and has affected all industries. Technological advancements are creating new and improved solutions at a rapid pace. By combining geospatial technology and artificial intelligence, enterprises may quickly identify hazards, bottlenecks, and poor supply chain performance, thereby fostering the growth of global supply chain management. Therefore, we consider it essential to discover how the pandemic has impacted today's global trade and what firms can do to improve the resilience of their supply chains in the future.

The following is our research question:

"How have global supply chains and e-commerce logistics been affected by COVID-19, and how to strengthen the supply chain resilience?"

2 Theoretical framework

This chapter explores theories that we have chosen to use in our research. The purpose of the theories is to provide the reader with an understanding by defining each theory that will assist them in understanding the research of this study.

2.1 Theoretical Approach

This section begins the research with a review of the literature on global supply networks. This was done to understand better today's supply networks' present issues and challenges. Following that, the implications of COVID-19 on global supply chains are reviewed. In addition, supply chain disruptions, strategies, and resilient supply chains in practice are reviewed.

Additionally, the current developments in the e-commerce industry will be examined. Finally, models and techniques for e-commerce logistics have been chosen to analyse to identify corresponding solutions to supply chain disruptions.

2.2 Global supply chain

Throughout this section, i will describe the challenges that global supply chains face today. The supply chain involves facilities that generate raw materials, turn them into various components, and deliver the finished product to clients through a distribution network (Foster, 2017, p. 460). Each component of a supply chain is responsible for fulfilling customer requests directly or indirectly (Chopra and Meindl, 2007). When selecting a supplier, companies should consider that relationships between them and their customers are not merely decided not just by price but also by quality, delivery, and adaptability (L. Fonseca, Domingues, & Marketing, 2017). Failures are more likely to occur in low-cost supply chains because of their inability to respond quickly to changes in demand or supply. (L. M. Fonseca & Lima, 2015).

It is vital to understand and evaluate performance's critical dimensions (Barbosa & Azevedo, 2019). There are risk factors in the make-to-order (MTO) supply chain, including demand uncertainty, disruptions in material supply, overdue orders, and long lead times. Barbosa and Azevedo's opinion, complexity, the volume of work, reuse of designs, kind of project, outsourcing, and technological experience are the top performance factors of Supply Chain (SC) performance(Barbosa & Azevedo, 2019). At the same time, consumers, manufacturers,

and suppliers are the leading causes of unpredictability. McKinsey Global Institute claims that lean manufacturing has improved delivery times, reduced inventory levels, and shortened lead times in the manufacturing process(McKinsey Global Institute, 2020).In addition to reducing costs and improving efficiency, the new manufacturing network was created to improve market proximity. However, this has resulted in a reduction in transparency and resilience. Many disruptions are occurring in the modern world. These occurrences may linger for a more extended period in many cases and can be pretty costly. (McKinsey Global Institute, 2020).

Based on research conducted by Free & Hecimovic, as supply chains have expanded in scale and complexity, there has been a decrease in their transparency. In this way, visibility among different layers is restricted, obstructing participants' ability to recognise manufacturing and capacity risks. Companies are thus less likely to remain resilient(Free, Hecimovic, & Journal, 2021). McLean and Rebernak pointed out that increased transparency can build better trust between stakeholders(MacLean & Rebernak, 2007). The following section summarises several of the material on the impact of COVID-19 on global supply chains. The initial proposition will be made as below based on studies.

Proposition 1: Supply chains become increasingly susceptible to disturbance as their length and complexity increase.

2.3 The impact of COVID-19 on the supply chain

The impact of the COVID-19 pandemic on the global supply chain is examined in this portion of the thesis.

On 11 March 2020, the World Health Organization proclaimed the COVID-19 virus a worldwide pandemic (Armani, Hurt, Hwang, McCarthy, & Scholtz, 2020). Though its exact origins are unknown, it is believed that the COVID-19 pandemic began in December 2019 in Wuhan, China. Due to the virus's variable intensity, symptoms range from mild fever, coughing, and difficulty breathing to serious respiratory issues. Hospitalization and even death have been reported in many cases(Zhou, Zhang, & Qu, 2020). Coronaviruses are widely regarded as one of the most infectious diseases because they result from humans contracting the rigorous acute syndrome of respiratory issues. Deaths from COVID-19 are more likely to occur among older individuals and those with pre-existing conditions (Zhou et al., 2020). The outbreak of COVID-19 has dramatically accelerated the transition toward digital commerce.

People have to get used to the new social distances in such situation. Since the nation's economy and the world have been significantly influenced, several governments have imposed higher limitations upon the citizens and businesses in response to this pandemic(Hasanat et al., 2020).

While the long-term impacts of COVID-19 remain unclear, most of its short- and medium-term effects have now been identified as more and more knowledge accumulates on how to combat this new virus. Therefore, it might make sense to examine the effects over different periods in 2020-2021. The long-term impact of this pandemic on supply chain management cannot be precisely determined; however, there is no doubt that it will have a profound impact on the businesses involved. According to an official report, COVID-19 caused supply chain interruptions for 94% of Fortune 1000 firms(McMaster et al., 2020).

A supply shock was the initial notable effect of COVID-19 on many Western firms' supply networks(Seifert & Markoff, 2020). Many factories were forced to halt operations when China enforced a stringent lockdown to prevent the spread of COVID-19. Most companies worldwide did not predict that the pandemic would cause such massive disruption to their supply chains, which has forced them to rethink their supply chain structures and resilience.

Supply chain resilience refers to a supply chain's capacity to anticipate and adapt to unanticipated risk events, improving customer support, share of the market, and economic condition by reverting to its previous state or expanding via a transition to a more desirable state (Ribeiro, Barbosa-Povoa, & Engineering, 2018). It is vital to increase supplier redundancy, increase the inventory of critical commodities, expand the supplier base, and reduce the number of unique components to guarantee supply chain resilience in the case of a crisis (L. M. Fonseca, Azevedo, & Marketing, 2020). The current COVID 19 pandemic can change how businesses look at supply chain resilience for a long time to come.

The COVID-19 pandemic also caused a demand shock in the supply chain, as customers stocked up on goods to avoid being unable to do so later due to anticipated shortages or restrictions in movement(Seifert & Markoff, 2020). Early in 2020, during the first lockdown phase, many countries were hit by demand shocks. As a result, many firms were unprepared to meet the new demand levels. In this market situation, larger firms may still be able to cope with the changing market conditions. However, it would undoubtedly be a massive blow to small and medium-sized companies. Therefore, these small and medium-sized businesses

were forced to shut down because of the adverse effects(Parsons, 2020; Zhu, Chou, & Tsai, 2020). There is a supply deficit and a surplus among suppliers and manufacturers, which are indicative of the bullwhip effect. When inventory swings are high due to changes in customer demand, there is a Bullwhip effect(Zhu et al., 2020). According to Zhu et al., the primary problem with the bullwhip effect is a lack of supply chain transparency(Zhu et al., 2020). During the pandemic, it was discovered that the lean supply chain model, which is primarily reliant on JIT and no inventory models, is unduly vulnerable to pandemic scenarios; hence, these approaches need to change(McMaster et al., 2020).

The pandemic has undoubtedly caused unprecedented upheaval in commerce and supply chains. There is no question that future supply chains will have to consider resilience and adaptability. (Hedwall, 2020). Hedwall expects companies to sift through contractual obligations, assessing force majeure clauses, tax and employment implications, relocation costs, employee's visa issues, and the option to quickly reverse changes if the situation stabilises or new developments require rapid supply chain adaptation(Hedwall, 2020). The COVID-19 pandemic has revealed the vulnerability of today's existing supply chain structures. As a result, more enterprises will adopt different measures to address disruptions in supply chains in the future.

Another aspect of global supply chains that will undoubtedly be critically reviewed in the future is the logistical aspect. The logistics sector is an integral part of a supply chain, facilitating both trade and commerce. As a result of the lockdowns and national border closures being imposed by many countries in early 2020, the logistic system was significantly disrupted. Figure1 which illustrates visually how logistics have deteriorated in China, using the example of long haul truck logistics(International Finance Corporation World Bank Group, 2020).

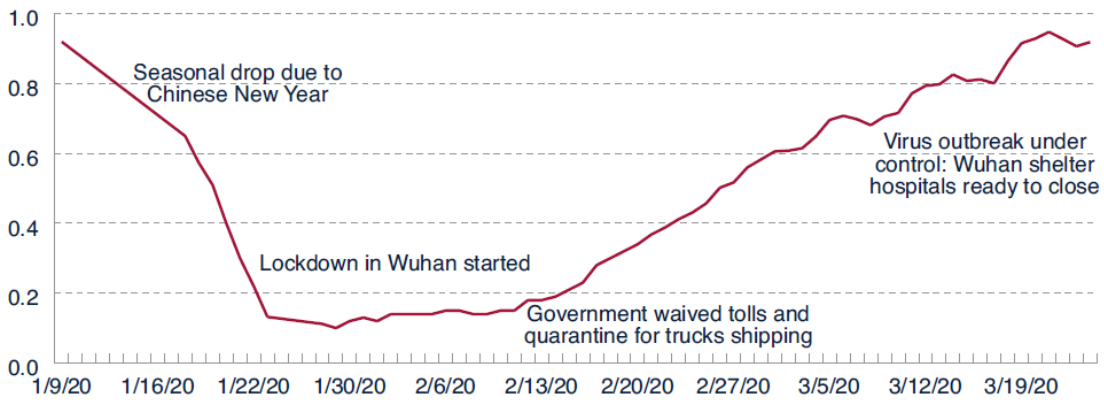

Figure 1 Full truckload (FTL) recovery rate according to World Bank Group sources (2020)

The pandemic has revealed vulnerabilities in critical economic regions like East Asia. As a result, many firms will want to diversify their supply chains instead of relying only on one location (many companies will contemplate nearshoring and reshoring). Furthermore, shortening global supply chains is another emerging trend that is expected to impact the global economy long-term (International Finance Corporation World Bank Group, 2020).

Increased transportation costs and the increased demand for transportation have significantly influenced global supply chains. Air transport is often used to carry raw materials and manufactured commodities. Due to COVID-19, commercial flights have been postponed, which has resulted in cargo that usually travels on such flights having to find alternate routes. As a consequence of this, global air freight expenses have soared. The demand for commercial flights has risen dramatically, and businesses struggle to catch up. Due to its transit system, today's global supply chains are prone to disruptions such as COVID-19. (Selwyn, 2020).

In conclusion, the pandemic caused significant turbulence to the global economy and supply chain management has been severely impacted. In the short term, it is reasonable to anticipate that businesses will seek more diversified methods to supply chain management and that logistical practices will be scrutinised. However, flexibility will be a critical component of any new supply chain tactics businesses adopt. One thing that will stay constant, even after the pandemic, is that every business will guarantee that its supply chain is cost-effective(Hedwall, 2020). Fonseca and Azevedo state that it is difficult to predict what will happen to supply chains and what effect the world economy will have over time (L. M. Fonseca et al., 2020). There are currently many governments assessing their dependence on other countries. According to Fonseca & Azevedo (2020), these governments are

implementing policies that force companies to re-evaluate their supply chain. Government officials may therefore turn to regional trade blocs in the coming years. Additionally, Fonseca & Azevedo predict that supply chain management channels will become increasingly digital in the future (e.g., the rise of e-commerce for retailers, and the rise of online food delivery for restaurants). Therefore, The second proposition was made as below(L. M. Fonseca et al., 2020).

Proposition 2: COVID-19 has had a significant negative impact on global supply chains and has also contributed to the rise of e-commerce.

2.4 Supply chain its disruption, resilience, and strategies

The phrase "supply chain interruption" refers to an unwanted and unexpected initiating event at a particular supply chain step, coupled with significant disruption to the business's normal operations (Bode & Wagner, 2015). Supply chain disruptions are generally triggered by events that are unlikely to occur but have a massive impact, such as natural catastrophes, manmade disasters, and pandemics. However, a pandemic outbreak is distinct from other disruptions because it causes long-term disruption, propagates disruption, and presents significant uncertainty(D. J. T. R. P. E. L. Ivanov & Review, 2020). While a single natural disaster tends to be centred on a specific geological region or time, a pandemic can occur anywhere and anytime(D. Ivanov & Das, 2020).

The resilience of supply chains is a complicated and multifaceted study topic(Ali, Mahfouz, & Arisha, 2017), and much work has been conducted to discover its essential parts. Although other aspects have been discovered in other research, the primary components are as follows: adaptability, visibility, teamwork, information exchange, and risk management(Christopher & Peck, 2004). They are referred to as supply chain resilience principles, and they are a set of factors that must be considered in a supply chain's operation and may be modified in order to assess and analyse the practical resilience of supply chains(Kamalahmadi & Parast, 2016). There are two critical elements affecting supply chain resilience: vulnerabilities, which drivers of change define, and supply chain capabilities, which may be enhanced by effective management(Pettit, Fiksel, & Croxton, 2010).

2.4.1 Supply chain resilience in practice

The most effective supply chains are nimble, adaptive, and cohesive, enabling them to recover from unexpected failures swiftly(H. L. J. H. b. r. Lee, 2004). Specifically, Lee et al.

emphasised the value of data and cooperation, particularly when establishing partnerships in agile supply chains. The most frequently suggested solutions for improving supply chain resilience include increasing agility, building redundant elements into the supply chain and establishing networks of collaboration within it (Tukamuhabwa, Stevenson, Busby, & Zorzini, 2015). Redundancy ensures that if one of the providers cannot offer the required resources, the other suppliers can assist and give what is required. Redundancy is an effective risk management technique that may also be used to plan inventories and capacity(Kamalahmadi & Parast, 2016). Holding enormous quantities of additional inventory and manufacturing capacity, on the other hand, is often prohibitively costly and frequently not worthwhile the hazard decrease that it provides(Miroudot, 2020). Miroudot says that it may be required for businesses that are often confronted with natural disasters such as tornadoes or tsunamis. However, the company is unlikely to spend millions of dollars in new manufacturing capabilities in preparation for an outbreak that occurs only once per hundred years (Miroudot, 2020).

Although, there is a significant difference between supply chain resilience theory and actual methods(Tarei, Thakkar, & Nag, 2020). Reports indicate that organisations address disruptions by increasing safety stock, consolidating or diversifying their supply chain, and improving forecasting. While resilience plans are inextricably linked to the notion of resilience, enterprises' actual strategies are often more focused on managing risk than on resilience. Risk management includes risk mitigation methods (for example, evaluation of suppliers, a sage of new technologies, adaptability of processes, and data security) and risk-sharing tactics (for example, profit sharing, insurance, cooperation)(Tarei et al., 2020).

A challenge to supply chain resilience research is the fact that it relies on data collected from enterprises. In theoretical frameworks, resilience measures are classified into three categories: recovery time, recovery level, and deficit in the meantime of the recovery phase(Behzadi, O'Sullivan, & Olsen, 2020). Although this measure reflects the diversity in the robustness of supply networks with steady demand, however, retail supply chains are exceedingly complicated in this regard. Additionally, the protracted interruption created by the COVID-19 epidemic has a detrimental effect on forecast accuracy.

Another significant issue arises due to a lack of coordination and information exchange. While studies often focus on the robustness of whole supply networks, in fact supply chain nodes operate independently. In reality, a supply chain's visibility is limited (Scheibe &

Blackhurst, 2018). Sheffi recommends that organisations thoroughly study their whole supply chain to prepare for these interruptions. It should contain information about the locations of critical production facilities and factories and a list of suppliers. (Sheffi, 2015). This will assist enterprises in determining the risk associated with their various goods depending on their location. To properly reduce COVID-19-related risks, it is critical to understand the interactions between the supply chain participants in its entirety. Furthermore, although quantitative indicators of resilience levels are essential, corporations are likely to avoid disclosing information to preserve a competitive edge(Baghersad & Zobel, 2021). In implementing transparency in the supply chain, some risks are involved, such as cyber-attacks and essential data leakage. Bartley and Doorey believe that striking a balance between threats and cooperation with suppliers is difficult. Because essential data are shared with other firms, they believe that although openness promotes collaboration among supply chain players, it might also be seen as a threat (Bartley, 2007; Doorey, 2011). Consequently, an organisation's fear of negative publicity may grow, and the firm-supplier relationship may deteriorate. (Egels-Zandén, Hulthén, & Wulff, 2015). The following propositions are made in light of the preceding discourse. The following propositions are made in light of the preceding discourse.

Proposition 3: With the appropriate strategy in place, the supply chain is resilient to withstand unanticipated crises similar to COVID-19.

2.5 E-commerce

Astonishing are the cutting-edge technologies that are now coming on the internet and the speed with which they are being adopted. It is such a vital instrument that it has revolutionised how organisations operate because it gives both corporations and customers limitless possibilities and chances(Markellou, Rigou, & Sirmakessis, 2006). E-commerce has become increasingly common in the marketplace due to the fast development and widespread acceptance of the internet (Cho, Ozment, Sink, & management, 2008).

The transaction of products and services over the Internet is known as e-commerce (Tian & Stewart, 2006). E-commerce is classified into two broad categories: business-to-business (B2B) and business-to-consumer (B2C). B2B e-commerce sells goods or services and shares information between two or more companies using electronic technology, most often over the internet, either publicly or privately (Mockler, Dologite, & Gartenfeld, 2008). Business-to-consumer (B2C) transactions include the direct sale of goods and services to consumers. While

most people know B2C, it is B2B that drives the vast majority of e-commerce revenues (Tian & Stewart, 2006).

One of the most distinguishing qualities of e-commerce against conventional media is the internet's relatively easy worldwide market reach. The internet's advanced capabilities facilitate direct, rapid, and flexible contact between manufacturers, suppliers, and consumers located in different countries(Egea & Menendez, 2006). Additionally, e-commerce offers significant cost savings, increased efficiency, and unrestricted reach, which motivates businesses and organisations to make significant efforts to use electronic platforms to reach consumers and generate new commerce prospects(Su, Chuang, & Commerce, 2011).

After the pandemic, this new shopping behavior may become the norm. Lately, both existing and new customers have contributed to online sales. E-commerce may provide retailers with assistance in adapting and surviving a crisis (Hwang, Nageswaran, & Cho, 2020). Hwang et al. also indicated that although the front-end shopping platforms played a significant role in e-commerce, back-end supply chains have become more critical to most firms, significantly affecting their operations(Hwang et al., 2020). As a result, during times of supply chain crisis, finding alternatives or new suppliers to shorten vast global supply chains into regional ones is becoming the new norm for many companies.

In short, the COVID-19 pandemic has interrupted supply, demand, and logistical all at the same time. The pandemic demonstrates the critical need to change existing supply chain patterns, structural consumption paradigms, and market digitisation (Kilpatrick & Barter, 2020). The long-term consequences are uncertain because of the unexpected size(D. Ivanov & Das, 2020). Furthermore, all aspects of e-commerce rely heavily upon supply chains. As a result of COVID-19, severe disruptions have affected the global supply chain. Many countries around the globe are experiencing severe problems with their supply chains, which adversely affect e-commerce sales performance(Hasanat et al., 2020). Investigating the multitude of unpredictability causes can help understand the optimal management methods for businesses in rapidly changing environments (Cohen, Lee, & Management, 2020). This paper will focus on how e-commerce retailers have dealt with supply chain disruptions resulting from pandemics and how technology plays a key role in this. According to the above literature, the following proposition can be derived.

Proposition 4: E-commerce helps retailers adapt and survive in crises.

2.6 E-commerce logistics models and supporting technologies

2.6.1 Self-support model

Numerous businesses tend to construct their own logistical network to ensure the quality of their logistics services and achieve the success of their e-commerce business, especially in the last mile delivery(H. L. Lee & Whang, 2001). Generally, the E-commerce industry has recognized the importance of sales and after-sales services; therefore, continual enhancement of the level of service is imperative(Delfmann, Albers, Gehring, & management, 2002). The individual supply chain member has difficulty optimising the entire supply chain system(Fugate, Sahin, & Mentzer, 2006). From warehousing to distribution, the product's logistics must be controlled to manage the majority of the supply chain effectively. The logistics service can be controlled both in terms of reliability and unpredictability of logistical services.

The disadvantage to a self-supporting logistics network is that it always results in limited profits and capital shortage(Damme & Amstel, 1996). Companies often need to invest many human resources and capital in setting up their logistics departments. In addition, the logistics network of e-commerce companies needs to cover the whole country and even the whole world. These factors will undoubtedly increase the pressure on the company's operations. However, improved logistics service capabilities will facilitate the success of the business strategy (Lynch, Keller, & Ozment, 2000).

Most businesses employ a mixed logistic model, utilizing a self-support system to ensure a portion of their logistical services is managed to a top standard while delegating some logistical responsibilities to third-party logistics. At the same time, third-party logistics (3PL) providers are increasing their capabilities to compete with the prominent e-commerce giants. Large Online shopping platform giants such as Amazon, Alibaba, and JD.com have also made significant investments in developing their own logistics facilities(Ellinger, Lynch, Andzulis, & Smith, 2003).

2.6.2 Outsourcing model

Outsourcing is another significant logistical method in e-commerce. Among the primary reasons companies choose outsourcing is that it can alleviate enterprise burdens (Xiao & Dong, 2015). Therefore, they can concentrate on their primary business without investing excessive resources. As a result, the core competence and competitiveness of the organisation

may be enhanced. Furthermore, outsourcing enables businesses to cut their capital expenditures on fixed assets such as field personnel, warehouses, fleets, information systems, and other procurement logistics equipment(Huq, Bhutta, Cutright, & Management, 2015). As a consequence, capital is turned over at a quicker pace.

Another argument favouring outsourcing is that the existing system is oversupplied with commodities. Customers are becoming more demanding. Today, there is a greater demand for customised products in smaller quantities and more varieties, making logistics challenging(Govindan, Chaudhuri, & Review, 2016). Companies can mitigate their risks by allocating resources in an export-centric manner through outsourcing(Govindan et al., 2016).

Nevertheless, it must be acknowledged that outsourcing can have drawbacks. To begin with, enterprises have limited control over the whole logistical process, which means that they have to negotiate with the logistics companies(Lau, Zhang, & Management, 2006). When dealing with consumer complaints, enterprises may be less efficient than they should be. Furthermore, logistics may provide significant earnings, but enterprises cannot obtain this portion of the profit when outsourcing is selected(Yi, 2006). We believe logistics is critical to the growth of businesses. Customers' faith in logistics companies cannot be built since they cannot demonstrate the product's features and functionalities.

In the context of the analysis above, several companies select to outsource their activities to keep the size of their operations within an achievable range.This allows them to concentrate their efforts on their primary business. Considering the downsides, they may use self-developed methods in certain areas to maintain more management over the whole chain.

2.6.3 Supporting technologies for e-commerce

E-commerce logistics is primarily enabled by three technologies: an e-Commerce system, a Warehouse Management System (WMS), and a Transportation Management System (TMS)(Yu, Wang, Zhong, Huang, & Systems, 2017). To carry out e-commerce effectively, a company needs an online platform. Today, there are various trading systems available. These systems allow customers to search for various products online. Thus, a description was generated using a soft computing approach to illustrate E-commerce activities' interaction. (Takács, Zuban, & Kovacs, 2015). E-commerce has recently been included in smart devices such as mobile phones. Because of their widespread usage, a multi-agent recommender system for e-commerce platform adaption has been suggested. (Rosaci & Sarné, 2012).

WMS is crucial in assisting with E-commerce logistics. Numerous WMS practices have been recorded globally. Real-time inventory visibility is a critical feature of a WMS(Wakabayashi, Suzuki, Watanabe, & Karasawa, 2014). Radio-frequency identification (RFID) and the Electronic Product Code (EPC) network have been developed to monitor and identify goods in WMS (S. F. Wamba, Lefebvre, & Lefebvre, 2006). A case study from the retail sector combined mobile B2B E-commerce with WMS, where the WMS utilises the RFID-EPC network(S. F. Wamba, Lefebvre, Bendavid, & Lefebvre, 2008). Most warehouse management software has lately included the intelligent concept. An intelligent warehouse with RFID allows all participants to evaluate their operations in B2B e-commerce to optimize and control vast quantities of commodities effectively (S. F. J. B. P. M. J. Wamba, 2012).

Logistics is a key component of e-commerce. Outsourced logistics is one of the modes of e-commerce logistics. According to the study, most companies that outsourced their transportation services were pleased with the service(Bardi, Tracey, & Management, 1991). In addition, transport management systems are constantly being optimised, which also helps to facilitate e-commerce logistics. A concurrent traffic control framework for municipal transport systems was built using artificial intelligence, computing, and parallelism. (Wang, 2008). In order to implement a smart TMS utilising information and communication technology, big data processing and mining should be used(Fiosina, Fiosins, & Müller, 2013). Fiosina et al. provide a real-life application of transportation and logistics optimisation in scheduling and execution(Fiosina et al., 2013).

We propose the following proposition based on the material reviewed above.

Proposition 5: The right logistics models and the use of advanced technology have a positive effect on e-commerce.

2.7 Literature gap

While there is a wealth of literature on the effect of COVID-19, research on the impact and particularly on remedies to lessen the impact on supply chains is quite scarce. The majority of these studies speculated on the potential impact of the current pandemic on global supply chains, the impact of COVID-19 on product variety and transportation or examined the potential social implications of the current pandemic. However, they overlooked examining how enterprises can address supply chain issues. The purpose of this study is to address this gap in the retail supply chain by examining how retailers may reduce the effect of COVID-19

on the retail supply chain in practice and how technology can be utilised to address supply chain disruptions triggered by a pandemic.

2.8 Theoretical model

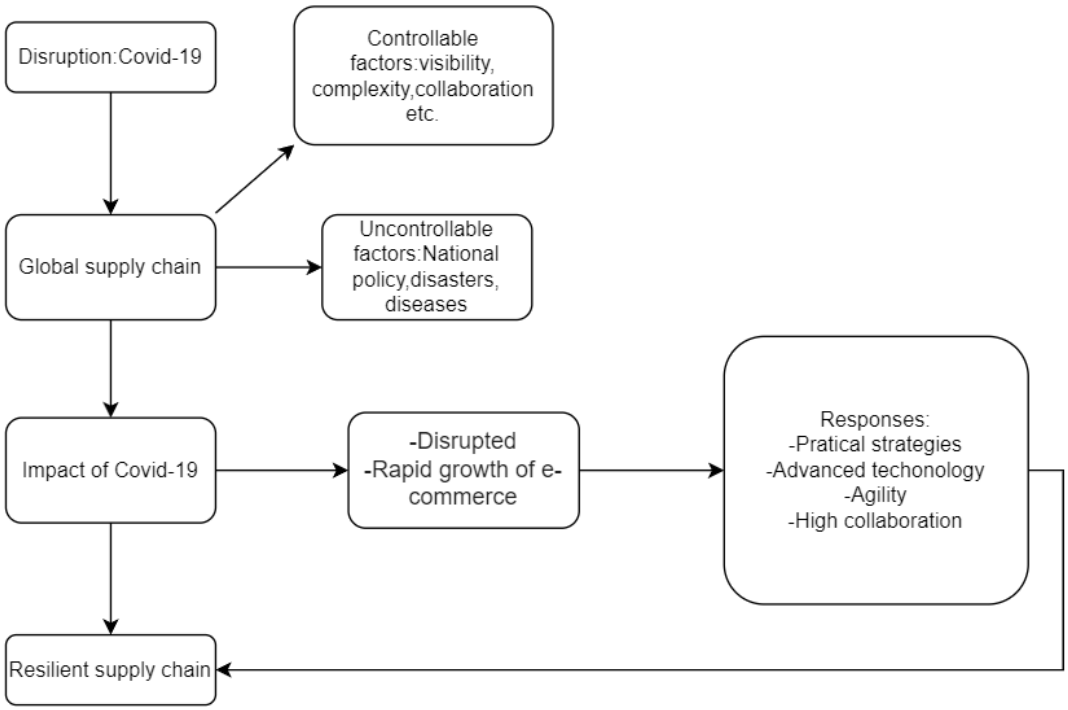

Figure 2Theoretical model

Figure 2 above illustrates how interruptions influence global supply chains and promote e-commerce while mitigating the impact. It begins with a supply chain disruption. The extent to which an influence is felt by the three controllable elements (visibility, complexity and collaboration) and the three uncontrolled factors (national policy, disaster, and disease). We will be able to improve a more flexible supply chain to cope with interruptions if enterprises in the network achieve well on these criteria. The damage will be more significant, and supply chain interruptions will arise if there is poor performance. Numerous preventive steps may be implemented in the future to increase resilience. Practical techniques, modern technology, agility, and collaboration are just a few examples. Please note that I did not incorporate any reactive measures. This was selected since I believe that such measurements are situationally and might restrict the use of the model.

3 Methods

The most exciting research progress plans are established utilizing a theoretical framework that assists the researcher in gaining a deeper understanding of the phenomena being researched(Kvåle & Brinkmann, 2009). Choosing a research strategy that addresses the research topic and is also realistic in terms of time constraints is an essential part of the study's design. Chapter 3 details our research methodology concerning the study topic. First, we dissect the research topic, offering suggestions on the research approach, study design, and data gathering methods. The study's quality is then assessed by resolving crucial research feasibility and reliability problems. A review of the study methodology concludes the chapter.

3.1 Question structure

We aim to address the impact of COVID-19 on retailers and how they may be able to increase their resilience in the face of potential supply chain disruptions. It is intended to understand better the variables and elements affecting supply chain performance and their relationships.

3.2 Research strategy

Qualitative techniques and quantitative methods are the two main approaches to research. How research is carried out and gathered data differs significantly across these approaches. Understanding social phenomena require qualitative research, whereas quantitative research aims to quantify findings and generalise across vast populations(Savin-Baden, Howell-Major, & Routledge, 2013). Qualitative research often relies on in-depth interviews or observations to get information. Furthermore, qualitative studies offer a broad scope for determining the magnitude of phenomena. Methods selection may be considered a pragmatic choice. The research topic dictates which is the most appropriate method for investigation(Jacobsen, 2005).

Our study issue is interpretive, seeking to ascertain why and how something occurs. As a result, qualitative research is the most appropriate research approach. Qualitative research gives thorough descriptions and more profound knowledge and appreciation of phenomena. This thesis will use a case study and SWOT analysis as research methods. A case study is a research method that entails the empirical examination of a particular current occurrence utilising various sources of information in a real-world setting(Robson, 2002).

3.3 Data collection

To address the research questions, authors analyze previously collected data and then collect updated information pertinent to the study objectives (Saunders, Lewis, & Thornhill, 2009).

To accomplish the study's aims, I searched data sources to shed light on how organizations deploy their resources. By examining essential textual materials such as annual reports, press announcements, websites, public interviews, and media articles, I was able to ascertain which appropriate resources the company had and which resources they see as vital in today's COVID-19-affected market environment. Using resource-based theoretical literature, I was able to determine how COVID-19 might influence the company and describe the response options it has taken. Additionally, pertinent public interviews with the company have been extracted. When these sources are combined, sufficient data is available to meet the research issues.

4 A Case study of JD.com

4.1 About JD.com

JD.com is now one of China's largest online stores and overall retailers. In 2020, JD.com had an 18% market share of the Chinese e-commerce market. Its market share is the second-highest in China(Forward-theeconomist, 2021). The company is committed to providing its customers with the most satisfactory online shopping experience possible. Since its establishment in 1998, the company has endured periods of instability and development.

JD.com entered the e-commerce business officially in 2004, and the JD.com Group's market capitalization exceeded RMB 1.7 trillion in 2018. JD.com was ranked 139th on the Fortune Global 500 for the fourth time in July 2019. JD.com sales reached 406.2 billion RMB in the first three quarters of 2019. Furthermore, the company spent more than RMB 13 billion in research and development, vaulting to become one of China's largest technology investors.

4.2 The Position of the Brand and the Strategic Objectives

Examining JD.com's main website and development reports will help us determine its long-term objectives and learn a great deal about its business strategy. JD.com is the gold standard for internet purchases due to its commitment to quality and authenticity and its enormous product range. Deliveries are done the same day or the following day to over a billion people in China, an unprecedented level of service and speed around the globe. The company's objective is to become the world's most trusted brand.

JD.com's core values are putting the customer first, maintaining integrity, working together, and expressing gratitude.

4.3 JD.com Business Area

JD.com invested in a four-square meter retail unit in Beijing's technological district in 1998 and viewed the SARS outbreak as a chance for JD.com to expand the Internet. It moved its business model from brick-and-mortar to online sales. Due to this strategy shift, JD.com accelerated its expansion and became one of China's biggest enterprises.

Over the years, JD.com became one of the top online retailers using various strategies, including development, sale, merger & acquisition, and strategic partnership. JD.com is

currently concentrating its efforts on three key areas: e-commerce, JD logistics, and technology. (This information is taken from the official website of JD.com.)

The annual report of JD.com will serve as the foundation for the following analysis, which will provide an overview of the company's sales and profitability. The annual report could reveal which businesses are the company's stars, which have the most potential, and which are the company's primary focus. We will then examine JD's three core businesses to further assess their strengths and limitations. Following these judgments, we deduce JD.com's strategy and ambitions.

4.3.1 The structure of JD.COM's supply chain

JD.com has established an accurate and efficient match between the demand and supply sides through Internet e-commerce. Supply chain management is a core capability in retail intermodulation, a vital embodiment of the retail platform's capabilities, and a link for close cooperation between suppliers and JD.com. It will become a core link in the future layout of JD.com's intelligent commercial platform.

A key strength of JD.com is its tightly integrated supply chain, making it a retail powerhouse. JD.com has achieved substantial growth in China due to its business model, which is known as a "self-operated mode". JD.com purchases all of its items directly from vendors with whom it has developed a long-standing business relationship. Additionally, JD.com is also in charge of the following operations, including inventory control, sales, transportation, and after-sales support. As a result, the business can efficiently manage the quality of its goods and services. Additionally to self-supporting shops, individual retailers and enterprise shops can manage their stores on JD.com

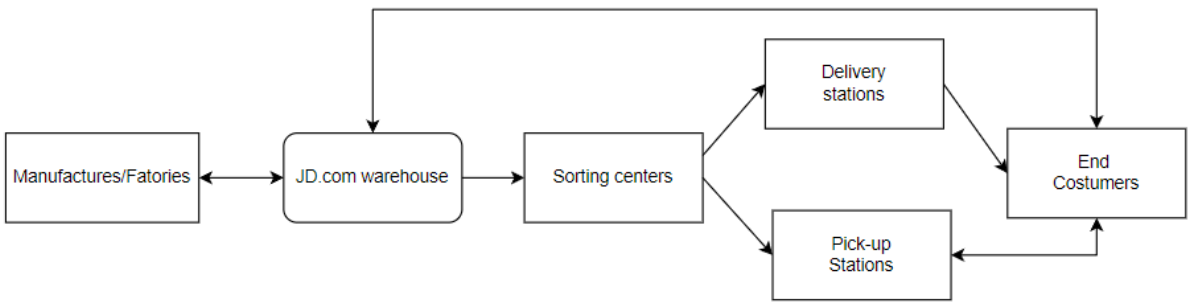

Figure 1 Structure of JD.COM's supply chain

JD.com Supply Chain's products offer various supply chain solutions for different industries and product varieties. Supply chain management, warehousing, logistics and after-sales support are all included in these options. According to the official website of JD Logistics(JD.com), Jingdong has formed a supply chain solution covering almost all categories of products for people's clothing, food, housing and transportation.

Compared to conventional supply chains, JD.com's innovative integrated supply chain model is more scalable and robust. The traditional supply chain structure comprises multiple players, with products moving from raw materials to factories to manufacturers, then from manufacturers to distributors to retailers, and finally to the end consumer. It is difficult for each participant to obtain complete information during this process, which can easily lead to disruptions or delays in one part of the supply chain. The bullwhip effect occurs when supply and demand are not aligned, and the impact of supply chain disruptions can be magnified. JD.com's integrated supply chain has several characteristics.

4.3.1.1 Effective information sharing

JD.com's integrated supply chain ensures that supply and demand data is readily available across organizations.. JD.com can promptly relay reviews from end customers to each provider. Simultaneously, each supplier will exchange operational data with JD.com, establishing a virtuous information loop.

4.3.1.2 Efficient cooperation

Producers, distributors, and retailers can collaborate efficiently because the information is appropriately exchanged. JD.com's supply chain has been simplified due to effective supply chain integration, which has enabled them to strengthen its supply chain strategy. JD.com is China's leading retailer. They foster intimate relationships between suppliers and customers, enhancing collaboration among all supply chain participants.

4.3.1.3 A high degree of adaptability

Compared to traditional supply chains in which each participant is independent, JD.com's integrated supply chain enables the company to quickly identify supply chain disruptions and effectively adjust the number of products purchased, distribute products to different distributors, and develop corresponding sales plans. Additionally, JD.com utilises various intelligent technologies to assist with market forecasts, automated replenishment, and customer support.

In summary, JD.com's integrated supply chain enables effective information exchange, efficient cooperation, and increased agility while being more resilient than traditional supply chains and many other enterprises. Additionally, through its integrated supply chain, JD.com is able to maintain a dominant position in controlling various elements of the supply chain. Moreover, the integrated supply chain has improved its performance due to the strategies. JD.com's supply chain structure is predicted to be superior to the conventional supply chain.

However, although JD.com's integrated supply chain outperforms the traditional supply chain structure, some retailers prefer the traditional supply chain structure. To begin, establishing an integrated supply chain structure is very challenging. To develop an integrated supply chain, a company must establish a countrywide distribution network, which demands significant capital and labor commitment. Simultaneously, the integrated supply chain must manage inventory and transportation expenses, which necessitates increased cash flow. It is undoubtedly a challenging challenge for the majority of enterprises to do.

Additionally, there are increased risks connected with an integrated supply chain. When the integrated supply chain is interrupted, only the firm that owns it will be responsible. Thus, supply chain resilience is even more critical for JD.com on this premise.

4.3.2 JD.com competes in the field of artificial intelligence

Since JD.com's total transformation to technology in early 2017, it has invested more than RMB 70 billion (Approximately USD 10 billion) in technology, based on financial reports from previous years.

As a result of our prior annual reports analysis, we know that technological research and development are critical components of JD.com's business strategy.

Academics think technology will become a critical corporate strategy for artificial intelligence. Because of its ability to cut the costs of products and services while increasing consumer attention, AI's value as a driver of corporate development and competitive advantages will continue to expand.

4.3.3 Forecasting technology in the JD.com supply chain

With the help of machine learning, big data, and other related technologies, JD.com has systematised many supply chain optimisation issues. Optimisation recommendations are

given automatically by the system and are linked to the production system to automate the entire process. Prediction technology plays a supporting role here.

Using forecasting technology, JD.com can calculate the approximate future sales of items. Then the warehouse will guarantee this volume and give the supplier a restocking notice if it falls below this volume. All in all, forecasting technology plays an important role here and is a crucial link.

Currently, the forecasting system supports three main businesses: sales forecasting, unit volume forecasting, and GMV forecasting.

- **Sales forecasting system**: mainly supports the replenishment and allocation of goods.
- **Single volume forecasting system**: mainly supports the operation management of warehouses and sites.
- **GMV forecasting system**: mainly supports the customisation of sales department plans.

4.3.4 E-commerce

JD.com is China's premier e-commerce platform, providing high-quality products and services to more than 550 million active customers. They aim to set the industry standard for online purchases and assist domestic and international companies entering China. Their efforts accelerate the expansion of the e-commerce business area.

JD.com has three main features. The first feature is that they offer a wide range of products for customers to choose from, such as fresh produce, electronics, apparel, furniture, fast-moving consumer products, and more. The second feature is JD.com's outstanding delivery speed, which is one of its key competencies. JD.com makes perfect use of its logistics network across China and data-driven delivery technology to provide consumers with accurate delivery services. Consumers can choose to receive their goods at a time of their choosing, with the fastest packages even reaching customers on the same day. There is virtually no competition for this outstanding service. The final feature is that JD.com has a cross-border platform. The cross-border platform greatly facilitates JD.com's global business,

helping domestic and international brands enter the Chinese market. It also means that consumers can buy quality products from home and abroad through JD.com's platform.

4.3.5 JD logistic

JD Logistics is a commercial group under JD Mall established in April 2017. Based on cutting-edge technologies, JD Logistics is a prominent supply chain solution and logistics service provider in China.

JD Logistics has optimized the integration of logistics services to reduce intermediaries and fulfilment times. In order to reach potential end-users as efficiently as possible, its integrated supply chain technology places inventory at the closest warehouse to the potential customers. Upon receiving an order, JD Logistics can dispatch the products from the closest storage to the end consumer, resulting in prompt delivery and greater consumer satisfaction.

4.3.5.1 Supply chain technologies

In order to build a complete supply chain covering upstream manufacturing, midstream logistics, and downstream distribution, JD Logistics has been committed to building an extensive logistics infrastructure network and has developed several proprietary technologies. Since 2017, JD Logistics has been opening its logistics capabilities and resources to external customers and operating independently of the JD Group.

Supply chain technology is the foundation of JD Logistics and sets it apart from its competitors. Over the years, JD Logistics has been strengthening its technological innovation and expenses in all aspects of supply chain solutions and logistics services, including automation, digitalisation, and intelligence. As disclosed through JD's public financial reports and official website, as of 31 December 2020, JD.com Logistics has obtained over 4,400 patents and computer software copyrights (including those under application), of which 2,500 are related to automation and unmanned operation technologies. By applying technology to all critical aspects of the supply chain, JD Logistics automates services, digitizes processes, and makes intelligent selections as a result of developing an intelligent logistics system.

4.3.5.2 Logistics Services

Besides warehousing and distribution, JD Logistics also offers express delivery, cold-chain, and oversea shipping services. The integrated model of JD Logistics allows the company to meet the needs of the market and its customers. The company's efficient logistical services

assure its clients a positive experience. Intelligent supply chains assist the company in optimising warehouse management, optimizing resource allocation, and reducing costs.

In addition, JD Logistics is not only open to its platform, but it is also open to external companies. This measure has dramatically improved the delivery service level of the whole industry.

Almost all products sold on the JD.com platform can be delivered on the same day or the next day to most cities across China. This solution sets a new global standard in e-commerce logistics. JD.com's intelligence and automation are among the best in the world. In order to assist with their warehousing and distribution work, they have developed numerous types of intelligent robots, which have proved to be extremely useful during the epidemic, preventing the spread of infection and ensuring the company's efficiency. Additionally, their continuous investment in artificial intelligence and machine learning has enabled them to anticipate market demand better and increase operational efficiency. Furthermore, according to JD.com's website, they are also the first company in China to use unmanned robots for delivery.

5 JD.com's performance during COVID-19 and SWOT analysis

5.1 JD.com operations before the pandemic (with December 2019 as the event point)

According to JD.com's 2019 annual results, JD.com achieved operating revenue of RMB170.68 billion (US$24.517 billion) in the fourth quarter of 2019, and well ahead of market expectations of US$23.8 billion.

Regarding revenue composition, JD.com's 2019 product sales revenue reached RMB 510.73 billion (US$73.38 billion), as shown in Figure 4, year-on-year growth of 22.7%, while service revenue was RMB 66.15 billion (US$9.89billion), a year-on-year increase of 44.1%. Notably, the company's service revenue has continued to increase as a percentage over the past three years, rising from 8.4% in 2017 to 11.5% in 2019.

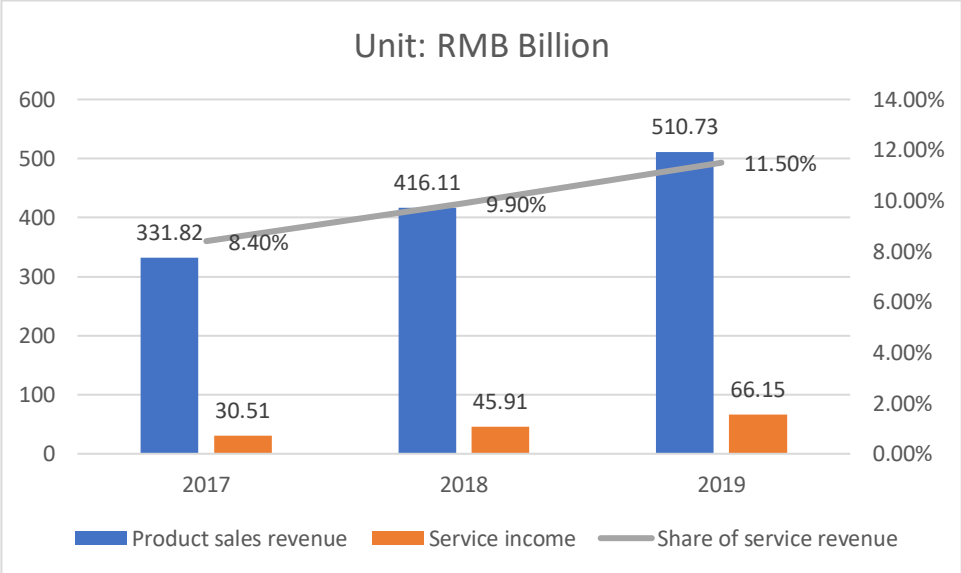

Figure 4Trend graph of revenue components and growth rate of JD.com, 2017-2019

As shown in Figure 5 below, JD.com's gross profit reached RMB 84.42 billion (US$12.62)billion with a gross margin of 14.6% in 2019. This gross profit is a growth trend compared to the last three years. This growth trend also indicates the economic benefits that JD.com has achieved over the past three years and the company's success in supply chain management and cost control.

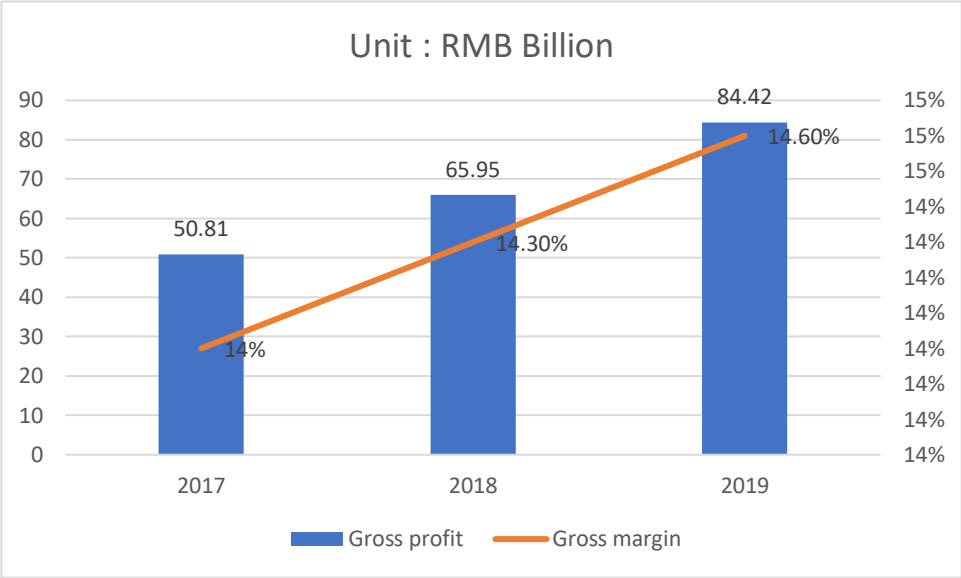

Figure 2 Gross Profit Trend Chart,2017-2019

In 2019, companies in the market will be affected to varying degrees by the objective effects of the global economy and the trade wars being waged by various countries. This has caused companies to control their internal costs. Among these companies, JD.com has also chosen to control its operating costs.

JD.com restructured its internal staff in 2019. In order to achieve optimal development as well as improved management, the company shut down some of its businesses that had no prospects for development. It also adjusted its staff structure according to the business level of different employees to achieve an optimised level of management of the company. This internal restructuring has led to an increase in the company's overall earnings in 2019.

JD.com's operating expenses include administrative expenses, marketing expenses, and research and development expenses. Of these, marketing and R&D costs are the main expenses of JD.com. Also, through 2017 to 2019 annual reports, we can see that JD.com continues to increase expenses on top of R&D, which is a good indication that JD.com attaches great importance to technological upgrading and innovation. According to the annual report, JD.com's total operating expenses in 2019 were RMB42.34 billion(US$6.33billion). The operating expense ratio was 7.3%, which was 0.6 % lower than in 2018.

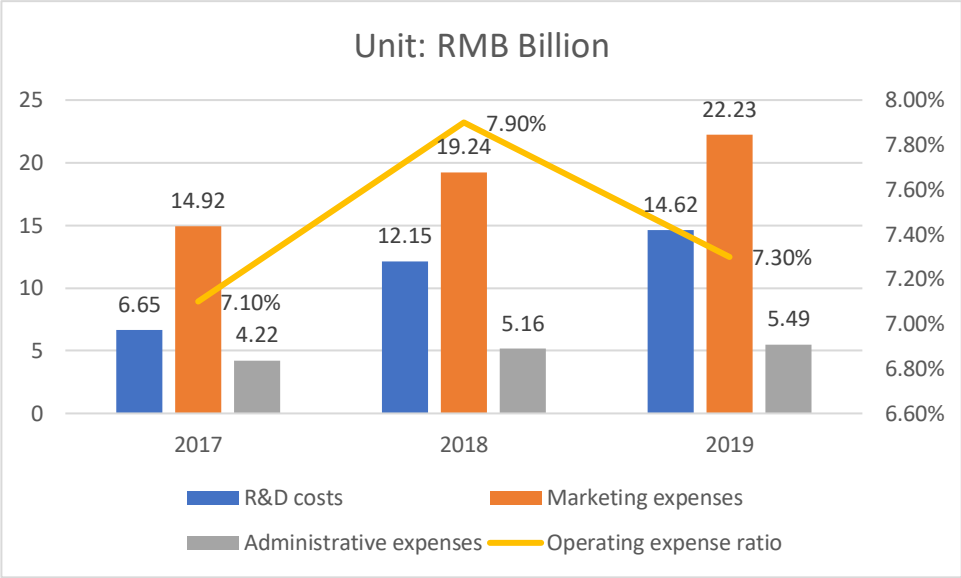

Figure 6JD.com's Operating Expense Components and Trends Chart in 2017-2019

In addition to this, according to JD.com's 2019 annual report, we know that the company's most significant expenses are fulfilment costs, and JD.com has successfully achieved cost reductions and efficiency gains. The company's fulfilment costs for 2019 were RMB36.97 billion, with a fulfilment cost ratio of 6.4%, showing a downward trend for the third consecutive year. At the same time, with the reduction in the company's fulfilment costs, the company has more costs to invest in technological development. Improvements in the company's technology and efficiency have led to an increase in the speed of the company's logistics services.

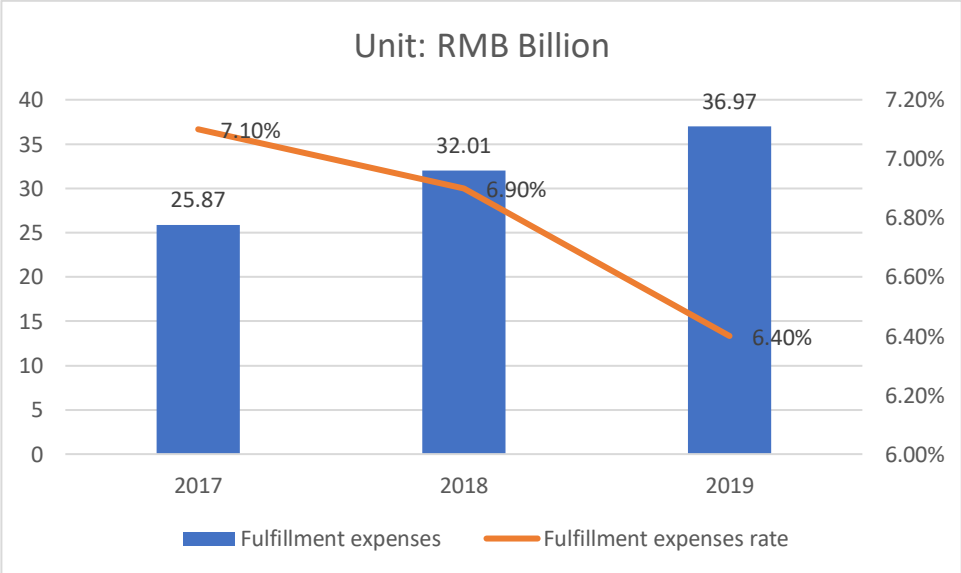

Figure 7 JD.com's Fulfillment Trend Chart in 2017-2019

5.2 JD.COM's response to supply chain disruptions under COVID-19

Throughout this section, we will discuss the steps taken by JD.com to enhance its supply chain resilience in the face of COVID-19. Several critical approaches include the extensive use of high-tech and digital platforms, the ability to adapt their operational strategies to the impact of a pandemic, maintaining order in the market and limiting the spread of a pandemic.

5.2.1 Support from its digital platforms

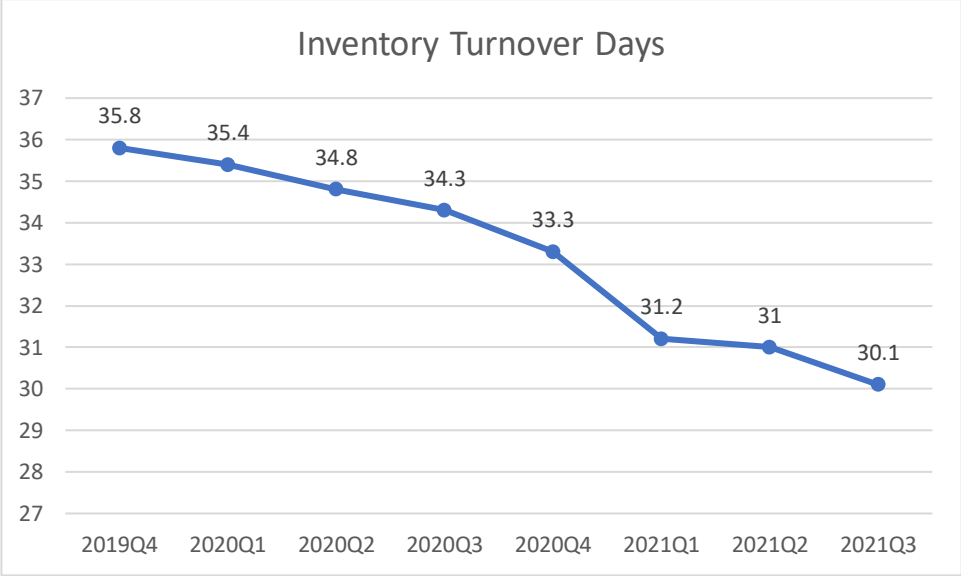

Figure 8 Inventory Turnover days 2019Q1-2021Q3

JD.com's latest annual report for the third quarter of 2021 showed that its inventory turnover days were 30.1 days, a decrease of 4.2 days year-on-year. Without JD.com's intelligent warehousing management, this drastic development would not have been possible.

JD.com uses big data to forecast and monitor output and make timely adjustments to production plans. Additionally, they can use the distribution of orders across areas, analyse future purchase trends, and stock up quickly. Moreover, employ a priority order approach for pandemic areas, such as Wuhan, to guarantee enough supplies for local pandemic prevention.

JD.com's supply chain is agile mainly due to its advanced information systems, which serve as its supply chain's 'brain.' This information system allows its manufacturing, storage, logistics, and marketing operations to respond rapidly to unexpected occurrences. Manufacturers may find it challenging to modify production and sourcing with the traditional methods, but JD.com's intelligent supply chain management technology enables

manufacturers to respond rapidly. The intelligent supply chain management system continuously offers JD.com correct suggestions by continuously analysing market data, allowing them to alter their crucial product procurement. Additionally, analysing the real-time market and consumer data from many places and proactively advising JD.com on resource allocation assists JD.com in allocating supply to regions with a demand gap. Additionally, the platform provides insight into items that are slow to sell and designs its promotions.

In the initial outbreak of the pandemic, an 'end-to-end model' which included forecasting and refilling functions was utilized. By adding data, including historical sales, product attributes, history replenishment lead time(VLT), order cycle, and Initial stock into the system, the multi-quantile RNN delivers anticipated sales and supplier delivery time. The restocking responses were actively generated from the multi-quantile RNN model. The 'end-to-end model' was utilized to assist the restock plan under COVID-19. This model sped the restocking process and enhanced management inventory effectively.

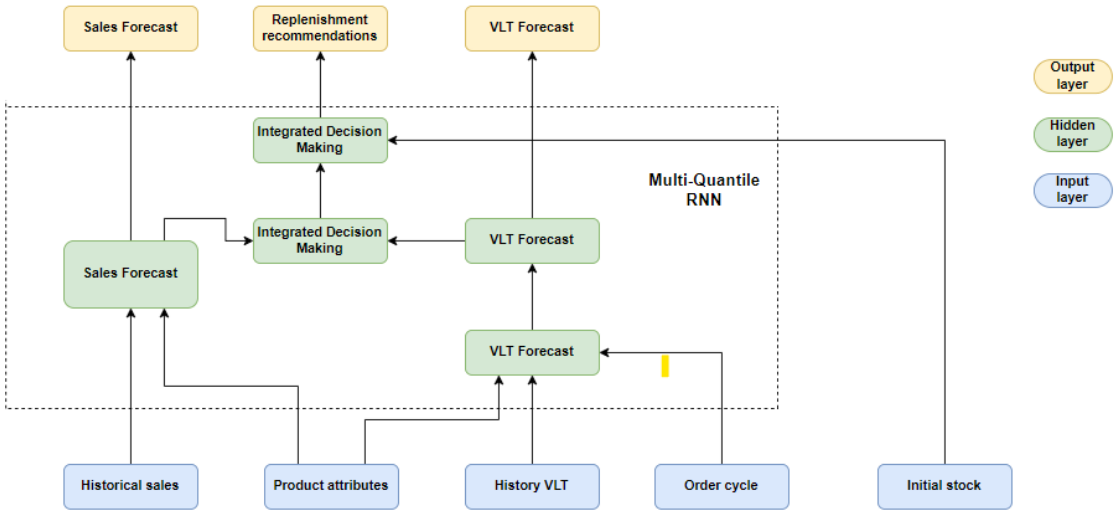

Figure 9 End-to-End module

5.2.2 Cooperation with suppliers

Numerous roads were blocked, and distribution was put under unprecedented strain due to the pandemic. Both independent and branded vendors were put to the ultimate test. JD.com worked closely with suppliers during the pandemic to assist them in resolving product stagnation; it also offered customers essential material security via safe methods. For example, JD.com established a green channel for fresh produce providers to assist them in

promoting the sale of their stalled products to minimize their losses. JD.com initiated a series of subsidies to assist platform merchants, including financial, logistical, and technical support. They also developed a series of measures to assist Hubei province's vendors, including reduced platform usage fees and free agency operation services during the pandemic.

Catering businesses were also heavily struck by COVID-19, as numerous anti-pandemic policy requirements resulted in the closure of many businesses. During the closure, those who stayed open experienced a considerable decrease in client volume. The industry's recovery time is questionable when combined with the epidemic's unpredicted state. At this time, JD.com established a green channel for catering businesses and provided fast delivery services to expand the options for many catering enterprises.

Many suppliers to independently held businesses are significant corporations. However, suppliers and owners of chain stores are primarily medium-sized and minor businesses that cannot afford these risks. They are suffering severe financial challenges as cycle durations in all industries grow. As a result of these issues, JD.com has implemented various initiatives to assist these businesses. JD.com, in particular, has adopted a proactive approach to shortening the cycle time to pay suppliers. JD.com was prepaying for items for firms with limited cash.

Additionally, JD.com's supply chain strength enables firms to get raw materials and other essentials necessary to manufacture emergency items such as masks. JD.com offered to share its distribution infrastructure with other businesses and help suppliers with deliveries to solve logistic issues. Supplier support also helped relieve the supply bottleneck on the JD.com platform.

5.3 Coping with merchants

Many offline merchants were forced to close down due to strict prevention and control policies during the epidemic. In the challenging market environment of the epidemic, JD.com launched a live streaming platform and provided live streaming training to offline sellers to help them sell their products via live streaming. As well as this, Jingdong planned different promotions on its platform to promote the sale of products whose demand declined or lagged during the epidemic. Jingdong provided supporting policies for platform sellers, including reducing operating costs and providing free traffic.

5.4 Coping with logistics disruptions

5.4.1 Distribution for hospitals

The pandemic has had a devastating effect on the survival and growth of China's logistics industry. Consequently, businesses adopt proactive efforts to mitigate the epidemic's detrimental effect on their operations. At the height of the pandemic, masks, goggles, and disinfectant water were in limited supply, and JD.com used a variety of measures to guarantee that hospitals received supplies. They have taken the following measures.

5.4.1.1 Create a green channel for supplies.

In order to be able to purchase a large number of epidemic supplies and get to the severe pandemic area faster, JD Logistics applied for an emergency transfer order. It cooperated with third-party logistics to transport emergency supplies through a green channel. A green channel transport system ensures that anti-epidemic supplies can quickly reach hospitals and epidemic areas while also managing resources efficiently and increasing efficiency.

5.4.1.2 Formation of temporary distribution teams

JD.com assembled a e mergency distribution team during the initial phases of an outbreak. The company ensured that pandemic prevention supplies worldwide could be distributed swiftly and efficiently to hospitals in Wuhan. The team expanded in size and distribution from Wuhan to Hubei province as the virus spread. Due to the young fleet's enormous workload, 24-hour on-call service has become the norm.

5.4.1.3 Building intelligent delivery robots

JD.com's self-developed intelligent delivery robots, "driverless vehicles," completed the first batch of intelligent deliveries in Wuhan during the pandemic. Medical supplies were delivered without incident from JD.com to Wuhan No. 9 Hospital. As the coronavirus epicenter, Wuhan No. 9 hospital only receives severe and critical patients; other personnel apart from patients and doctors were not allowed to enter. The use of a "driverless robot" avoids the risk of cross-infection and improves efficiency. In terms of capacity, the robots can accommodate 24 orders at a time. The crew specified a collection time of around 30 minutes, after which the robot will return automatically to the JD.com distribution center.

Moreover, undeliverable orders will continue to be placed on the robots, or the customer will be contacted to arrange a delivery time. The "driverless vehicle" will travel at approximately 30km/h.

5.4.2 Distribution for residents

Because most people stayed at home during the pandemic, many individuals turned to e-commerce platforms to purchase necessities. JD.com delivers to approximately 300 cities nationwide, ensuring that residents meet their basic needs. JD.com has developed a new delivery method to reduce the risk of infection during the delivery process. The couriers will deliver the products to the temporary mini delivery stations. Consumers can collect the parcels themselves after checking the real-time parcel logistics information. JD.com has launched a "drone" service in remote areas where transportation and delivery are difficult. Drones have significantly improved the efficiency of JD.com's. In addition, JD.com's smart logistics warehousing centers, such as the "Asia One" smart warehouse in Wuhan, also use automated logistics technology.

During the pandemic, staff responsible for delivery received special training to avoid personal contact, and deliveries and pick-up processes were carried out under tight protective gear. They are required to undergo COVID-19 testing, thus ensuring the health of couriers in order to avoid the spread of pandemics. The non-contact delivering method worked functionally. Despite the massive amount of orders during the pandemic, JD.com's flexible service resulted in fewer customer complaints.

5.5 Operation performance during COVID-19

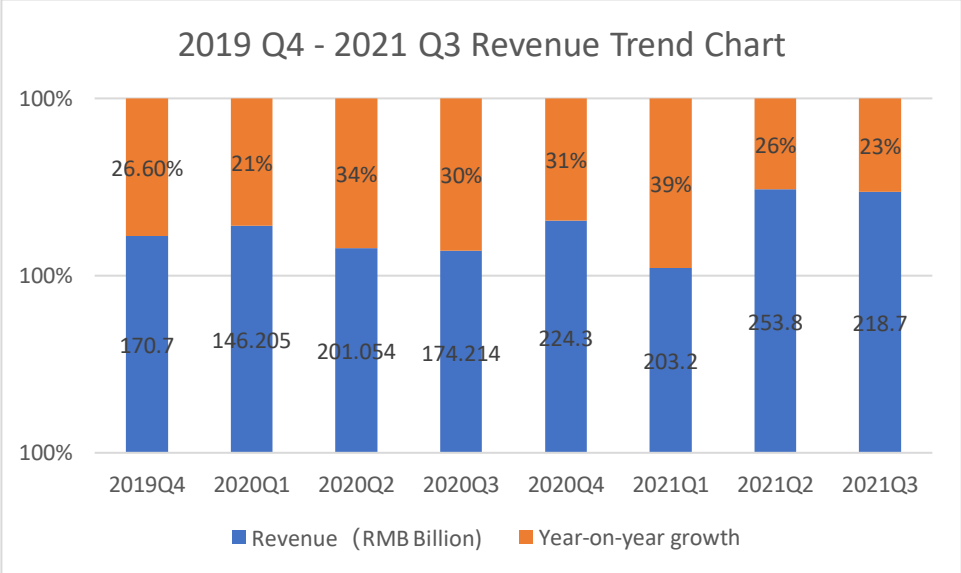

Figure 10 2019 Q4 - 2021 Q3 Revenue Trend Chart

According to JD.com's financial results, JD.com's net revenue in the first quarter of 2020 was RMB 146.2 billion, increasing 21% compared year-on-year. The company's overall income

and net profit for 2020 exceeded the company's estimated market value. JD.com's ability to maintain profitable sales growth in challenging times was primarily due to its integrated and intelligent supply chain. As shown in Figure 10 above, the net revenue for the entire year of 2020 was RMB745.8 billion (approximately US$114.3 billion), an increase of 29.3% year-on-year. Net revenue for the fourth quarter of 2020 was RMB224.3 billion (approximately US$34.4 billion), an increase of 31.4% year-on-year. Revenue has all shown continued growth.

Most shops could not operate normally under the prevention and control policy during the outbreak. According to the analysis of data obtained from the Ministry of Transport of China, the courier business in China was also unable to operate normally. From January to February 2020, China's express delivery industry recorded 6.55 billion parcels, a decrease of 10.1% compared to the same period last year. Its overall performance revenue was RMB 86.49 billion, a total decrease of 8.7% compared to last year's same period(MinistryofTransportofChina, 2020). In particular, only SF Express, JD Express, and China Post could normally deliver in areas where the pandemic was severe. In this case, the self-operated business carried out by JD.com enabled the company to grow steadily against the backdrop of the pandemic.

However, it is worth noting that while the COVID-19 did not have a disproportionate impact on JD.com's growth, it still brought about some irresistible negative factors. The mainstream business of the JD Group is JD Logistics, and the logistics business is the primary support that keeps the JD Group generally running during the pandemic. However, the impact of the COVID-19 and the government controls on transportation caused JD.com to increase the costs invested in logistics. As shown in the Figure below, the costs collected for the previous years show that the company's fulfilment costs ratio for the fourth quarter of 2019 was 6.4%. After the breakout of COVID-19, the cost of investment in logistics reached the highest since the fourth quarter of 2018, with a fulfilment costs ratio of 7.1%.

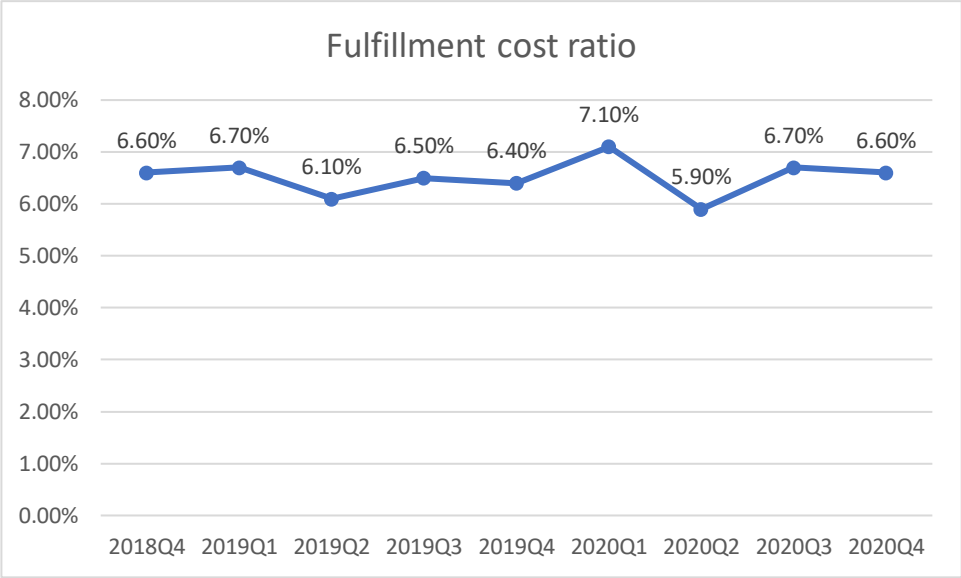

Figure 11Fulfillment cost ratio 2018-2020

The JD Group is an asset-heavy operation company, and changes in its fulfilment costs can also affect its operating costs. The size of JD.com's orders during the pandemic and the delivery efficiency will affect the company's overall revenue profile. As the number of orders increases during the pandemic, the company's fulfilment costs will gradually decrease. The reduction in fulfilment costs will lead to greater profitability for the company.

5.6 SWOT analysis of JD.com's supply chain

5.6.1 Strengths

5.6.1.1 Brand reputation

Alibaba is JD.com's primary competitor in China. With Taobao and Tmall, Alibaba is China's largest e-commerce site. Alibaba's business model differs from JD, with Taobao operating as a C2C platform. Simultaneously, starting up a business on Taobao is more accessible than JD.com. It attracts more small merchants to the Taobao platform. In addition, products sold on Taobao are usually cheaper, thus attracting many consumers, which has contributed significantly to Alibaba's rapid growth. However, this platform approach will make it more difficult to manage product quality than JD.com's self-operated model. Tmall operates similarly to JD.com's B2C model in that sellers must acquire a brand license to start a business on Tmall. However, unlike JD.com, Tmall is only an online sales platform. It does not have the same level of control over the complete supply chain as JD.com, which means they do not have direct control over its products. JD.com's unique integrated supply chain model allows them to work directly with suppliers of their products and thus have control

over the quality of their products. Compared to Alibaba, JD.com's products are generally perceived to be more quality assured.

JD.com has been self-operating for 16 years, so they have high recognition and reputation in the industry. Both overseas and local Chinese brands are more inclined to work with JD.com. Also, JD.com has made a massive effort in brand expansion, and they are actively building partnerships with different brands from overseas. The one that can compete with JD.com in this area is Kaola, but in 2019 Alibaba acquired Kaola for US$2 billion.

5.6.1.2 High-quality logistics experience

JD.com's unique integration of warehousing and distribution has significantly reduced logistics time. Most of the products sold on the platform can be delivered on the same day or the next day. This quality service experience has undoubtedly increased guests' recognition of JD.com and reduced the probability of customer churn.

One of JD.com's famous and influential services is 211 Limited-Time Delivery. This service can provide same-day delivery if an order is submitted before 11:00 am and the next day delivery for orders submitted before 11:00 pm.

In addition to this, JD.com also offers a fixed-time delivery service. Customers can ask JD.com to deliver the package at a specified time. At the same time, JD.com will place the parcel at the specified location within the specified time. This service significantly reduces the risk of lost and damaged parcels.

According to a report by the state post bureau of China, JD.com's effective complaint rate in December 2020 was 0.002, much lower than the average effective complaint rate of 0.22 for all Chinese courier companies, with the complaint rates for delays, breakage, and lost all under the industry overall(StatePostBureauofChina, 2021). From these data, it is clear that the high security, fast, and high quality of service are the strengths and core competencies of JD Logistics.

5.6.1.3 The layout of the intelligent supply chain

JD.com's intelligent logistics technology empowers its supply chain. Automated warehouses and other intelligent equipment increase efficiency, provide stability and security, and decrease expenses for human resources. Furthermore, the integrated logistics and

warehousing system reduce transportation costs and assures company continuity during periods of vacation and crisis.

The beginning of the outbreak coincided with the Chinese New Year when many couriers had already stopped delivery services before the Spring Festival. However, JD Logistics has always adhered to the service concept of not closing for the Chinese New Year, which has enabled JD.com to have sufficient human resources and material resources to operate during the outbreak, thus ensuring the regular operation of goods during the pandemic.

In order to enable deliveries to reach customers effectively during the pandemic and to the risk of infection, JD.com used its big data platform and intelligent supply chain to enable the delivery on the front line during COVID-19. On 6 February, the JD.com's self-developed intelligent robots had successfully delivered supplies to the Wuhan No.9 Hospital. It is the first order delivered by intelligent robots since the outbreak. After the successful launch in Wuhan, JD.com has also launched intelligent deliveries in others cities. JD.com has also implemented a drone delivery service model in some areas of Hebei Province due to traffic conditions.

5.6.1.4 Technology

Every business unit in JD.com strives for innovation and improving its advanced technology, which has become one of the company's highlights. This is particularly true of JD.com's Technology-X department. This department is a team of several internationally renowned experts in artificial intelligence who have contributed to automating JD.com's supply chain.

Automated warehouses

In 2017, JD.com completed the construction of the first wholly automated warehouse in the world. Although Amazon achieved automated picking back in 2014, its warehouses are not fully automated. JD.com's warehouses are fully automated for product entry, storage, packaging, and picking. The

Figure 3 Robots handling of parcels(source: JD.com)

warehouse can handle 9,000 packages per hour, which is equivalent to the workload of 180 manual sorting machines. The fully automated warehouse has certainly helped JD.com save on human error costs.

In addition to having advanced technology, JD.com's approach to logistics management is also very advanced. JD.com uses integrated warehousing and distribution to complete its logistics work.

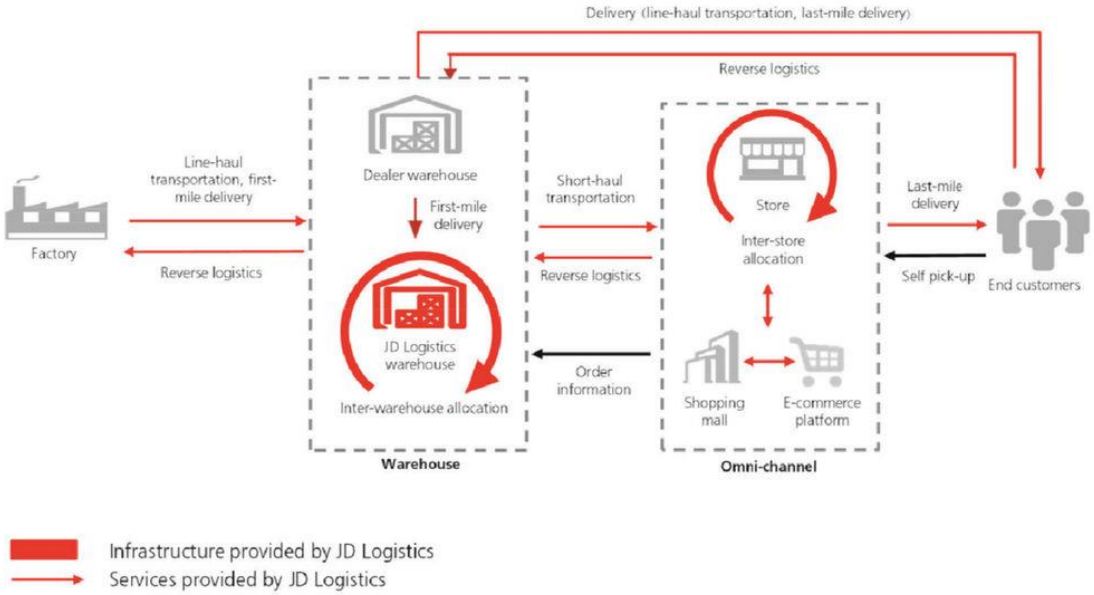

Figure 13 JD.com warehousing and distribution process (source:JD.com)

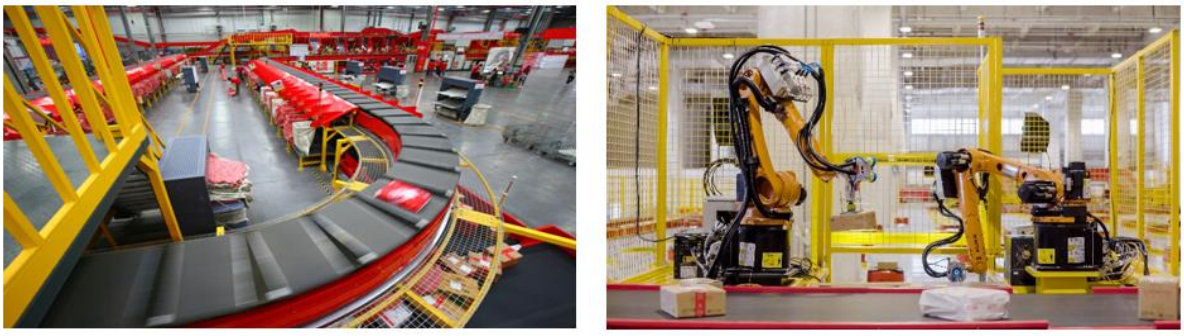

Figure 14 Fully Automated Sorting Centre (source:JD.com)

JD.com built its first fully automated sorting center in Shanghai in 2018. This cnter can handle 20,000 orders per day. Moreover, the entire center employs only four people for robot inspection and maintenance, which is undoubtedly a significant breakthrough in saving human resources.

Unmanned supermarkets

In addition to the breakthroughs in logistics, JD.com has also entered other areas such as supply chain financing and blockchain. The unmanned supermarkets set up by JD.com to attract investment have been all the rage in China for several years now. JD.com's unmanned supermarkets are open 24 hours a day, all year round, significantly reducing labor costs.

Figure 4 JD.com Unmanned supermarket (source: sznews.com)

Customers need to scan a QR code for first-time entering the unmanned supermarket to tie their identity and payment information. When they revisit the shop, they only need face recognition to enter the shop without scanning the QR code again. The supermarket uses RFID technology to achieve passive product counting. Customers walk through the checkout lane and leave the shop with automatic checkout. The whole shopping process is completed in the "no perception" situation.

Delivery robot

Another innovative technology of JD.com is the delivery robot. The delivery robots developed by JD.com have a delivery range of 50 kilometers and can put 12 parcels per vehicle. Generally, JD.com's delivery robots are used for last-mile deliveries in urban areas. The delivery of robots can be applied to almost all life scenarios, such as schools, communities,

P*Figure 5 JD's delivery robot (source: sohu.com)*

shopping malls, offices, etc. JD.com was also the first company to use robotic delivery to prevent personnel contact and infection during the COVID-19 period in Wuhan.

Drone

JD.com has developed multiple types of drones to reach rural China, each with a particular set of skills. JD's drones can carry 1,000 kg and travel 100 kilometers, which will be the new delivery method for rural areas that have not yet benefited from the ease of online shopping. Drones provide for a more efficient distribution of logistical resources by eliminating the cost of bringing items to remote areas by car.

Figure 6 JD's Drone (source:chineseonline.se)

5.6.2 Opportunities

The spread of the Internet and the rise of the economy

With the growing popularity of the Internet, many potential consumers will enter the market. According to a report by China's National Bureau of Statistics, the number of people with Internet access in China was 1.032 billion by the end of 2021, including 1.029 billion people with cell phone access. The Internet penetration rate was 73.0%, including 57.6% in rural areas(Statistics, 2022). Further, mobile devices, 5G, and the Internet are all gaining popularity in China. This new market and customer base will greatly benefit the e-commerce and logistics industries.

Of the total number of Chinese Internet users, youth and middle-aged people are the mainstays of the online population. This segment of the population has more experience in online shopping. Instead of purchasing cheaper products, they are concerned more about the quality of the product and the quality of service. JD.com uses big data to analyze consumers' behavior and preferences. Through the use of technology, JD.com can provide consumers with more appropriate products and a more satisfying user experience.

In addition, China has a rapidly rising middle class. As shown in Figure 18 below, according to a McKinsey study, it is estimated that 54 percent of urban families and 56 percent of urban personal spending would belong to China's middle class by 2022. China's middle class is also shifting its consumption preferences from low-cost to high-quality products. This also creates an opportunity for JD.com, as its products are of better quality than Alibaba's. At the same time, JD.com has more well-known overseas brands, which helps JD.com cater to future consumer trends.

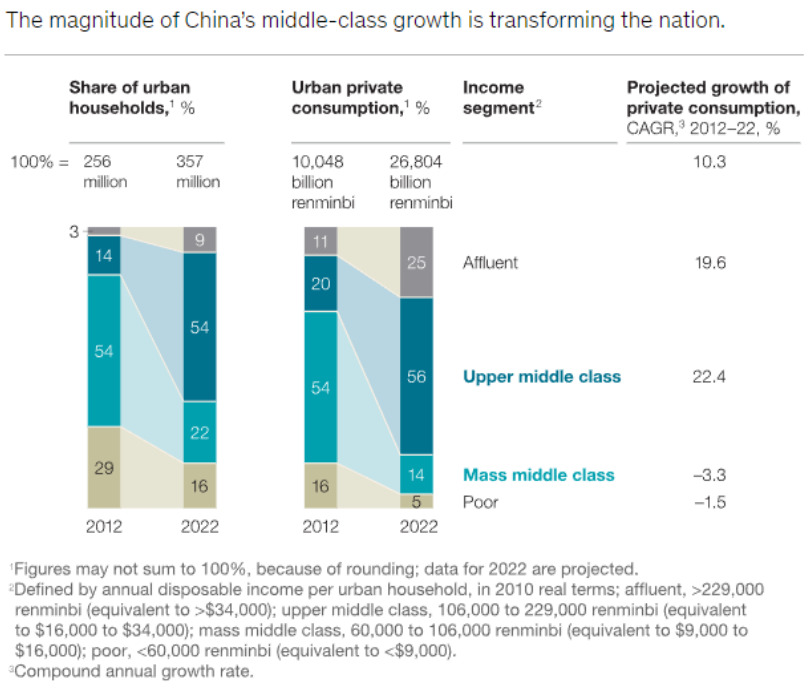

Figure 7 The magnitude of China's middle-class growth(source: McKinsey)

Government support

The government implemented a variety of economic reforms after the outbreak of the epidemic to facilitate the recovery of the market economy. The government has proposed tax and fee reductions for the logistics industry, such as reducing road access costs and rail and air freight charges. This policy has enabled companies to reduce logistics costs and stimulate competition and recovery in the logistics industry.

5.6.3 Weakness

High capital investment and long capital recovery period

Since JD.com started building its logistics in 2007, it has invested much money in technology, talent, and infrastructure, which has undoubtedly placed a substantial financial burden on the company. According to JD.com's annual report, JD.com has invested RMB 12.1 billion in research and development since 2018. In terms of profit, JD Logistics' gross margin for 2021 is 5.5%, which is a margin of improvement from 2.9% in 2018. However, JD Logistics' financial report analysis shows that its profit and loss situation in 2021 is still a loss. In the long run, JD.com is trending towards turning a loss into a profit. However, because the company invested a tremendous amount of money in the initial stage, the payback period for the capital invested by JD.com will be relatively long from the current financial analysis, which has a huge investment risk for the company.

Limited delivery area

Although JD.com has built warehouses and logistics networks in major cities throughout China.However, they still do not have full logistics coverage in some remote cities, suburbs, and sparsely populated areas. Some of the more established third-party logistics companies can deliver to these areas. For example, China Post is the only logistics company in the country that can deliver things to every corner of China, which JD.com is currently unable to do.

Figure 19 JD Logistics' Scale in China (source: JD.com)

Difficult business management

As JD.com expands its scale, its management has become increasingly difficult. For example, in terms of personnel management, employees also increase as the company's scale expands. The uneven quality of the employees also poses a challenge to the company. As some of the cities are located in remote mountainous areas, their economic development and infrastructure is far less developed than that of large cities. These remote cities pose a challenge to JD.com's warehouse management. Therefore, while JD.com is developing, its management problems are gradually exposed.

5.6.4 Threats

Competitors and technology

As the world's largest online e-commerce platform, Amazon has 80 warehouse sites and efficient and leading warehouse management worldwide. At the same time, Amazon has built several large-scale distribution centres worldwide and has divided the management of the different distribution centres. In addition, Amazon uses big data analysis to filter out the optimal distribution path to better solve the end distribution problems. On the contrary, although JD.com has been expanding overseas these years, its scale is inferior to Amazon. So Amazon will have more experience than JD.com in global supply chain management. In the meantime, Amazon has an excellent cloud computing service, the AWS system, which allows it to use big data capabilities fully. This system helps upstream and downstream supply chains to reduce IT input and maintenance costs, thus increasing the efficiency of the entire supply chain system.

Low penetration of new technologies in less developed cities

While JD.com has continued to build modern warehouses and digitalised intelligent logistics information platforms in major Chinese cities these years, most of them are in developed cities or densely populated areas of China. For some rural areas and remote cities, digital, smart logistics technology penetration is not high. At the same time, JD.com's self-built logistics network does not cover all cities in China, so it still uses third-party logistics for delivery in areas that JD logistics cannot reach.

Unstable international situation

Relations within different governments can affect economic cooperation between countries and business abroad. For example, Huawei and its 5G business is one of the most affected in the US-China trade war. In a similar trade war, JD.com's overseas business may also be affected by the relationship between countries. JD.com has been committed to expanding its overseas business for many years, and its main overseas markets are concentrated in Southeast Asia. In terms of the current international situation, the relationship between China and several Southeast Asian countries is still relatively friendly, so it is more favorable for JD.com to develop its market in Southeast Asia. However, there is no way to predict long-term international relations. Suppose there is a sudden conflict between China and other countries and it will inevitably affect JD.com's business in overseas markets. Therefore, JD.com should prepare strategies to deal with unexpected events in advance.

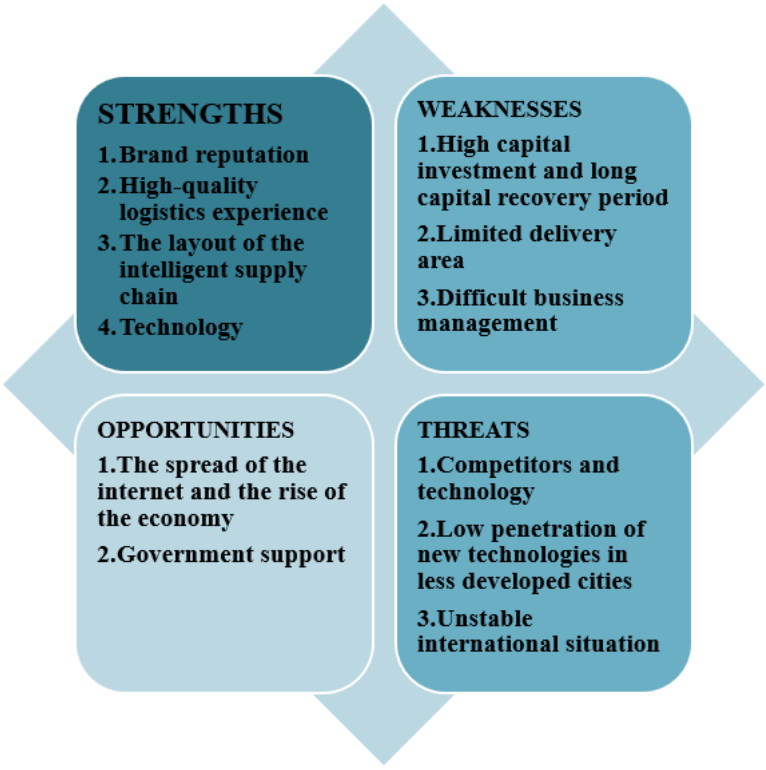

Figure 20 SWOT analysis of JD.com's supply chain

6 Discussion

In this chapter we will examine the performance of the above literature and determine whether the data backs up any of our current ideas, discoveries and concepts.

Proposition 1: Supply chains become increasingly susceptible to disturbance as its length and complexity increase.

Global supply chains remain vulnerable to the continuing outbreaks of COVID-19, with multiple outbreaks plaguing major manufacturing nations and many disruptions to supply chains due to difficulties with international transportation. Many countries have been forced to reflect on the independence and autonomy of their supply chains in the wake of the pandemic. Meanwhile, the pandemic exposed supply risks in the emergency supplies industry. Despite the end of the epidemic, the length of global supply chains is likely to shorten. A trend of localisation of industry chains can be expected after the end of the pandemic.

In addition, the global production network is interconnected. Based on our literature review and case studies, it is clear that both global industry chains and global supply chains have been adversely affected by the outbreak, including forced shutdowns in manufacturing, labour shortages, logistics disruptions and backlogs of goods. The end consumer will ultimately be the one affected by these problems.

The appeal discussion has led us to concur with proposition 1, which states that supply chains become more susceptible to disruption as they grow in length and complexity.

Proposition 2: COVID-19 has had a significant negative impact on global supply chains and has also contributed to the rise of e-commerce.

Both theoretical and research show that one of the pandemic's significant effects was that the firm's capacity could not meet urgent needs. Countries introduced varying degrees of preventive control policies under the pandemic, leading to road closures and flight cancellations. Commodities had to find another alternative of transport, which led to an increase in the cost of goods, and the risen price had to be borne by the end customer. When the outbreak brought Chinese manufacturing facilities to a halt, many worldwide merchants

and producers could not get the supplies they needed and were forced to shut down their businesses.

A further impact of the virus is greater demand volatility. The purchasing behaviour altered significantly during the pandemic. Some consumers started to panic-buying due to the pandemic. This is supported by the theoretical findings, which refer to significant swings in need that many businesses were unprepared for it. While the company in the case study made it through the pandemic, others did not fare as well.

In addition, the various quarantine and lockdown policies during the epidemic led to a shift in how people shopped. In the case study, it can be observed that since the outbreak, JD.com's sales have shown an upward trend compared to the same period in previous years. This also confirms that the epidemic has changed people's consumption behaviour and thus contributed to the development of e-commerce.

From the above discussion, it is clear that both theory and practice verify that COVID-19 has serious adverse effects on both businesses and supply chains. So we can conclude that there is a negative relationship between them. At the same time, because the epidemic has changed people's daily shopping behavior, on the other hand, it has facilitated the development of e-commerce.

Proposition 3: With the appropriate strategy in place, the supply chain is resilient to withstand unanticipated crises like COVID-19.

COVID-19 has exposed companies must plan for potential interruptions and build more resilient supply chains. According to JD.com's case study analysis, sales are typically forecasted based on historical data, and inventory is prepared so that there is enough inventory to satisfy consumer demand. Masks and other pandemic items are not usually in high demand during non-pandemic periods, so they are in short supply in warehouses. Upstream suppliers have also limited their production capacity. Since the outbreak, these commodities have increased in demand, causing panic buying and stockpiling. If it is permitted to panic buy, the supply of these commodities will not be fully utilised.

Scientists at JD.com Smart Supply Chain predicted the demand for epidemic supplies by creating an algorithmic model based on the data collected from the platform. This allowed stockpiling to be avoided in non-epidemic areas. The model forecasts the demand for

pandemic supplies, ensuring that the limited supplies are allocated to where they are most needed. Additionally, procurement staff mobilised upstream manufacturers to increase production capacity and speed up delivery.

Furthermore, there is the issue of logistics capacity. The outbreak occurred during the Chinese New Year holiday when most logistics workers were still on break. Logistics and distribution have become more difficult because of the partial closure of transportation routes. JD.com has solved this problem by optimising its warehouse network. Numerous essential supplies bypassed regional transportation systems and arrived directly at warehouses in the city during the pandemic. In response to the efforts of JD.com, the availability of products of its platform has remained stable.

Based on the analysis above, we remain positive about the third proposition. With the right and effective strategies in place, the supply chain's resilience can be improved to counteract different kinds of unexpected disruptions.

Proposition 4: E-commerce helps retailers adapt and survive in crises.

The global pandemic and geopolitical turmoil have significantly impacted economic activity over the past two years. There has been a significant shift in consumer habits and the digital platforms used to conduct business. Today, the rise of e-commerce has contributed to the ability of businesses to operate and launch their operations more quickly and easily during the recovery and growth of the new normal.

A case study of JD.com displays a pattern of innovative thinking, with the company shifting its activities to digital platforms. This is whereby they expanded their market potential, reduced costs, increased operational efficiency and competitiveness, and adapted to the new environment. Promoting e-commerce is one of the solutions that companies prioritize. Furthermore, it is an inevitable trend to ensure companies survive and grow after COVID-19.

According to the above discussion, we agree with the fourth proposition that e-commerce assists retailers in adapting to and surviving crises.

Proposition 5: The right logistics models and the use of advanced technology have a positive effect on e-commerce.

From the results obtained from the case study, we see that JD.com has implemented risk management measures, predicted market demand through big data analysis and machine learning, and increased inventory in advance for products in high demand, which was very valuable to them during COVID-19. By creating redundancies, companies must invest additional funds and the risk increases.

It can also be concluded from the case study that JD.com's self-built integrated supply chain model provides participants with the ability to access information from across the supply chain rather than relying on third parties. By using this model, real-time data can be collected, analyzed, and shared in the supply chain, allowing for the coordination of activities and processes. In this way, companies will be able to gather more correct and timely data, allowing them to base their decision-making better and improve the efficiency of their supply chains. However, several risks are involved in implementing transparency in the supply chain that needs to be aware, such as cyber-attacks and leakage of sensitive information.

Enterprises may need to collaborate with other organisations to contain the damage caused by widespread disruptions. Furthermore, the company's operating plans can be modified as needed. Additionally, before the pandemic, JD.com established several advanced technologies for forecasting, automated restocking, and network optimisation of warehouses. These technologies were used to support the implementation of practical tactics. Other modern technologies, such as automated logistics, helped alleviate the logistical difficulties created by the epidemic.

In light of the discussion above, we agree with proposition five that E-commerce can be positively affected by the proper development of logistics models and advanced technologies.

7 Suggestions on countermeasures for supply chain disruption and how a supply chain should build up resilience in its system through lessons from JD.COM

7.1 Establishing supply chain emergency mechanism and strengthening risk management

In global economic integration, it is essential to establish an efficient and rapid response mechanism between enterprises in the industrial chain and between governments, for example an early warning system for emergencies, a crisis management system, etc. Companies should also improve their early warning systems, establish partnerships with different suppliers and share information to establish a comprehensive early warning information network.

Several aspects of supply chain operations need attention: firstly, it is necessary to pay attention to the supply and demand side, for example, to make effective forecasts and assessments of the impact of the pandemic on the market in terms of supply and demand. Secondly, the disruption of the logistics and transport chain caused by COVID-19 has led to a massive backlog of goods at the hub points. It requires the establishment of alternative logistics systems to share the pressure of the original logistics chain. Moreover, in terms of information sharing, each party in the supply chain has access to a full range of timely operational data and information, thus improving the resilience of the company's supply chain and operations. Furthermore, it is also essential to focus on the adequate adjustment of the payment and settlement cycle for purchases and sales to ensure the efficient turnover of capital flow.

The pandemic's impact on the supply chain is becoming increasingly severe, and companies should promote the transformation of the supply chain from centralised to distributed and promote the diversification of the supply chain. COVID-19 has exposed the problem of many enterprises relying too much on a single supply source. The epidemic outbreak has posed a fatal threat of supply disruption to the supply chain. Companies should seek multiple supply sources locally or in the nearest region where possible. Then build additional buffers for vital raw materials and supplies in case of emergencies to reduce supply risks that could disrupt supply chain operations. Enterprises should accelerate the construction of a flexible supply chain system and cooperate with suppliers from multiple countries to expand supply channels. It will help enterprises avoid the risk of supply chain disruptions and promote their development from centralised to distributed diversification.

COVID-19 has also made people aware of the importance of optimising intelligent logistics emergency measures. Firstly, companies should set up emergency response teams and implement a 24-hour operation system. Advanced technology facilitates automating, visualising, tracking, and controlling emergency supplies in supply chains. Secondly, through big data prediction, rescue supplies should be allocated to the corresponding areas to avoid a shortage of supplies. Finally, it is crucial to re-examine the shortcomings of smart technology, big data forecasting, emergency measures, and response time revealed by the pandemic to optimise the emergency response plan further.

7.2 Promote the use of digital platforms and advanced technologies

Under the impact of the pandemic, Increased digital capabilities enable companies to anticipate market trends and potential risks, prepare for potential risks, and improve their data processing capabilities. The use of digital technology can improve supply chain resilience in the face of disruption and accelerate its recovery. Digital technology can enhance information processing capabilities and enhance the visualisation and traceability of the supply chain.

The construction of a digital supply chain requires multifaceted considerations. For situations where a low level of digital capability is present, and a high level of supply chain risk exists, it may make more sense to use a third-party digital platform instead of developing its own. Furthermore, companies with digital capabilities and high supply chain risks can build their digital platform and improve the supply chain network's efficiency by collaborating with stakeholders.

In terms of technology, information systems, sensors, and other technologies in storage automation should be strengthened. There should also be greater use of intelligent robots and mechanical equipment to replace most human resources and reduce errors during operations. AI facilitates efficient resource allocation and improves production and management efficiency through increased use of resources. Enhancing industrial automation allows artificial intelligence and robotics to serve production and management better.

As COVID-19 is contagious, enterprises must accelerate the improvement of logistics facilities and equipment, achieve automation, and implement contactless distribution in the last miles of delivery. This pandemic also presents an opportunity for companies to innovate in technology and improve service quality. Through the case study of Jingdong, we learn

from practice the advantages of robots such as unmanned vehicles and drones in last-mile delivery. In the future, companies should strengthen their research in areas such as artificial intelligence and big data in order to achieve full automation and digitalisation as soon as possible.

7.3 Optimising e-commerce logistics service

E-commerce platforms can cooperate their logistics with other third-party logistics companies to make deliveries to customers in post-lockdown affected areas a top priority. At the same time, in the event of an epidemic, open emergency transport routes in the epidemic zone, design transport links for merchants with different order volumes, allocate capacity resources, effectively arrange for dispatchable staff to be on full duty to support online order picking, maintain picking and shipping efficiency, and guarantee merchants' delivery speed. In addition to this, there is a need to strengthen the no-touch pick-up and delivery service to ensure epidemic safety. For merchants whose cargo is not located in the epidemic area, the platform can provide sub-warehouse and transfer services to ensure order fulfillment. For special needs, the platform can coordinate transport resources with third-party transport companies and adopt unconventional means such as chartered flights and ships to speed up logistics operations.

7.4 Recommendations for management

First, we recommend converting to a more digital supply chain, which will increase transparency within the supply chain. This will require some time, as the technology has to be mature to achieve this. Cyberattacks and data leaks are possible within the digital supply chain, and we must be aware of these potential risks.

Another recommendation is to develop a risk mitigation plan in which suppliers and customers are listed, and the risks associated with them are analysed (Sheth, 2020). Digitalization and automation will gradually replace manual analysis and operation in the future, i.e., to have real-time information on the supply chain participants and risk predictions. A risk analysis of disruptive events will allow a firm to deal with disruptions better and recover faster.

Safety stock is also recommended for companies with products that are essential to their operations. These problems are severe when suppliers are few and located in areas prone to natural disasters such as hurricanes and earthquakes. Therefore, firms will be less susceptible

to shortages of these components and will be able to maintain their capacity to continue production even when these components become scarce.

In addition, the pandemic has revealed the importance of flexibility in managing and using different ways of working. For example, working from home and video conferencing have allowed businesses to continue operating despite the adverse conditions. Considering the uncertainty of the future, improving flexibility to company management and project running helps increase the company's resilience to disruptions.

7.5 Strengthening infrastructure

China experienced a new wave of COVID-19 outbreaks in March 2022. This latest outbreak has affected various provinces and cities, but Shanghai has been more severely affected. On March 28, Shanghai implemented a citywide lockdown. As a result of this outbreak, even JD.com, which has a robust supply chain, was affected by logistics problems. The JD Group has supported Shanghai by dispatching many foods, medicine, and other essential protection items to the city. At the same time, thousands of couriers provide material delivery services on the frontlines in Shanghai. However, as the JD logistics fleet was trapped on the highway, several JD logistics warehouses were under closed control, and couriers also had to stay at home due to control regulations, so the delivery had to be postponed.

In terms of logistics issues, capacity increases can only temporarily resolve problems. The supply chain's resilience should be further improved by strengthening infrastructure in the medium to long term. Developing real-time information updates and sharing will help achieve parallel logistics and data flows. At the same time, big data platforms can provide digital support to the logistics industry based on analysis and research. For example, logistics with exclusive routes can be established to assist with delivering pandemic-approved supplies. Real-time information about the logistics situation around the country, including information about drivers, goods, and driving routes, can be accessed in real-time online. This enables efficient closed-loop management. In order to improve quality and increase efficiency in logistics, it is essential to speed up the digitalization process.

7.6 Taking an active role in social responsibility

The impact of COVID-19 was more significant than previous natural disasters or man-made accidents, and almost every industry was affected by it. The pandemic's impact has caused disruptions in the supply chain due to delivery obstacles, labor shortages, and other issues.

When disruptions occur, companies and governments can work together to establish green channels in the supply chain. For example, during the COVID-19 outbreak, JD.com and the Hubei government worked together to develop a supply chain platform to track emergency supplies' supply, inventory, and delivery information(ChinaNewsService, 2020). This platform provided companies with practical information on supply and demand and maintained order in the market.

Companies should actively contribute to society when emergencies occur. For example, during the COVID-19 outbreak, JD.com took the initiative to take up delivery service in infected areas. By 10 February 2020, JD.com had delivered more than 2,000 tons of epidemic prevention supplies and emergency supplies to Wuhan and surrounding areas(ChinaNewsService, 2020). In addition, Its proactive approach to social responsibility allows JD.com to better understand the current market status and trends and collect more accurate market data, which can help them forecast and analyze future markets and needs more accurately.

8 Conclusion

A worldwide supply chain has been severely affected by COVID-19. Using JD.com as a case study, we examine its supply chain and its strategies to deal with the pandemic and the significant issues affecting the retail sector. According to the case study, JD.com's supply chain has good resilience due to its unique integrated supply chain model. As a result of the integrated supply chain model of JD.com, efficient cooperation, data exchange, and flexibility can be achieved. This model allows JD.com to adapt its strategy to different situations and conditions quickly.

Although JD.com has managed to resolve the various problems effectively that COVID-19 caused during this pandemic; however, it has to be noted that JD.com has invested a massive amount of money in its technology and equipment, which will also affect its ability to withstand risks. Thus, this also provides insight for the retail industry to consider risk management aspects as part of its daily operations.

In addition, this thesis contributes to the analysis of future supply chain resilience. Currently, most research on supply chains is conducted through interviews, which requires a significant investment in time and effort. Our research reveals the possibility of using operational data of companies to analyse the supply chain resilience. In addition, valuable operational data can help companies analyse the shortcomings of their supply chains.

In terms of future research, we suggest exploring the potential benefits of digital supply chains. Further, we recommend examining how new technologies can be incorporated into supply chains. With its intelligent supply chain and technology, JD.com makes a good starting point. Moreover, we recommend that further research be carried out regarding how the various risk management strategies can be used together. Some academics argue that there is a lack of explanation regarding how to combine risk strategies or how to use different risk strategies in different situations(Mishra, Sharma, Kumar, & Dubey, 2016).

Under the influence of this COVID-19, technologies play a crucial role in the practice of e-commerce. Advanced technology can increase the efficiency and effectiveness of supply chain management. It is believed that future technologies such as the Internet of Things (IoT), big data analytics, and cloud computing may enable real-time and intelligent decision-making to enhance e-commerce logistics and operations.

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