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# RETHINKING SUPPLY CHAIN STRATEGY TO FACE GLOBAL CHALLENGES IMPOSED BY COVID-19

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## Abstract

COVID-19 has been perceived as a new menace to undertake business relations in the marketplace. Consequently, supply chains have been required to reevaluate how to manage their key functions to cope with harsh business environment under this pandemic outbreak scenario. Therefore, supply chain strategies have taken an essential role in achieving resilience, flexibility, responsiveness and sustainable operations. As a result, the introduction of new digital technologies has contributed to enhance organizational performance and to face COVID-19 challenges in global markets. The purpose of this chapter is to provide insights of current literature on supply chain operations by identifying strategic practices within this pandemic health outbreak crisis. The chapter introduces an overview of the supply chain key functional areas. Then, the discussion concentrates on describing a series of observations and empirical research developed by academics and experts on the topic. After that, supply chain strategic practices are analyzed, followed by a description of digital technology as a critical tool to achieve operational excellence and to compete in tougher market conditions. Finally, a conceptual model is proposed to ensure effective supply chain functioning and value creation across the entire firm's operations. Conclusion are drawn to summarize the contribution of this chapter and to highlight the importance of rethinking new practices for achieving higher performance results. Future research suggestions are presented to advance the discussion and research in embracing new supply chain models under market uncertainty in terms of demand, supply and operations.

## Keywords

supply chain, strategy, COVID-19, digital technology, Industry 4.0

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## 1. Introduction

COVID-19 has prompted new ways of thinking with evolving strategies in supply chain operations. The past year has observed intense business disruption and growth in unexpected customers' demands, impacting organization's ability to meet requirements and planned objectives. These strategies pursue to help organizations in their struggle to survive in an uncertain business world affected by the pandemic. As a result, supply chains have been forced to reconsider the way to operate from a sourcing, manufacturing, logistics and customer service perspectives, and how to address current market environment. Therefore, rethinking the supply chain strategies to enhance organizational performance and associated results is nowadays a must to stay in business and compete in the new global market challenges.

COVID-19 has been considered one of the most widespread and catastrophic public health emergencies in a century (Sarkis, Cohen, Dewick, & Schröder, 2020) and caused major supply chain disruptions (Van Hoek, 2020). Organizational new challenges have arisen due to COVID-19 pandemic where firms are endeavored to develop an efficient and flexible response through their supply chains. Organizations have been facing several problems due to this global condition (Ivanov, 2020a). This situation has brought difficulties which affect businesses in fulfilling their functional strategies and customer demands throughout their supply chains. Practitioners and researchers have been required to reconsider and question supply chain management assumptions and future endeavors due to COVID-19 pandemic (Flynn, Cantor, Pagell, Dooley, & Azadegan, 2020). Scholars and consulting firms have investigated the impact of COVID-19 on different industrial sectors, while customers' buying potential has decreased as well as global economy as a result of this pandemic (Cai & Luo, 2020). Additionally, managers have been prompted to call for improved supply chain performance to deal with severe disruptions caused by the pandemic (Jacobsen, 2020). As a result, COVID-19 pandemic presents a paramount situation for supply chain stakeholders, researchers, academia and professionals to investigate and assess implications, risks and opportunities for business improvement.

Furthermore, nowadays organizations and their supply chains are competing globally in an increasing complex and uncertain business environment. Supply chain operations have profound implications on organizational performance outcome, becoming critical to the established strategies and objectives' achievement. For example, global supply chains from manufacturing and service sectors have been significantly affected due to their dependence on China as a partner on global business operations (Belhadi et al., 2020). Academics and researchers have argued that uncertainty is a tough condition which can diminish supply chain performance (Slack & Brandon-Jones, 2019; Tseng, Wu, Hu, & Wang, 2018). This uncertainty, present in current pandemic situation, impacts the supply chain (SC) and makes it challenging to completely advance on effective ways to develop strategies for future scenarios and long term results (Ivanov & Dolgui, 2020). In addition, there exists scarce evidence to lead global supply chains for a resilient operation against COVID-19, since this pandemic is a new worldwide situation, where its consequences are still unpredictable (Belhadi et al., 2020). Van Hoek (2020) emphasizes the complications of managing risk and resilience in supply chain and

stresses the need for empirical research to examine how firms are confronting COVID-19 challenges. Also, Ivanov and Dolgui (2020) urge for empirical research on how supply chain are facing this pandemic in a need for robust and resilient operations to overcome the threats this situation is bringing worldwide. El Baz and Ruel (2020) have researched how risk management in supply chain influences its resilient and robustness capabilities to deal with COVID-19 outbreak, in an effort to contribute on facing disruption. Due to this pandemic supply chains have encountered substantial disruptions up and downstream, affecting demand and supply, and making it imperative to study policy-making decisions and managing strategies in supply chain operations (Nikolopoulos, Punia, Schäfers, Tsinopoulos, & Vasilakis, 2020). Also, designing resilient supply chains to COVID-19 and the tactics to achieve such performance, have become an urgent topic for scholars to investigate.

This chapter presents some insights on strategic supply chain decisions by including an overview of its key functional areas and underlying characteristics; then the discussion elaborates on global challenges in supply chain management (SCM) where a series of observations and examples are provided. Following, supply chain strategic practices are examined and to achieve this goal, empirical research examples are included. The research implications comprise future research areas for potential in depth investigation to advance on knowledge on the topic and a concluding section summarizes the chapter.

## **2. Supply chain key functional areas overview**

Supply chains have changed in the last three decades as products and markets have become more complex. Global market uncertainties and trends have forced organizations to respond to customer shifting requirements and as a result, SCs have defined a wide range of competitive strategies to satisfy such demands for products and services (Chopra, 2019). Some examples are Walmart, Home Depot and several retailers which are offering an extensive variety of products to meet customer needs with low costs and quality standards in every market segment. As a result, supply chains functional strategies have been aligned to organizational objectives to execute the required activities and provide customer satisfaction through the on time offering of products and services.

### *2.1. Sourcing*

Sourcing is a decision of who will carry out the activities of warehousing, distribution, transportation, production and information management within a supply chain (Chopra, 2019). Also, it has been defined as “the process of identifying a company that provides a needed good or service” (APICS, 2016, p.175). Sourcing involves supplier selection, procurement and managing the relationship as key activities; the decisions undertaken by the sourcing function define who will perform an activity and as a result which activities will be outsourced. Sourcing represents the tactical and operational activities of procurement (Mena, van Hoek, & Christopher, 2018).

Nowadays, global SCs can be designed with complete utilization of worldwide sourcing, providing a broad variety of products and services to satisfy customer needs (Dubey et al., 2018). Substitute products and dual sourcing can now be offered when product supply may be

disrupted and demand volatility impacts the business (Gupta & Ivanov, 2020). Therefore, product substitution and dual sourcing strategies are often jointly used to design SCs that are more resilient to the high impact of disruption events (Lu et al. 2011). Furthermore, product substitution is an advantageous sourcing management strategy effective in multiple sourcing. Risk mitigation has also engaged on dual sourcing strategies to ensure a stable flow of supply and to diminish the threat of supply shortage (Li, Sethi, & Zhang, 2017). Global sourcing has become a common practice, in some instances entire industries have moved to locations all around the world (Mena et al., 2018).

The worldwide presence of COVID-19 has strongly impacted the sourcing for manufacturing industry operations, due to supply chain management key principles such as: low-cost country procurement, global business activities and low inventory targets (Cai & Luo, 2020). Researchers have argued that supply source has been weakened after the breakout of COVID-19 and have asserted that COVID-19 has also impacted small business performance facing higher bankruptcy risks and fierce competition of global economics along the worldwide market (Ivanov, 2020b). This pandemic has offered the opportunity for research on supply chain design to balance global multiple sourcing, with nearshore and local options, less focus on costs and taking into account the importance of flexibility and de-risking business operations (Van Hoek, 2020). After all, sourcing impacts the entire supply chain operations, and it is a critical function for successful organizational performance and the enhancement of competitive advantage.

## *2.2. Manufacturing*

Manufacturing activities are related to the production of goods and meeting customers' requirements, and directly impact the cost and performance of supply chains. In past decades, different techniques such as Lean Six Sigma have prevailed in organizations to solve a large number of problems and to avoid potential wastes which undermine operations performance on their manufacturing systems. Manufacturing recovery is an important task to reinforce supply chain performance to minimize the total impact and to speed up response to market and customer satisfaction (Chopra, 2019; Slack & Brandon-Jones, 2019). Although, manufacturing organizations are currently occupied in solving immediate drawbacks, they are seeking new strategies and plans to face a post-crisis world to overcome their challenges on their supply chains (Belhadi et al., 2020; El Baz & Ruel, 2020).

Recently, operation performance excellence has been studied extensively and research has been carried out by academics claiming that organizations are more interested in excelling on their manufacturing operations for surviving in a fiercer market competition. Companies are forced to improve operations performance as they increasingly face severe adversities from their business markets. Operational excellence is in a relentless pursuit of reinforcing their productive activities (Miller, 2014). Researchers have also point out that operational excellence is a dynamic and continuous ability to open up the door to competitive leadership and high profits in a continually changing business condition (Hossenfelder, 2010).

Also, a new concept called Industry 4.0 has been created to enhance manufacturing performance of supply chains and organizations. Industry 4.0 has provided the optimum

conditions to become a fully connected organization and to achieve a state of the art system where machines, materials, tools, warehouses and transportation technology are communicated in an intelligent system to react faster and effectively (Luthra & Mangla, 2018). Now, supply chains can be more connected with their sourcing and distribution channels along with creation of digital technology. Supply chains create value in the manufacturing activities for conveying quality products to consumers (Singh & Agrawal, 2021).

COVID-19 has provided profound consequences to manufacturing supply chains affecting from global to regional operations and speeding up the supply chain digitalization (Cai & Luo, 2020). Ivanov and Dolgui (2020) have emphasized the importance of reinforcing empirical research on SC resilience and robustness to scrutinize how organizations are facing COVID-19 threats to develop survival mechanisms in order to mitigate this pandemic outbreak. El Baz and Ruel (2020) have conducted a research by defining a theoretical framework to investigate the role of SC risk management (SCRM) in reducing disruption impacts on SC resilience and robustness. Some studies have also been developed to find out the role of risk control in mitigating the frequency and negative impacts of SC risks by evaluating the performance of SCRM (Manuj & Mentzer, 2008; Wieland & Marcus Wallenburg, 2012). Ivanov (2020b) has illustrated an historical perspective of transformations along the last three decades by adopting different aspects: “being lean, responsive and globalized in structural design...become sustainable...how to strengthen their resilience during disruptions triggered by severe natural or man-made disasters, how to recover and manage the ripple effects, and how to utilize the advantages of digital technologies in SC management” (p.2). In this manner, digital technology and Industry 4.0 have played an important role to cope with disruptions encountered by organizations to maintain and survive themselves in this pandemic (Ivanov, 2020a, 2020b). As a result, digital technology and Industry 4.0 have been considered important assets further in this research to define a new framework for manufacturing companies.

### *2.3. Logistics*

Some scholars have implied that supply chain management requires an organization to develop a strategic alignment when it offers efficient and flexible response to market share (Feldmann, Delke, & Wasserman, 2019; Skipworth, Godsell, Wong, Saghiri, & Julien, 2015). Chopra (2019) presented six key drivers of supply chain performance, these are: facilities, inventory, time, information and product price. He also implied that facilities, inventory and transportation are defined as logistics factors whereas information, sourcing and pricing are determined as multifunctional factors; all of them crucial in supporting the supply chain operations. Also, it has been argued that organizations need to effectively manage all these factors to succeed in facing numerous market changes and trends, and in fulfilling tougher customer demands under uncertain conditions.

Furthermore, organizations have been adjusting their SC configurations as they have taken important decisions on number of required facilities versus customer response capacity. Such decisions affect different logistics costs based on inventory handling and transportation systems (Yang, Pan, & Ballot, 2017). Decisions about sourcing and logistics have also been impacted as organizations have developed more in-depth commitment with their suppliers for ensuring

market demands by establishing longer-term relationships (Mangla, Sharma, Patil, Yadav, & Xu, 2019). While some organizations are struggling to reduce their logistics and distribution costs, there are other effectively seeking better technological tools for communicating with their sourcing and distribution channels as several production activities depend on suppliers and subcontractor's capabilities (Leuschner & Lambert, 2016).

Logistics has become a fragile function in industry due to the pandemic since the demand for its services has decreased dramatically in manufacturing industry and delivery time frames have been extended. Also, international logistics has been affected by COVID-19, due to restrictions in import and export activities, worldwide flight control and stricter goods inspection (Cai & Luo, 2020). International trade has become critical as operations and raw materials costs have increased due to limited supply from different sources (Cai & Luo, 2020). Academics and scholars have described severe conditions on logistics costs, lead times and service availability (Queiroz, Ivanov, Dolgui, & Fosso Wamba, 2020). As a result, logistics activities have been more complex due to new barriers imposed by governments of different countries and limited capacity of logistics service providers.

#### *2.4. Customer service*

Customer service has been defined as “the ability of a company to address the needs, inquiries, and requests of customers” (APICS, 2016, p.43); in supply chain management, a crucial objective is to meet customer needs and at the same time generate profits, becoming a critical process (Chopra, 2019). Firms having an efficient supply chain, generally consider different approaches to answer their customers' requirements and during this process focus as well on the earnings. In essence, a primary role of customer service is to add value to the product through its service, based on the eyes of the customer (Christopher, 2016).

COVID-19 has impacted the customer service function in a supply chain, where the unexpected emergency pandemic has provoked the development of new means to do things differently to meet customers' needs (Flynn et al., 2020). The market dynamics have been altered by the pandemic, increasing uncertainty in demand and changing customers' requirements, in response supply chains have been forced to modify their strategies for building flexibility (Russell, Ruamsook, & Roso, 2020). It has been more than a year since COVID-19 pandemic started and research on how this health crisis has affected customer service and the effects along the supply chain on servicing in every stage are scarce. As a result, academics and researchers are prompting for empirical research around supply chain operations being impacted by COVID-19 pandemic (Belhadi et al., 2020; El Baz & Ruel, 2020; Nikolopoulos et al., 2020; Van Hoek, 2020).

### **3. Global challenges in SCM a COVID-19 perspective**

Globalization has conveyed opportunities and risks for supply chains (Chopra, 2019). New challenges have arisen throughout organizations to encounter the new COVID-19 pandemic, where supply chains are strived to provide an efficient and flexible response to market requirements. Furthermore, firms are facing disruptions in their supply chains due to this global condition (Ivanov, 2018). This situation has brought difficulties which affect organizations

ability to fulfill on-time customer demand and carryout functional strategies. Additionally, COVID-19 is directly causing disturbances in supply and demand at global and local scales, stopping industry operations and impacting worldwide economy (Ivanov, 2020a). Furthermore, Gartner research showed that 38% of supply chain leaders stated that their supply chains are not well prepared for the coming challenges in the next two years (Gartner, n.d.).

As a result, supply chain disruption has been acknowledged as a growing field for research to mitigate risks and improve supply chain performance (Xu, Zhang, Feng, & Yang, 2020). Mena et al. (2018) provided different supply chain risks, which include supply and demand amongst others. Belhadi et al. (2020) proposed an immediate redefinition of operations to confront COVID-19 challenges, overcome disruption and preserve business continuity. Also, risks have risen including supply chain disruptions due to setbacks in sourcing, manufacturing, logistics and market uncertainties (Nandi et al., 2020). The challenges are present and supply chains need to acknowledge them to confront them.

### *3.1. Use of Technology*

COVID-19 has changed the way supply chains operate. The use of technology has dramatically been forced to accelerate, while communications abilities have been required to improve and hence doing business has changed (Flynn et al., 2020). Digital supply chains are now being a critical factor to rapidly succeed during the pandemic and to enhance the responsiveness capacity to market (Cai & Luo, 2020). The implementation and usage of new technology in a fast moving business environment has not been easy, adjusting supply chains processes to new market requirements within this context has been quite a challenge to overcome.

The need for greater utilization of information technology in a day to day basis across all functions within the supply chain brings in challenges and practical implications to a more complete and real time information availability for decision making (Van Hoek, 2020). Blockchain technology has proposed potential benefits when applied to supply chain operations and has been argued to be an underlying source for improving supply chain resilience. However, it also presents implementation challenges such as infrastructure availability, technical expertise and managerial knowledge on business procedures to be conveyed (Min, 2019). Singh and Agrawal (2021) stated that adopting new technology presents technical and managerial challenges, mainly referring to skills and knowledge, but also referring to challenges due to highly complex supply chains, high costs, and unpredictable demand.

Furthermore, the constant increase in complexity of supply chains combined with the pandemic, makes imperative for the adoption of technology as a source for managing risks and beneficial for business continuity. Paul, Riaz, and Das (2020) studied factors influencing the implementation of artificial intelligence (AI) in the field of supply chain risk management. They implied there should be a combination of other advanced digital technologies and AI for more effective benefits and for overcoming technological challenges. Additionally, Golan, Jernegan, and Linkov (2020) recommended to research on emerging concerns and trends associated to AI, machine applications and analytics of risks, such as COVID-19.

### *3.2. Uncertainty in business environment*

Supply chains need to be designed to handle uncertainties. Contemporary supply chains are characterized by persistent uncertainties such as economic, environmental and social factors. As a result, supply chain strategies have been in the need to change in an answer to such market dynamics (Russell et al., 2020). Furthermore, the global context has exposed supply chains to disruptions due to increased complexity and uncertainty on business operations as a consequence of COVID-19 (Golan et al., 2020). Therefore, supply chains are simultaneously operating under an environment of demand and supply uncertainty, distribution channel instability, labor variable availability and financial jeopardy (Flynn et al., 2020).

Demand management presents a challenge for practitioners and professionals, due to its extraordinary uncertainty in the middle of the pandemic. Demand in supply chains has been impacted profusely while COVID-19 is being spread along different countries where products and services are offered throughout organizations (WTO, 2020). This unprecedented situation has caused supply chain operations slowdown in satisfying customers' requirements. Besides, market demand has decreased due to a large number of consumers experiencing lower incomes and near future job uncertainties (Cai & Luo, 2020). Malik and Kim (2020) researched uncertain demand and concluded real constraints such as: production rates, product quality and space limitations, should be considered when designing and optimizing supply chain systems. This approach coincides with current COVID-19 business environment, where organizational priorities are redefined, constraints analyzed and strategies reconsidered. Also, pandemics generate risks in business and supply chains operations due to their potential long term duration, worldwide ripple effects and high uncertainty (Ivanov, 2020a). This situation provokes disruption risks along the supply chain and negatively impacts the performance of the supply chain across its functions (Xu et al., 2020). Firms are confronting disruption risks and global competition under a pandemic scenario, consequently they need to prepare themselves to overcome such challenges.

### *3.3. Worldwide sourcing disruptions*

Supply chain globalization has brought more sourcing options, which at the same time has delivered risks and opportunities. Consequently, due to the continuous global spread of COVID-19, industry has confronted sourcing and distribution challenges. Also, on time deliveries failure, shortages of goods, and fulfillment deficiency have been some of the consequences from sourcing disruptions across the supply chain. Furthermore, sourcing plays an strategic role when it comes to sharing information and agility improvement across the supply chain (Kim & Chai, 2017), as a result, any interruption in the suppliers' operations, the entire SC encounters trouble. Jabbarzadeh, Fahimnia, and Sabouhi (2018) proposed a model which defines outsourcing decisions and strategies to decrease costs and increase performance across a resilient and sustainable supply chain, highlighting that random disruptions at suppliers can impact the total supply chain cost.

The challenges in sourcing due to this COVID-19 pandemic include transportation and distribution activities. A global supply chain entails a major sourcing of raw materials, components and products coming from China and other Asian developing nations (Kumar,



Luthra, Mangla, & Kazançoğlu, 2020). In consequence, worldwide networks in supply chain have caused transportation to collapse from an availability and capacity, negatively impacting business results. This situation has affected the sourcing capability of reaching the customer on time-in full, from a raw materials to a finished goods scenario. Queiroz et al. (2020) literature review on the effects of epidemic outbreaks on SC, showed that optimization of resource allocation and distribution are key topics when handling supply chain operations under these circumstances.

Global sourcing can be a suitable strategy under certain business scenarios, however there could be other circumstances under which local or regional sourcing strategies are more appropriate (Mena et al., 2018). Nowadays, with the propagation of COVID-19, supply chains functional regionalization such as: manufacturing and sourcing could be the new normal (Cai & Luo, 2020). Moreover, balancing global, regional and local sourcing could become a practical consequence for decreasing risk in supply chain operations in future business transactions (Van Hoek, 2020). Hence, embracing multiple sources could be a strategy to achieve performance improvement. However, the challenge is the role of multiple sourcing as a basis for making a SC more resilient (Mehrjerdi & Shafiee, 2020).

Kim and Chai (2017) studied global and strategic sourcing, and the relationship between supplier innovativeness and its impact on supply chain agility, sharing of information and collaboration. In essence, the sourcing of products and services influences the supply chain performance.

### *3.4. Achieving Sustainability*

COVID-19 pandemic has exposed unique challenges for supply chains and their operations worldwide (Ivanov, 2020b). Sánchez-Flores, Cruz-Sotelo, Ojeda-Benitez, and Ramírez-Barreto (2020, p. 5) defined sustainable supply chain management as “the preservation of balance that may exist between social responsibility, care for the environment and economic feasibility throughout the supply chain functions”. Therefore, having to find an equilibrium between the three pillars is per se a challenge, now doing so within a pandemic scenario, it is a major task to achieve. Queiroz et al. (2020) proposed a framework for SC operations, including amongst others, a sustainable perspective, due to the importance of achieving sustainable development under COVID-19 times. Mehrjerdi and Shafiee (2020) researched the impact of supply chain strategies and highlighted the imperative need of merging resilient and sustainable concepts in a closed-loop supply chain. Also, they stated that by applying these concepts at the same time, costs and resources would be optimized. Nowadays, the challenge within sustainability is being resilient as well, to endure through time under disruptive circumstances and safeguarding resources to do so, while achieving business performance.

Disruptions in supply chains negatively impact its sustainability across the economic, social and ecological dimensions (Xu et al., 2020). How to transform to a more sustainable supply chain from a global or local perspective is now the challenge, in this regards whether supply and operations will be rebuilt and the sourcing options reconsidered (Sarkis et al., 2020). Mangla et al. (2020) studied critical activities as part of current pandemic scenario, to improve sustainable performance in supply chains within an operational excellence context; these

activities included: collaboration, flexibility and related topics to supply chain capabilities. Also, Dev, Shankar, and Qaiser (2020) considered sustainable development, reverse logistics and the integration of Industry 4.0 (I4.0) principles as vital elements for supply chain excellence in operations. Furthermore, Luthra and Mangla (2018) evaluated the challenges to I4.0 for developing supply chain sustainability from an Indian manufacturing industry perspective. The results of the research showed that organizational and technological challenges hold the highest importance. Global supply chain systems have been disrupted due to widespread of the COVID-19, the challenges of being sustainable in production and operations management need to be addressed effectively for handling such disruptions in the supply chain (Kumar et al., 2020). Still the implications of COVID-19 pandemic on supply chain sustainable performance are to be seen (Sarkis et al., 2020).

The continuous progression of COVID-19 pandemic has affected supply chains performance and organizations are in need to adopt new practices to survive under different market demands. Firms are facing unprecedented events to response effectively to new market trends and companies are encountering difficulties to meet on-time customer requirements with the required quality levels. Furthermore, different challenges emerge from different contexts, therefore strategic practices need to be implemented (Sánchez-Flores, Ojeda-Benítez, Cruz-Sotelo, & Navarro-González, 2020). As a result, it is crucial organizations conceive new strategies to attain the operational excellence level required to stay in business and compete in this unexpected global market situation.

#### **4. Supply chain strategic practices to overcome COVID-19 threats**

In order to face global challenges and overcome critical market conditions caused by this pandemic, it is essential to strengthen business competency in supply chain by adopting different practices along its entire operations (Sarkis et al., 2020).

##### *4.1. Technology: An essential strategy*

Organizations are able to access to a myriad of information technologies to cope with several setbacks derived from this pandemic. Such technologies have been studied by several authors in order to establish optimum conditions to meet new customer demands and confront market share difficulties (Ivanov, 2018). The Internet of Things (IoT), cyber-physical systems, and smart connected products, enable the progress of smart supply chains' operations (Strozzi, Colicchia, Creazza, & Noè, 2017; Yang, Pan, & Ballot, 2017). Digitalization and Industry 4.0 are encouraging new models and principles on operational performance in supply chain management (Ivanov, Tsipoulanidis, & Schönberger, 2019).

COVID-19 pandemic offers the opportunity for digital technology to provide the means to tackle the global challenge (Ting, Carin, Dzau, & Wong, 2020). Digital technology and analytics support organizations to confront the supply chain difficulties and better serve customers' demands. A digital supply chain will be essential to overcome the pandemic and subsequently to enhance the responsiveness to market (Cai & Luo, 2020). Ivanov, Dolgui, and Sokolov (2019) proposed a framework for analyzing interrelations of digital technologies, SC disruption risks and the ripple effect by developing four principles to establish the logical links

between business, information, engineering and quantitative analysis perspective on digitalization.

– *Blockchain and Big data*

The Blockchain concept was created to ensure financial transaction of the crypto-currency bitcoin. Blockchain technology is considered as a chain of blocks, where data is stored along a network of hundreds of computers and offers a platform to execute smart contracts as transaction, relying on high visibility of shared information through a network (Di Vaio & Varriale, 2020). Nevertheless, the recent introduction and application of Blockchain technology to supply chain management has been changing operational practices in order to increase visibility by keeping and managing transactions and information records. As a result, the application of Blockchain technology to supply chain management was developed to enhance the scale and scope of digital processes including the creation of information systems and supply chain finance operations (Hofmann, Strewé, & Bosia, 2018). Therefore, Blockchain as a network of information technology can reduce risks and enhance resilience throughout the supply chain functions (Min, 2019).

Big data analysis (BDA) concerns with creating a systematic structure of data and information from supply chain performance which is produced, adjusted and organized every day (Ferreira, Lee, & Simchi-Levi, 2016). Some authors have argued that BDA has been the most elaborated area of digital technologies application to Supply Chain Management over last decades. Research on this technology has been undertaken by several researchers. Ferreira et al. (2016) carried out a comprehensive analysis of the application of BDA in retailers' businesses. They have argued that retailers must continuously strive to grow their revenue, margins and market share, and proposed a method which recommends the prices that could maximize revenue and profits. BDA application to supply chain management can also be applied in procurement processes, production shop floors, routing optimization, real-time traffic operation monitoring and proactive safety management (Addo-Tenkorang & Helo, 2016; Gunasekaran et al., 2017; Zhong, Xu, Chen, & Huang, 2015). Niesen, Houy, Fettke, and Loos (2016) stated that BDA can provide the means for supporting risk management and Papadopoulos et al. (2017) proposed it as a tool to develop resilient supply chain for sustainability.

As a result, there is an imperative necessity for developing strategies to support organizations overcome the challenges while taking advantage from Blockchain benefits and BDA (Min, 2019). It can also be concluded that Big data analytics play an important role by providing real-time information across the supply chain operations (Belhadi et al., 2020).

– *Augmented reality*

Augmented reality (AR) has been described as a potential tool and useful digital technology to reinforce procurement processes and supplier facilities reviews. AR has provided the conditions to interact with a 3D computer-simulated environment as if it was real. For instance, by wearing a virtual reality (VR) device, any user can be accessed in a virtual environment to visualize the process of new product development. The user can access to virtual reality by wearing VR-glasses or similar devices like a head-mounted display. Ivanov, Tsipoulanidis, et

al. (2019) stated that AR is a technology that can be used on production today in order to analyze the sequence of the assembly processes in a logical manner for identifying the defective product when a problem had occurred. They have also inferred that it can be used in logistics processes, where an operator or forklift truck driver can receive all the information through a device (like VR glasses) that shows the final products that must be chosen for shipment (Ivanov, Tsipoulanidis, et al., 2019). Therefore, AR can be an important resource to design robust systems for predicting anomalies and anticipating problems when a new process is developed.

– *Robotics, automation and Smart Logistics*

Large number of organizations have started to increase customer satisfaction more rapidly. Automated processing provides a good condition to support organizations and supply chains to be more agile. Nandi, Sarkis, Hervani, and Helms (2021) argued that agility means “making changes in a timely, responsive, and flexible way to meet the changing demands patterns” (p. 13). Robotic process automation (RPA) and artificial intelligence enable organizations to increase the customer satisfaction in terms of flexible response and market change resilience. RPA can offer a myriad of options from software applications into different activities that normally are done by a person in administrative tasks at procurement processes. Robotic processes have been used in different scenarios where operators are exposed to critical and dangerous tasks. Automated processes and computer numeric control (CNC) technology provide an excellent support to increase the effectiveness of manufacturing operations by achieving quality and flexibility levels required for complex products. Nowadays, it has been argued that future moving robots can execute different operations to assist in production operations performed in different types of industries such as electronics, automotive, food and beverage, metal machinery, pharmaceuticals and others by adopting different configuration shapes. Based on this scenario, many authors have coined a new expression to describe the collaboration of a robot with a human, which is called Cobot (Ivanov, Tsipoulanidis, et al., 2019).

Finally, Ivanov, Tsipoulanidis, et al. (2019) argued that Smart Logistics is the process of integrating transportation devices, vehicles, products, materials, pallets and load units; also, they stated traceability and tracking can be done by using digital technology and BDA in order to optimize routes and loads during shipment and delivery processes. There is a myriad of smart devices in logistics that have been studied for reinforcing supply chain operations performance. Most popular are drones, which is a flying robot that can be controlled remotely to deliver goods to customers efficiently. Companies like Amazon and UPS have used these drones to carry packages from warehouses to customer houses or facilities. Also, driverless transportation systems (DTS) are mainly used in intralogistics and warehousing. Some authors have stated that DTS are considered for increasing safety during loading and unloading of materials and finished goods, and also have argued that such devices can assist operators in every step from goods receipt and storage to order picking and preparation for shipment (Ivanov, Tsipoulanidis, et al., 2019). In summary, all these technologies and practices can support supply chain management operations in a quest for successfully overcoming COVID-19 pandemic.

#### 4.2. Sourcing practices

Sourcing has been an important activity for supply chain management since a successful development of competitive strategy depends on the effectiveness of locating and choosing the right raw materials and supplies providers. Some organizations have preferred to outsource their operations in order to reduce vertical integration, manufacturing and labor cost; such as Sony, Nike, Apple, Zara, Home Depot, Grainger, amongst others. For example, Sony Electronics has decided to transfer manufacturing operations to Foxconn in order to increase incomes as it reduces costs in manufacturing, labor and inventory handling. Therefore, outsourcing has been a convenient strategic decision for organizations that wish to increase value in SC, and where resources, transportation, inventory handling and storage, and labor costs can be shared to increase profits margins in the SC.

Sourcing practices include the value of flexibility in supply chain management along with short response times, multiple sources and methods for developing supplier segmentation (Van Hoek, 2020). Enabling flexibility in supply chains operations is critical during and after COVID-19 pandemic to facilitate working under uncertainty (Russell et al., 2020). Multiple sourcing is predominantly important when suppliers are threaten with disruptions, decreasing their capacity to supply required materials (Mehrjerdi & Shafiee, 2020). Jabbarzadeh et al. (2018) found that having backup suppliers, multiple sourcing and growing supplier capacities are strategies that provide resiliency in supply chains for facing disruptions. Gupta and Ivanov (2020) stated dual or multi sourcing is a supply management strategy to mitigate the risk of supply due to a disruption in the supply chain. Also, Li, Zhang, Chiu, Liu, and Sethi (2019) argued this strategy can attract customers since it can provide the opportunity of selling a variety of substitute consumer goods in certain markets. Additionally, Mehrjerdi and Shafiee (2020) emphasized the importance of multiple sourcing and backup sourcing strategies integration as a means to overcome uncertainty in demand and supply.

Furthermore, new sourcing technologies have been developed to achieve excellence in sourcing and procurement as many organizations rely on supplier performance. Some digital technologies which fall in this category are artificial intelligent, augmented reality, big data, Blockchain technologies, digital data management, procurement digital platforms and robotics amongst others (Bag, Wood, Xu, Dhamija, & Kayikci, 2020; Di Vaio & Varriale, 2020; G. Li et al., 2019; Min, 2019; Ting et al., 2020; Treiblmaier, 2019).

### 5. The importance of digital technology to improve supply chain performance

Nowadays, COVID-19 pandemic have forced organizations to speed up the adoption of digital technology to achieve operation excellence as it enables supply chain to cope with disruptions and ripple effect. Based on such market situation, digital technology is being considered as an alternative to carry out the required number of duties along the SC in order to reinforce organizations resilience. For instance, Blockchain enables organizations to cope with ripple effect derived from COVID-19 and other unexpected market trends as traceability can be executed to ensure security, customer response and delivery feedback.

Some scholars have argued that Industry 4.0 represents a smart manufacturing networking concept. Several studies undertaken by different authors have suggested that Industry 4.0 is the

acquisition of state of the art process technology, which enables organizations to implement a global networking system where machines and products are integrated without human involvement (Strozzi, Colicchia, Creazza, & Noè, 2017).

The proposed conceptual model, shown in Figure 1, has considered concepts and empirical work from different authors and researchers about COVID-19 experiences from different organizations in their SC functioning. COVID-19 has affected mostly in every market segment and its presence has caused the modifications in operations practices along the SC. It can be implied that COVID-19 brought different disruptions where organizations have faced through their operations to survive for competing against this adversity.

Resilience and flexibility are important SC strengths for reacting to SC disruptions because of COVID-19 presence. Consequently, companies have been adopting different strategies for mitigating ripple effect problems. Unexpected conditions derived from this pandemic has provoked to organizations for searching new methodologies to meet different demand patterns according to their functional strategies. Contributions from several scholars have been beneficial for implementing flexible and reconfigurable logistics systems and buffer inventories for risk mitigation (Dolgui, Ivanov, & Sokolov, 2018; Ivanov, 2018; Ivanov, Pavlov, & Sokolov, 2014).

Due to this pandemic, new problems derived from unexpected needs and market restrictions are forcing organizations to increase their agility to respond special requests to deliver products on time. Challenges faced with this pandemic include the shortage of products, lack of sourcing capacity to develop transactions through value chain, and the difference between customer order sizes vs real delivered quantities (Queiroz et al., 2020). In order to coordinate contingency policies, to develop a better sourcing response system and to build up a more agile manufacturing system, the proposed methodology implies to manage operations from a product life cycle perspective by identifying market disruption and integrating existing process into industry 4.0 for pursuing operations excellence and innovation. First at all, it is essential that functional and SC strategies, goals and performance objectives be clear from top management and they must be understood by all stakeholders. Secondly, strategies are important to be driven by core processes. It is necessary to standardize operations, eliminate any source of waste and non-valued added activities and reinforce people skills and knowledge on innovation and operations discipline. A company should be organized as one entity which has to be aligned into one strategic approach where departments and people focus on driving process innovations, developing continuous improvement plans, and undertaking agile decisions for designing new mitigation plans when unexpected demand patterns and harsh conditions occur. As a result, operations excellence and Industry 4.0 provides the conditions to operate in a single company unit by integrating innovation and digital technology. Digital technology can provide real conditions to integrate sourcing and logistics systems more effectively and to respond to different demand patterns according to the functional strategy.

When ripple effects and SC disruptions are present, flexible systems and redundancy can provide conditions to cope with different changing market scenarios. By developing an Industry 4.0 system, organizations should be able to collect faster valuable data from SC performance against market demands to anticipate SC possible disruptions. Nowadays,

Industry 4.0 has been recognized as a new academic concept which implies the implementation of digital technology to have faster information access to a real situation. Consequently, digital technology has been an important asset which brings support to organizations managers to react quickly to unexpected changes on production systems in order to meet performance objectives. Sourcing strategies have been crucial to overcome disruptions along upstream channels because of COVID-19. Digital technology assets for developing a strong relationship with suppliers are 3D printing devices and augmented reality systems to simulate procurement operations upon different harsh conditions for reinforcing purchasing decision-making processes. Managers from SCM can be supported by such technological tools to visualize purchasing operations performance in a virtual reality before they undertake any decision (Ivanov, Tsipoulanidis, et al., 2019).

Flexibility and robustness have improved organization agility by using digital technology in order to face several disruptions (Dolgui et al., 2018). Information technology like Big Data and Data Analytics are considered important assets to operate production operations based on availability of prompt information upon COVID-19 conditions. Organizations which have gained access to automated systems and information technology enables operations managers to produce goods and services more effectively according to the master production schedule and customer demands. Agile manufacturing and process innovations can be achieved by implementing Industry 4.0 system because core processes might be aligned to functional strategies. Managers, labor and physical resources could also be integrated in real time by using Industry 4.0 as one single unit by moving forward to same performance objectives. As a result, automated manufacturing processes like: CNC, Automated Guided Vehicle (AGV), Robotics and Big Data Systems are important elements of Industry 4.0 because they have played important roles to operate production systems accurately and meeting higher quality standards without human being attendance and more severe inspection controls. This advantage can provide enormous benefits to avoid human resource being involved when pandemic conditions are present within production daily programs.

Nowadays, several SC disruptions have been affecting supply chain performance in supply and distribution channel. COVID-19 impact on customer demand patterns has not been predicted accurately yet. Organizations which have faced this global outbreak are forced to change production planning constantly because of market disruptions. Supply chain managers are searching for new methodologies to become agile and flexible to cope with COVID-19 disruptions in logistics and transportation systems. Blockchain technology can be used in sourcing and distribution operations where product delivery information and transactions can be monitored along supply chain. Blockchain benefits can be focused on achieving a better inventory control, reinforcing product delivery confidence, reducing waste and risk patterns, developing better contingency plans and meeting customer satisfaction more effectively.

Finally, smart driverless transportation systems and unmanned flying vehicles connected with GPS and other software devices have played important roles to deliver products in places which are difficult to reach because of several harsh conditions (Ivanov, Tsipoulanidis, et al., 2019). The advantage of using such devices opens up new opportunities to organizations to become

more connected with their distribution channels in order to satisfy their customer and market needs.

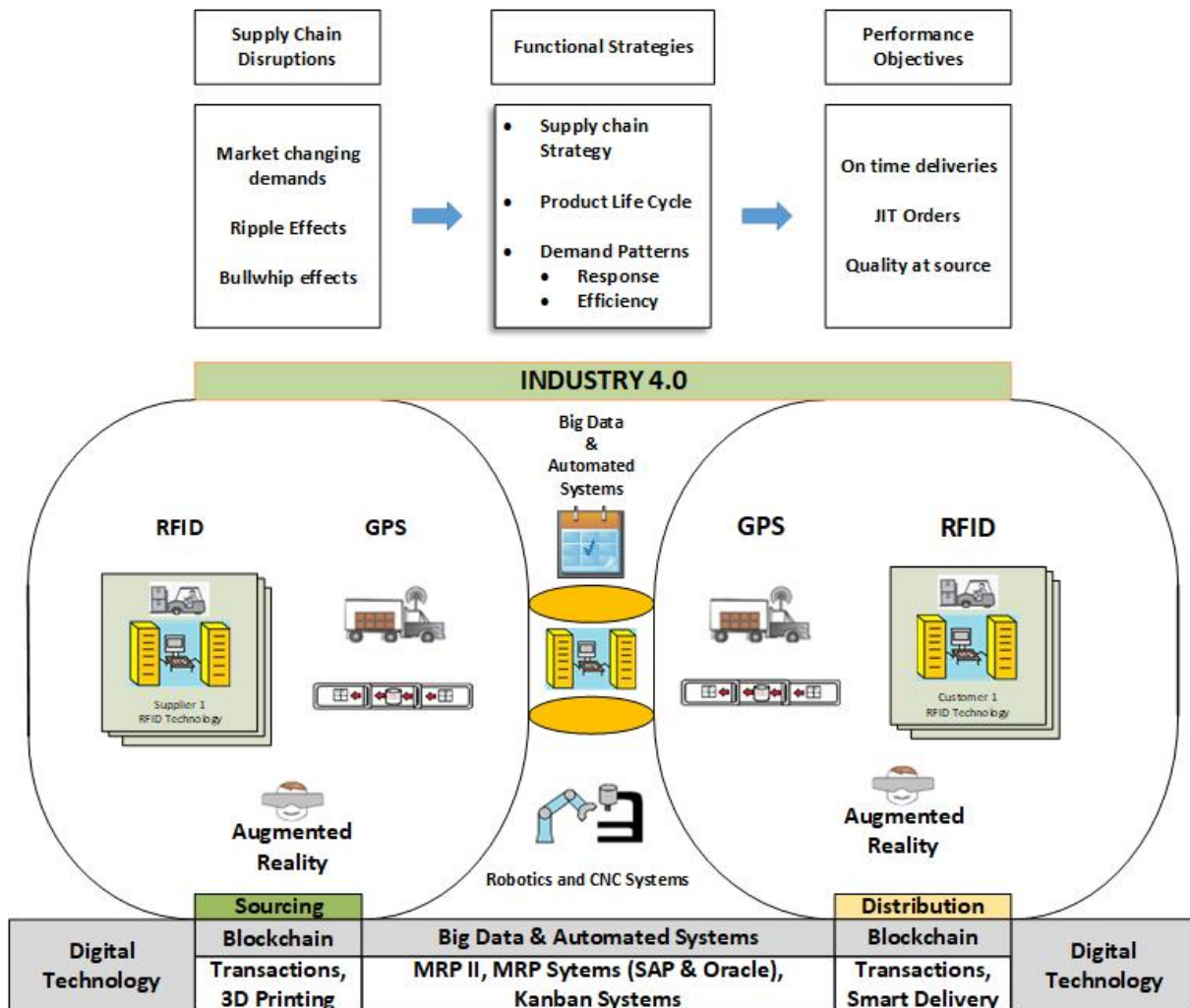


Figure 1. The role of digital technology for creating Industry 4.0 in supply chain management

Industry 4.0 has been a new paradigm to face a new era of automation and use of smart devices to create value along with supply chains, especially at this time when pandemic outbreak has been present. Thus, the role of Industry 4.0 shown in Figure 1, describes how digital technology can contribute to manage SC complexity upon this scenario to attain promptly e-business solutions. Orders from suppliers which are linked by Blockchain technology can be controlled when contracts have been celebrated with partners and suppliers. Sourcing orders can also be monitored from beginning by using Radio-frequency identification (RFID) and Global positioning system (GPS) technologies until they have been received by customers just in time with the right quantity and quality required.

## 6. Conclusion

Nandi et al., 2021). Nevertheless, this pandemic provides a rich opportunity for managers to



perform a reconfiguration of supply chain processes, how goods are manufactured and distributed, and whether global or local sourcing will be the trend (Sarkis et al., 2020).

SC strategic practices such as the implementation of digital technologies for its operation, are key elements to achieving operational excellence. Sourcing practices, such as the use of sourcing technologies and dual or multiple sourcing, are also being considered to meet excellence in procurement and logistics operations. The conceptual model proposal provides guidance on the role of digital technology in supply chain management during these unexpected market conditions. Therefore, the purpose of this model is to help organizations achieve their functional and supply chain strategies during and after the pandemic. Besides, the proposed model is based on research developed on new digital technologies to cope with all new supply chain challenges under COVID-19 business scenario.

This chapter contributes to the extant literature by exploring the challenges in industry and presenting different perspectives on strategic practices along the supply chain operations, contributing to the rethinking of supply chains strategies. COVID-19 provided the scenario to better prepare for future disruptive demand and supply conditions. It also presented an occasion to analyze and change practices along the supply chain operations, and conveyed a great opportunity for organizations to rethink the supply chain strategies for facing challenges imposed by global market dynamics.

Further paths for research can include the combination of different methodologies and empirical studies to be more accurate and profitable for the supply chain members to mitigate the risk in everyday operations. It is also interesting to research on the impacts of pandemic on emerging SCs in comparison to well established SCs, in order to learn from their strategic perspectives and successful venues. Also, areas of research opportunity embrace supply chain models within a context of uncertainty in demand, supply and operations. Furthermore, future research can focus in supporting firms to improve supply chain performance and resilience, and to be strategically well-prepared for new coming challenges.

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