Supply Chain Resilience Digitalization, and Localization

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ABSTRACT: *The epidemic of COVID-19 exposed companies to the failure of typical manufacturing and consumption patterns and their long-term effects on supply chains. This conceptual paper discusses localization, agility, and digitalization factors that make the supply chain more resilient. From a theoretical perspective, this research intends to investigate how these characteristics interact to assist the supply chain in becoming resilient by using digitalization, localization, and agility as enablers through conceptual models. The methodology used in this study is an exploratory conceptual investigation to cover the theoretical gaps. A critical evaluation of the literature was conducted to develop a conceptual model to ascertain the current state of knowledge regarding the relationship between supply chain resilience, localization, agility, and digitization in management practice. The study's primary data are the responses to questionnaires issued to respondents, analyzed, and hypotheses were formed and tested using the structural equation modeling technique. The result indicates that agility, localization, and digitalization positively impact supply chain resilience. Additionally, the industry's size and type positively impact the supply chain resilience as a control variable. As a result of the research, a new understanding of supply chain resilience emerges that can assist firms to gain new possibilities to develop new ways to do business under stress.*

KEYWORDS: supply chain, resilience, digitalization, localization

INTRODUCTION

Man-made disasters, Natural disasters, political and economic upheavals have all harmed supply networks in recent years. According to surveys, 75% of firms experience supply chain disruption each year(Scholten et al., 2020). Many international airlines have canceled flights to China, resulting in hotel chains issuing refunds to their guests in response. China plays such an important role in global value chains the negative consequences of these interruptions are felt worldwide. A South Korean automobile manufacturer Hyundai, was forced to halt car production due to difficulties obtaining parts from its Chinese manufacturing facilities (Walker 2020). These and other comparable disasters have motivated researchers to effectively focus on supply chain resilience to mitigate disruptions (Tukamuhabwa et al., 2015). Supply chain resilience is the capacity to recover from shocks. It entails avoiding identifiable risks, attaining corporate objectives in the

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context of disruptions, and re-establishing the needed performance level after the interruptions (Sawyerr and Harrison, 2020). COVID-19 epidemic is merely the latest and dramatic case of a worldwide disaster that highlights the far-reaching effects and problems of change in a reasonably short period and the importance of promising alternatives (Albach et al., 2015). To adapt more effectively to change, organizations must possess many critical characteristics, which have become keywords in recent years: sustainability, resilience, agility, and localization. Additionally, businesses and organizations have demonstrated a lack of preparedness for a global health disaster, as exemplified by the COVID-19 coronavirus pandemic. This criticality has emphasized the importance of developing a rapid ability to adapt to change, rapidly adopting appropriate responses to the current circumstances.

The world has confronted a generationally unprecedented health and economic crisis with the COVID-19 pandemic. However, even in times of crisis, there remains a chance for innovation and insight. The COVID-19 epidemic teaches us valuable lessons about supply chain management and the fragility and brittleness of natural resources (Sarkis et al., 2020). During crises, the difficulties encountered have been a lack of commodities, an inability to obtain products, and a discrepancy between product sizes and quantities against what was needed (Nandi et al., 2021). This research suggests three of the most promising and insightful lessons from the crisis, namely localization, agility, and digitization (LAD), illustrating how better resilient supply chains may be handled. Localization methods mitigate unanticipated distance-related risk in production and supply chain activities (Choi, 2020). Agility in the supply chain is defined as meeting customer needs that compete in quick market changes and rapid opportunities (Humdan et al., 2020). Digitalization transforms the traditional company strategy into global business processes that work across time, geography, and operational boundaries (Nandi et al., 2021). Supply chain resilience is a relatively contemporary idea that has gained growing attention from researchers in several research fields over the last two decades. However, it has been conceptualized theoretically, resulting in many distinct definitions, methodologies, ideas, and interpretations. The researchers' perspective focuses primarily on resilience as an 'absorbing' or 'adaptive' ability using the terminologies typically employed in systems and evolution theory. The literature has not addressed the linkage between localization, agility, and digitization, even though it appears to be an apparent solution. Pandemics have naturally been excluded from supply chain localization research, which primarily concentrates on financing and warehousing optimization.

Similarly, researchers focused on supply chain agility to assess the relationship between technological flexibility and agility (Gigor, Gligor, and Holcomb et al., 2019). The relationship between digitization and supply chain management research is growing (Das et al., 2019). Even in the absence of interrelated research on all three dimensions, numerous combinations of linkages exist. Significant connections and correlations between agility and digitization have been found in the literature (Power et al., 2001, Yusuf et al., 2004, Centobelli et al., 2020). The relationship between localization and agility is rarely studied or analyzed. Localization can contribute to agility in several ways, one of which is developing responsive partnerships by local organizations (Trapp et al., 2020, Sarkis et al., 2007). Localization, digitization, and local supply chains have recently received attention, partly due to the epidemic. The body of research lacks an understanding of localization, agility, and digitalization (LAD) factors that contribute to supply chain resilience and, thus, can successfully cope with change.

Furthermore, this research investigates the elements associated with supply chain resilience and LAD. Secondly, previous studies typically only investigated the supply chain resilience with either one. No integrated framework is designed in conjunction with the LAD concept, so this research fills this gap. Hence, to enhance understanding of the role of the localization, agility, and digitalization factors on supply chain resilience, we formulate the following research question.

RQ1 What are the effects of agility on supply chain resilience

RQ 2 What are the effects of localization on supply chain

resilience RQ 3 what are the effects of digitalization on supply

chain resilience

To answer the research question, we first determine the elements that influence supply chain resilience, such as localization, agility, and digitization, and then analyze the data acquired from a sample of 236 manufacturing companies. The methodology used in this study is an exploratory conceptual investigation to cover the research gaps indicated in the previous section.

We have arranged our paper as follows. The theoretical foundation and research hypotheses are explained in the next section. We then discussed the study design, research method, statistical analysis, and results. The final section presents the managerial implications, conclusion, and future research direction. Towards a Conceptual Framework

A critical literature evaluation was conducted to develop a conceptual model to ascertain the current

state of knowledge regarding the relationship between supply chain resilience, localization, agility, and digitization in management practice. The literature review included a bibliographic review of English-language papers published in the Google Scholar and Scopus repository database. The main words and terms utilized for the search have been: " supply chain resilience," "localization," "digitalization," and "agility." Therefore, the literature study has been carried out using the critical review technique, an ideal strategy to deal with novel themes to permit new interpretations and views (Snyder, H2019). This view is different from the systemic literature review because it claims not to incorporate all published papers but rather to blend opinions and insights from several academic domains to create a new conceptual model or theory

The following is a literature review organized into three subsections that summarise the essential concepts associated with the keywords. Finally, a conceptual framework has been established by articulating constructs that aid in making sense of the knowledge gained on the topic.

Supply Chain Resilience

In recent years, Covid 19 pandemic has interrupted the supply chain networks. This has turned attention to resilience. The requirement for resilience comes from the idea that no risks can be eliminated.

Companies can overcome disruptions to their supply chains by establishing resilience to continue delivering products and services to their consumers (Tukamuhabwa et al., 2017). Resilient companies are generally more ready to deal with change, and better organize their internal capabilities, resources, and systems against disruption (Martins de et al., 2019).

Resilient supply networks can anticipate and mitigate the negative consequences of disruptive occurrences while significantly lowering the time required to resume normal activity (Ruiz-Ben_1tezet al., 2018); Scholten et al., 2020). The COVID-19 epidemic is a massive disruption that tests the resilience of global supply networks. The capability of supply chain operators to plan well, allowing the supply chain to adapt, absorb and recover from interruptions of varying durations, affects, and probabilities, is critical for the supply network's performance and success. Measuring such capabilities elicits information about one's strengths and weaknesses and can aid in focusing future action plans. Existing literature on supply chain resilience indicates that environmental risks and disruptions do not respect organizational boundaries; they affect the overall supply chain. Consequently, companies must establish capacity in line with their supply

chain participants to overcome expected and abrupt changes (Chowdhury and Quaddus, 2017). Apart from overcoming disruptions, research indicates that supply chain resilience can directly impact an organization's performance outcomes (Chunsheng et al., 2020, Chowdhury et al., 2019; Altay et al., 2018).

Localization

Localization is defined in supply chain literature as the placement of a company's physical facilities andthe geographic location of these operations and facilities (Meijboom and Voordijk, 2003). Localization may be able to help solve this more widespread worldwide issue. Resilience in the supply chain can be improved by localizing supplies. It's critical for businesses to keep their R&D purchasing and manufacturing operations nearby to remain competitive. When it comes to costs, companies' localization strategies have a significant impact: transportation costs and risks rise as distances increase, labor costs differ widely around the world, and tariffs account for a substantial portion of product costs when trading across national and regional borders(Reza-Gharehbagha et al., 2020). Localization strategy refers to a subset of supply chain strategies. Localization strategy purely depends on internal and external factors. Table 1 explains the internal and external factors for the localization

Critical drivers of supply chain localization include developing and safeguarding patented in-house technology, boosting employment and investment in locally-oriented production, and minimizing supply chain risks (Stentoft et al., 2018, Arvanitis et al., 2017). Localization may be deemed more robust due to shorter distances and more consistent supplies from local businesses that respond more rapidly. While the scope for localization is constrained by the local resource availability or materials for procurement and replenishment, it utilizes waste created locally to design new ones that can be remanufactured, recycled, reconditioned, or reclaimed, and effectively provided to locals. By focusing on the specific demands of a particular geographic place, localization aims to build local capacity to deal with pandemics or global crises. Based on this propose that

Proposition 1

(H1) Localization enablers contributing positively to supply chain resilience

Agility

The COVID-19 pandemic also stressed the need for more agile companies and supply chain services, similar to localization benefits. Agility is a strategy for meeting customer needs while

competing in a rapidly changing market with quick opportunism (Humdan et al., 2020). Agility includes market-specific expertise, sharing demand information, and exploiting partners' interconnected capabilities to meet customer needs (Cao and Dowlatshahi, 2005). Agility is the ability to adapt quickly, responsively, and flexibly to shifting demand patterns. COVID-19 created a bottleneck in supply chain manufacturing enterprises', resulting in a shortage of finished products due to restricted raw material supply due to lockdowns (Kraus et al. 2020). Supply chain agility is a strategic capacity developed by the firm to respond fast to external changes. Supply chain agility demonstrates a business's ability to integrate a mentality, information, and rapid procedures across the supply chain organization to respond to external volatility (Wamba and Akter2019). Supply chain Agility necessitates improved supply chain partner cooperation and reliability in reducing the total cost of responsiveness and reaction time to meet changing customer needs. Supply chain -Agility is particularly crucial during interruption because it enables supply chain partners to share knowledge and collaborate (Scholten et al., 2020). Supply chainswith increased SC-Agility are better equipped to detect the probability of disruption using their collaborative provider networks, redundant resources, and collaborative risk response infrastructure (Teece, 2007). All of these efforts contribute to supply chain resilience. Table 2 explains the factors for supply chain agility.

A quick response to unforeseen changes in supply or demand is needed in the supply chain agility. A fundamental to a practical agile approach is the ability of agile partners to support responsiveness, flexibility, and extra capacity both upstream and downstream. Being agile enables firms to respond quickly to problems and opportunities and to enhance their performance. As the COVID-19 virus spreadglobally, supply chain agility became more obvious. Shortages of high-demand commodities or waste caused by low-demand products need greater agility for enterprises and their supply chains. The abovefactors have led to the rise of agility as a more adaptive management strategy for enterprises and their distribution networks. Based on the above, argue that

Proposition 2

(H2) Agility enablers contributing positively to supply chain resilience

Digitalization

Digitization is the underlying principle for social separation and alienation to preserve economic sectors, allow socialization, and make online purchases easier (Matthews, 2020). Due to the pandemic, organizations and individuals have increased their use of virtual collaboration in place of physical meetings and travel. Increased virtualization has caused a saturation and scarcity of computer cameras, speakers, and home office equipment due to the supply chain for digital equipment and services. Supply chain (SC) digitalization occurs in an era when real-time coordination and communication are emphasized despite the emergence of numerous risks(Corallo et al., 2020). Data collection and analysis are critical in operationalizing the supply chain resilience concept. (Evrard Samuel and Ruel, 2013).

Analyzed data can assist supply chain managers in making sound judgments and developing the capabilities in the supply chain concept, for instance, collaboration, anticipation, and visibility. The Supply chain resilience study is still in its infancy despite the increased use of digital tools. Much of the research has focused on one digital tool's influence on supply chain resilience. Nevertheless, as organizations begin to digitalize their supply chain, many digital tools may be implemented simultaneously. Table 3 explains digital tool contribution to supply chain resilience.

Digital tools affect the traditional supply chain (SC) and speed up the transition to digitalized supply chains. These tools improve the supply chain management practice, enabling the transformation to provide better advancements and meet stakeholder expectations in real-time. However, firms need organizational and infrastructure capabilities that facilitate the deployment of digital tools. Services provided by one system to another through value-creating provider-user interactions can be considered digital capabilities (Srivastava and Shainesh, 2015). Digitization can help the organization give real-time insights to customers. The skills need to expand beyond pure information technology to include specialized technologies such as mobile or social media and the analytic ability to extract big data knowledge. Digital capabilities provide a platform for developing additional products, technology, and services by other companies (Kohli and Grover (2008). Therefore, propose that

Proposition 3

(H3) Digitalization enablers contributing positively to supply chain resilience

Designing the Conceptual Model

Based on the above discussion, a conceptual framework has been formed to examine the localization, agility, and digitalization (LAD) toward supply chain resilience. Finally, we take into account the control variable as the size of the organization (OS) and the type of industry (industry) (IT). The first research framework for this investigation is shown in Fig. 1. This research intends to explore how these aspects(H1, H2, H3) interact to aid supply chain resilience using LAD as facilitators by building a concept model. Also, the COVID-19 pandemic has the potential to endure for an extended period, requiring a new supply- chain management paradigm. The establishment of supply chain resilience is therefore extremely important.

RESEARCH METHOD

Instrument developed

A survey and structural equation modeling were the tools that we used to answer the research questions. The method allows us to evaluate the hypothesis for the study. The research team used well-established techniques to construct survey items following a literature review and discussions with manufacturing executives with over five years of experience. The scales were chosen from established research to confirm the validity and reliability of the investigation. The study hypotheses were tested by conducting a survey. Five academics and five senior managers from the manufacturing business in India helped us pretest the study. Based on their suggestions, we have changed our questions' wording to make them clear and ensure that the survey questions' length is correct. Finally, the questionnaire was finalized and ready for data collection. The manufacturing companies are targeted for data collection. As a result, the most critical step in gathering data was creating a survey instrument that was both valid and reliable. We have used data from a cross-sectional study (see Fig. 1). Five-point Likert scale, the survey-based instrument values ranged from strongly disagree (1) to strongly agree (5) for the dimensions was used to collect the data. Finally, the constructs were developed into reflective constructs. The list of constructs and variables used for each construct is mentioned in appendix A.

Data Collection

Data was acquired by collaborating with the Indian Chambers of Commerce and Industry(FICCI) and the National Association of Software and Services

Companies(NASSCOM). The structured questionnaire was e-mailed for a cross-sectional survey to more than 2,000 manufacturing companies in India. Only a few of the most critical people were asked to fill out the questionnaire. Respondents must be head of technology or a chief technology officer (CTO) involved in the deployment and integration of new technologies inside their organization as a criterion for participation. As a consequence of two rounds of data collecting, we received an adequate response rate of 16.01 percent. Data on respondents' firm-level demographics are included in Table 1. food (16.12%), chemicals (16.10%), machinery and industry equipment (16.13%), automotive components (20.23%), electrical equipment (16.30%), and Pharmaceuticals (15.12%), and are among the industries represented in the survey (15.23%).

The common method bias (CMB) is frequently related to the design of cross-sectional surveys used to collect data (Guide and Ketokivi, 2015), implies that "*the instructions at the top of a questionnaire may influence the answers provided by the different respondents in the same general direction, causing the indicators to share a certain amount of common variation.*" Podsakoff et al. (2003) claim that CMB may also result from the social acceptability associated with a specific style of responding to questions, resulting in the indicators sharing a certain level of common variance. We used a variety of methods to check for CMB. We conducted a conservative version of Harman's one-factor test to ensure that a singlerespondent does not influence the results (Podsakoff and Organ, 1986). The test results indicate that the single component accounts for 41.03percent of overall variation, indicating that CMB is not a significant issue. Second, we performed a correlation marker analysis to determine the presence of CMB (Lindell and Whitney, 2001). We observed just a small change in adjusted and nonadjusted correlation. Additionally, the correlations' significance did not alter. In conclusion, we can state categorically that CMB had no discernible influence on our study. We assessed the possibility of non-response bias by analyzing data obtained in two phases, as recommended by Armstrong and Overton (1977). We compared two phases using the t-test of early and late respondents to the survey. The results indicate no statistically meaningful difference between the two phases for each survey item ($p > 0.05$). Based on these findings, we are convinced that non-response bias is not a significant issue.

CONCLUSION AND FUTURE RESEARCH DIRECTION

One of the most significant lessons learned from the COVID-19 crisis and subsequent solutions is the importance of carefully managing the supply chain and resilience in the face of a vulnerable supply chain. We developed an exploratory model incorporating the LAD concept for supply chain resilience through a literature survey. We identified and explored critical enablers and modeled a path to supply chain resilience using the LAD principles, which are hypothesized to be a pillar of supply chain resilience. Doing so demonstrates the complexities and interactions that exist regarding supply chain resilience. Thus, it is necessary to identify the LAD enablers and additional performance metrics required to apply supply chain resilience using LAD principles for organizational decision-making.

Further research is needed in case studies to examine the LAD outcome with circular economy practices, firm capability to adapt the LAD concepts, and interaction among these factors contributing towards supply chain resilience. As supply networks return to a post-pandemic "normal," we must balance LAD with efficiency and effectiveness issues. Effectiveness versus efficiency is critical in the LAD concept.

Efficiency may be associated with brittleness and fragility when effectiveness is linked to an agile supply chain. The government's roles in supporting LAD models for supply chain resilience must consider for further research. Another area of investigation is research across supply chains and within organizations at the operational level to support LAD capabilities for supply chain resilience. People worldwide have been striving to respond promptly to emergencies, but society and industry have ignored supply chain issues until they become a crisis. As a result of COVID-19, we have seen that present supply chains need to be strengthened before continuing improvement, which begins with the companies themselves and their supply networks. All stakeholders can be made aware of the stress areas in the supply chain through supply chain mapping. To understand the complicated relationships, operational, supply chain, and sustainability research must collaborate. This conceptual model paper provides an opportunity to understand, implement, and validate this model through implementation. The implementation study's findings assist in refining the model and learning more about how COVID-19 lessons might be used to strengthen supply chain resilience

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