Operations Management Research
https://doi.org/10.1007/s12063-021-00203-1

Supply chain sustainability during turbulent environment: Examining the role of firm capabilities and government regulation

Sheshadri Chatterjee[1] · **Ranjan Chaudhuri**[2]

Received: 16 April 2021 / Revised: 9 June 2021 / Accepted: 2 July 2021
© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2021

Abstract
The turbulent environment like COVID-19 has forced many firms to the brink of collapse. It has a devastating impact on the supply chain management and its sustainability. Many firms were forced to close due to unavailability of raw materials, essential ingredients, and labor shortage. Not many firms were capable of efficiently handling such disruptive situation. There is not much study on appropriate supply chain strategy for such turbulent situation. The practitioners as well as academic researchers are interested to know how to deal with such situation and remain sustainable for any such future crisis like COVID-19. In this background the aim of this study is to examine the determinants that impact the supply chain sustainability during turbulent situation. The study investigates how firm capability and government regulation impact the supply chain sustainability during turbulent environment. With the help of literature review, dynamic capability theory and contingency theory, a theoretical model has been developed. Later the model has been validated using PLS-SEM technique with 315 usable responses from employees of different firms in India engaged in supply chain management process. The study finds out that firms' capabilities, leadership team support and contingency plan play vital role to formulate appropriate supply chain strategy which in turn positively impacts supply chain sustainability during turbulent environment. The study also finds that there is a moderating role of government regulation impacting supply chain management during the turbulent environment.

Keywords Technology capability · Innovation capability · Relationship management · Government regulation · Contingency plan · Sustainability

1 Introduction

Supply chain management and its sustainability are considered as a well-accepted topic in the field of operation management. Sustainable supply chain research focuses on three aspects. Amongst these, economic and environmental aspects play dominant role (Hallinger 2020) though the social aspect is also receiving increasing attention (Walker et al. 2014; Nath and Agarwal 2020). However, unprecedented emergence of COVID-19 pandemic across the world has caused awful disruption in the supply chain system. In this scenario, business community has started thinking how to address the supply chain disruption during such crisis (Handfield et al. 2020). For sustainability in supply chain, efficiency and flexibility of the system are needed to be improved to appropriately respond to an efficient supply chain for their innovative products (Fisher 1997). It has been argued that for responding to address the dynamic and turbulent situation, the firms are needed to embrace supply chain which can quickly respond to the short-term changes of demand and should restructure the supply chain practices for adjusting to the long-term market changes (Lee 2004; Aslam et al. 2018). Different scholars have advocated as to what to do regarding sustenance of supply chain in turbulent environment. But how that could be executed was not studied in an explicit way. Hence it is needed how by improving the firm technological, managerial, and other capabilities supported by leadership with structured contingency plan, supply chain strategy can be improved. The practitioners have started thinking how appropriate use of advanced technology could improve the competence of the firms to

✉ Ranjan Chaudhuri
ranjan@nitie.ac.in

Sheshadri Chatterjee
sheshadri.academic@gmail.com

[1] Department of Computer Science & Engineering, Indian Institute of Technology Kharagpur, West Bengal, India

[2] Department of Marketing, National Institute of Industrial Engineering (NITIE), Mumbai, India

Published online: 23 July 2021

address such ominous situation in future (Oh et al. 2020). It is essential to think how the use of technology could improve the supply chain resilience through integration of different functional areas of the firms by linking them with the distributers, suppliers, and customers (Kim and Park 2017). Also, it is considered that by improving Customer Relationship Management (CRM) abilities, the collaboration among the different stakeholders of supply chain activities could be improved (Mofokeng and Chinomona 2019) in such hostile environment. Thus, for addressing any turbulent environment, firms need to take help of advanced technologies like blockchain, artificial intelligence (AI), cloud computing, internet of things (IoT) and so on for sustaining the supply chain system (Kumar et al. 2020). Use of advanced technology in sustaining supply chain management is commonly called supply chain innovation management (Oh et al. 2020). The innovative abilities of firms needed to sustain supply chain management during any unstable environment is perceived to be improved by the active interference of leadership support (Lei et al. 2018). The firms are needed to adopt effective supply chain strategies for ensuring its sustainability during any turbulent environment (Wieland and Wallenburg 2012). During any crisis, the role of regulatory authorities is perceived to be important. In such turbulent environment, execution of strict regulation imposed by the regulatory authorities would destabilize the supply chain system (Aigbogun et al. 2018). For this, collaborative regulation is needed to be implemented (Christopher and Peck 2004). Collaborative regulation is associated with the concept that emerges from collaboration between supply chain actors and regulatory authorities (Aigbogun et al. 2018; Chatterjee 2020). Studies are there that investigated role of supply chain management to impact firm performance (Kumar and Kushwaha 2018; Saberi et al. 2019). By the help of DCV theory (Teece et al. 1997) and contingency theory (Fiedler 1993), a model has been developed by formulation of some hypotheses which have subsequently been tested by PLS-SEM technique. Extant literature has investigated how economic, environmental as well as social aspects play critical role to sustain supply chain management (Hallinger 2020). However, there are a few studies investigating how different firm abilities and business contingency could help the firms to develop supply chain strategy for addressing the sustainability of the supply chain management during turbulent situation under the moderating influence of government regulation. Thus, there is a research gap. This has motivated the authors to undertake this study. In such background, the aim of this study is to address the following objectives.

a) To examine how the firms can cope with hostile environment by improving their intra and inter firm operations to increase supply chain adaptability and agility for sustaining supply chain management.
b) To investigate how the government regulation could act as a moderator to help or impede the supply chain sustainability of the firms during turbulent environment.
c) To develop a model for determining how firm capabilities and appropriate business plan could help the firms to sustain their supply chain during turbulent situation.

The remaining parts of the study are structured as follows. Next, literature review and theoretical background with development of hypotheses have been presented followed by proposing a conceptual model. Thereafter the model has been analyzed by rigorous statistical process with analysis. Thereafter discussion on the results has been presented. Next, implications and limitation with scope for future research have been presented.

2 Background studies and theoretical underpinning

2.1 Background studies

Strategic supply chain management not only means to move the products to the place where they should be, but strategic supply chain management is also considered as a tool that helps to enhance the key outcomes of the firms (Hult et al. 2004). Supply chain entities depend on each other through parallel and sequential network structure (Hult et al. 2007). The supply chain entities transform the raw material to the finished products, and it is highly vulnerable to turbulent environment (Roh et al. 2014). Turbulent environment like abrupt outbreak of COVID-19 caused disruption in supply chain of many firms across the globe that caused labor shortage, stock outs of medical commodities, and food (Larue 2020; Min et al. 2020; Sarkis 2021). To address the turbulent environment, the businesses are found to be up and doing to manage the disruption of supply chain sustenance using advanced technology (Sharma et al. 2020). However, it is observed that the stakeholders were not able to fully utilize the potential of innovative technologies in supply chain since socio-material arrangements stood on the way during such turbulent environment (Pratono 2016; Nandi et al. 2021; Sarkis 2021). To address any unforeseen situation, firms are found to insist heavily in using modern technology for improving efficiency and adaptability for sustaining the supply chain during any hostile situation (Chakravarty et al. 2013). Several studies have investigated customer satisfaction towards supply chain portfolio strategy (Tokman et al. 2007), and supply chain resilience (Altay et al. 2018). Environmental dynamism is concerned with unpredictability and volatility of the external environment of the firms (Schilke 2014). In such turbulent environment, the dynamic capability of the firms has considerable influence to improve several

supply chain characteristics (Rojo et al. 2018). Sustainability in supply chain is highly essential because supply chain is involved with the processing of raw materials to the finished products with ultimate delivery of those products to the customers (Linton et al. 2007). Firms will survive if they can address any turbulent environment sustaining their supply chain arrangements with the help of appropriate strategies (Mishra et al. 2016; Kalaitzi et al. 2017). For diffusion of innovative technologies in the supply chain management to address any turbulent environment, appropriate process synchronization is necessary (Zimon and Madzik 2019; Free and Hecimovic 2021). Turbulent environments are those environments which are not recognized in advance like abrupt outbreak of COVID-19 pandemic, famous trade war between China and United States of America and so on (Nandi et al. 2021). Turbulent environment affects the society (Nath and Agarwal 2020), and economic aspects (Hallinger 2020; Butt 2021). Supply chain practices embedded with blockchain technology is perceived helpful as it would share information accurately and quickly with transparency (Kumar et al. 2020). Studies transpire that it is possible to address any turbulent environment towards sustainability of supply chain using modern technologies (Sharma et al. 2020). Supply chains are found to be typically composed of several firms located in different places and they are impacted by locational practices and regulations (Montabon et al. 2016). Regulatory policy is considered as a fundamental driver of sustainable supply chain (Zhu and Sarkis 2006). Throughout the supply chain process, the firms are needed to reduce environmental impacts throughout the supply chain process (Linton et al. 2007). However, in the turbulent situation, the governments also adopt a collaborative approach for the firms for sustaining their supply chain resilience (Oh et al. 2020).

From the studies of literature in the context of sustainability of supply chain during turbulent environment, many things have emerged and may things did not come out. We have discussed some of the research works in this regard. Some of the studies highlighted what are the impediments to keep the flow of supply chain during turbulent situation (Roh et al. 2014). Some studies mentioned, in the context of supply chain management during crisis, different problems like labor shortage, stockouts, and so on stood on the way (Larue 2020; Sharma et al. 2020). Again, some studies highlighted that socio-material arrangements posed impediment to keep the flow of supply chain during hostile moment (Pratono 2016; Nandi et al. 2021). It has been suggested that the appropriate strategies are to be developed to sustain supply chain of the firms during turbulent situation (Mishra et al. 2016; Kalaitzi et al. 2017). Sustainability of supply chain management can be achieved by the application of modern technology (Kumar et al. 2020). But these studies did not explicitly describe how a firm can develop its supply chain strategy to address the turbulent environment by effectively meeting the present needs without compromising the firm's capabilities to address the future needs. This has fueled the motivation of the authors to take up this study.

2.2 Theoretical underpinning

This study has taken an attempt to search a solution for sustaining supply chain management for the firms during any unforeseen turbulent environment. For this, we have taken help of dynamic capability view (DCV) theory (Teece et al. 1997) and contingency theory (Fiedler 1993). DCV theory is concerned with dynamic ability and strategic management abilities of a firm by which the firm can integrate, build, and reconfigure its internal and external capabilities to address any environmental issue which is rapidly changing (Teece et al. 1997). In this study, the issue is how firms can successfully sustain its supply chain resilience during any turbulent environment. In this context, the inputs of DCV theory are perceived to be helpful. In terms of DCV theory, it is known that dynamic capabilities emphasized on the abilities of the firms for responding and reacting timely and adequately to any abrupt external environmental change (Gregory and Jon 2011). For exhibiting reactions and response, the firms must have to improve their several capabilities. Thus, to address any external environmental issue, the DCV theory suggests that the capabilities of the affected firms are needed to be developed by adopting appropriate strategies through improvement of the firms' several competencies (Felix and Lamar 2018). In this perspective, the DCV theory helps to provide a transparent roadmap on how a firm can sustain its supply chain management during any turbulent environment. The DCV theory advocates that to address any turbulent environment, a firm needs to develop their several capabilities (Basiouni et al. 2019). In the context of this study, the capabilities are perceived to cover technological, innovative as well as relational development aspects. Dynamic capability being the higher order capability explains the firms' abilities to face volatile market in the highly dynamic and changing environment (Eckstein et al. 2015). In this context, we seek to realize the role of firms' dynamic capabilities and their influence on supply chain strategy to sustain supply chain in hostile circumstances. Here, we consider firms' capabilities as dynamic capabilities and in conformity with Teece (2014), we expand the definition of firms' capabilities with other sub capabilities to sense, seize, and reconfigure so that in dynamic turbulent situation, the firms can develop their supply chain strategy to sustain their flow of supply chain.

Again, contingency theory (Fiedler 1993) approach is perceived to serve as a basic concept concerning nexus between external uncertain environment and emergent strategies needed to be adopted by the firms to sustain supply chain system. Contingency scholars argue that firm performance is

considered as a function of congruence between the affected firms and the external environment as well as the strategies (Venkataraman 1989). In terms of the contingency theory, it is known that there is no best way a firm can adopt to address any uncertain external situation. Hence, firms needed to have a contingency plan with several options to address any turbulent situation. In this context leadership of the firms is needed to be flexible in choosing succinct strategies that suit the abrupt change in the external situation. Thus, to address any unforeseen turbulent environment, leadership is needed to decide which action is befitting to address any external situation (Pratono 2016). Thus, to adopt supply chain strategy in the context of this study, the firms need to adopt congenial contingency plan and to apply appropriate strategies to address changed situational environment for sustaining the supply chain system and for this, support of leadership is also considered important (Peter 2007).

3 Formulation of hypotheses and development of conceptual model

With the study of literature, the DCV theory and contingency theory, the determinants that impact supply chain strategy prompting supply chain sustainability during turbulent environment could be identified. Also, moderating effects of government regulation have been considered in this study to affect sustainability of supply chain of the firms during turbulent environment. All these aspects will be discussed here to help for formulation of several hypotheses that would help to develop the conceptual model.

3.1 Technology capability (TC)

Many studies have suggested that transportation, partners, external suppliers, and the customers are required to be interlinked for ensuring integration and collaboration in the supply chain system (Sungbae and Taesoo 2016; Panahifar et al. 2018). To ensure such effective integration and collaboration, there is need of accurate exchange of information among the supply chain stakeholders (Errassafi et al. 2019). Developing technological capability of the firms, the information exchange system will be improved within the supply chain system helping to mitigate the uncertainty enabling the firms to promptly respond to demand of the customers (Mofokeng and Chinomona 2019). To address any turbulent environment, the firms are needed to adopt appropriate supply chain strategy under such dynamic situation. This concept is in conformity with DCV theory (Teece et al. 1997). For adoption of appropriate strategy to sustain supply chain resilience, information flow must not be interrupted and obviously, this requires use of advanced technology (Li et al. 2009). Accordingly, it is hypothesized as follows.

H1: Technology capability (TC) of a firm positively impacts the supply chain strategy (SS) of that firm to address any turbulent environment.

3.2 Innovation capability (IC)

Innovation capability (IC) of a firm is considered to comprise of technological innovation and social innovation in the context of addressing any turbulent environment for keeping the supply chain system sustainable (Sarkis 2020). In response to address any turbulent environment for sustaining supply chain, a firm needs to adopt industry 4.0 technologies like IoT, AI, cyber physical system (CPS), blockchain technology, cognitive computing technology and so on (Kumar et al. 2020; Chatterjee et al. 2020a). It is important to realize that social and environmental crisis will occur in future. None knows when and in what level such turbulent incident would take place. But having necessary data driven system like big data, a firm can quickly and aptly respond and react to such social and environmental crisis (Desjardine et al. 2019). Data sharing can be made transparent and accurate in a quicker way with the help of blockchain technology and if such technology is integrated with AI and IoT, the firms' supply chain managers can take quick decision for subsequent actions to address such uncertain situation (Saberi et al. 2019; van Hoek 2019; Chatterjee et al. 2020b). Social innovations are concerned with technological transformation landscape. Social innovations like sharing economy and circular economy are perceived to have impacted a firms' supply chain resilience (Aigbogun et al. 2018). Firms should emphasize on supply chain localization by the help of industrial symbiosis, use of local biproducts, and so on which are considered as supply chain enablers as well as circular economic practices (Smart et al., 2017). The firms can develop supply chain strategy by developing technological and social innovation through improvement of research and development practices (Smart et al. 2017). Accordingly, it is hypothesized as follows.

H2: Innovation capability (IC) of the firms positively impacts the supply chain strategy (SS) to address any turbulent environment.

3.3 Relationship management capability (RC)

Relationship management capability (RC) of a firm is considered as a communication among different stakeholders of the firms in the context of relational view that would improve the sustainability of supply chain system in any turbulent environment (Paulraj et al. 2008). RC has the power to acquire new skills and can enhance the collaborative activities among the stakeholders involved in supply chain (Kale et al. 2000). RC is also conceptualized as the ability

to tighten relationship through development of trust and sharing knowledge (Park 2015). RC includes the qualities like dedication, mutual trust as well as benefits (Wu et al. 2014) which strengthens supply chain performance enhancing coordination among the partners (Wu et al. 2014). RC helps to the supply chain partners for focusing on decision making, adopting accurate strategies to achieve the common goal (Zacharia et al. 2011). Trust, relationship immersion and communication are considered as fundamental elements of RC which are perceived to help for adopting accurate supply chain strategy (Wittmann et al. 2009). Accordingly, it is hypothesized as follows.

H3: Relationship management capability (RC) of a firm positively impacts the supply chain strategy (SS) of a firm to address any turbulent environment.

3.4 Contingency plan (CP)

Contingency theory (Fiedler 1993) posits that there is no best specific way to address any turbulent environment to sustain supply chain system. What steps would be taken by a firm to address a turbulent environment depend on the nature of turbulence and on the firms' internal and external situation (Pratono 2016). This is the main theme of contingency theory. Accordingly, it can be said that a firm must have an appropriate contingency plan to address any turbulent environment for sustaining supply chain management (Fredericks 2005). Effective contingency plan is perceived to help a firm to adopt appropriate supply chain strategy. Firms adopt strategies to sustain supply chain resilience and the specific strategy to be adopted depends on the nature and level of the uncertain turbulence (Pratono 2016; Salam et al. 2017). Accordingly, it is hypothesized as follows.

H4: Contingency plan (CP) of a firm positively impacts the supply chain strategy (SS) of the firm to address any turbulent environment.

3.5 Leadership team support (LS)

Studies have revealed that leadership team support (LS) has an effective influence on the innovation abilities of a firm to address any turbulent environment (Zhang et al. 2018). For sustaining supply chain management of a firm at the time of turbulent environment, the firm needs to adopt a particular strategy that depends on the characteristics of the turbulence which is the concept of contingency theory (Fiedler 1993). In such situation, the firm requires financial help and that can be ensured by the leadership team support (Le and Lei 2018). To implement a strategic plan, a firm needs appropriate fund and considerable efforts of the employees of the firm (Venkatraman 1989; Smart et al. 2017). In this context, LS plays a critical role since such support helps to create a conducive atmosphere in the firm ensuring to effectively execute the strategy (Donate and Guadamillas 2011). Accordingly, it is hypothesized as follows.

H5: Leadership team support (LS) of a firm positively impacts the execution of supply chain strategy (SS) of the firm to address any turbulent environment.

3.6 Supply chain strategy (SS)

Value of supply chain can be perceived from the fact that how a firm is being able to use its supply chain management as a strategic weapon (Ketchen and Hult 2007). Supply chain process has become borderless, and it is an invisible process that emphasizes on the flexibility and speed of the process (Bowersox et al. 2002). Flexibility is conceptualized as how the supply chain could estimate the nature of uncertainty it might have to face, and it could create an alignment by adopting effective strategy (Schlittgen et al. 2016). Speed of the supply chain is conceptualized as the time required from placing the order by the customer to delivery of that product to the customer. Again, the supply chain is needed to measure the operational performance of the supply chain process in the context of turbulent environment that can evaluate the effectiveness of the supply chain strategy (Ringle and Sarstedt 2016). Accordingly, it is hypothesized as follows.

H6: Supply chain strategy (SS) of a firm positively impacts the firms' supply chain sustainability during turbulent environment (ST).

3.7 Moderating role of government regulation (GR)

It is recognized that the supply chain flow depends on the natural environment where it is embedded (Chopra and Meindl 2013). Supply chain involves multiple firms dispersed geographically and as such, the firms are influenced by the regulations of that land where they are operating (Manning et al. 2012; Montabon et al. 2016). Consequently, regulatory policies at one place in the chain may be different for the other firms connected in the chain but functioning in another place. Three types of regulatory policies are there which are market-based policies, command-and-control regulations, and non-regulatory approaches (Darnall et al. 2019). The regulatory authorities always encourage the forms' involvement in supply chain activities to reduce the environmental impacts throughout the process. In the turbulent environment, the firms encounter several constrains in the supply chain process and over this, if the impacted firms are to adhere to obey all the regulatory checks in the process in such situation, it is likely that supply chain sustainability in the turbulent environment is impeded (Gupta and Piero 2013). Accordingly, it is hypothesized as follows.

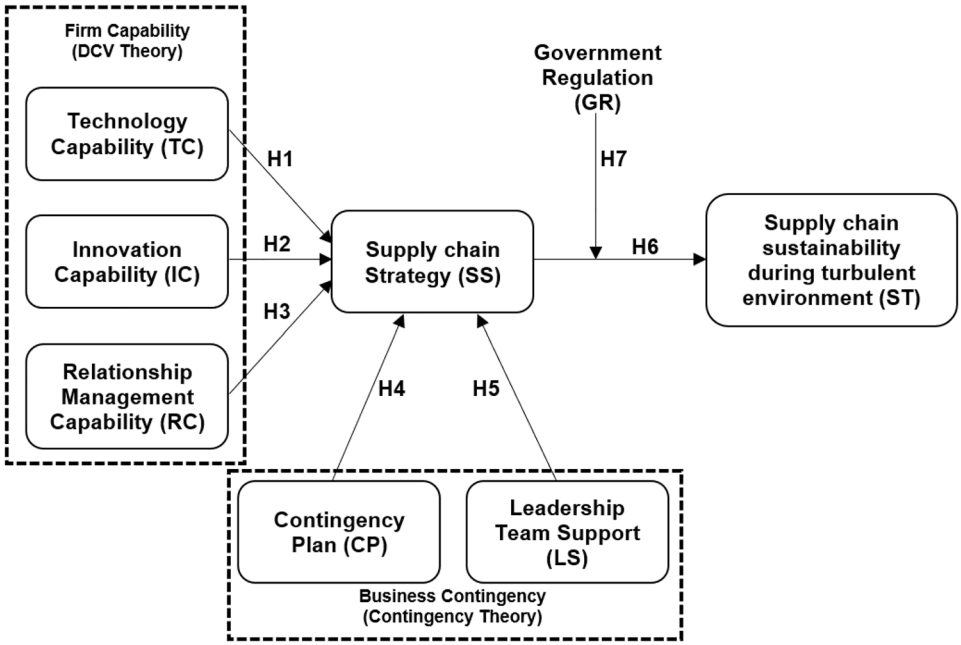


Fig. 1 Conceptual model for supply chain sustainability during turbulent environment

H7: The government regulation has a negative impact on the relationship between supply chain strategy (SS) and firms' supply chain sustainability during turbulent environment (ST).

With all these inputs, a model is developed conceptually. It is shown in Fig. 1.

4 Research methodology

For this study, we have used Warp PLS 6.0 for testing the hypothesized model (Wamba et al. 2020). We have used partial least square (PLS) structural equation modelling (SEM) technique (Kock 2019). However, it is observed that in traditional PLS method, the latent variables are measured as weighted aggregation of items by not including the errors in measurements (Henseler et al. 2014). It has been argued that without consideration of measurement errors, the use of composites without consideration of factors could have invited some unwanted known source of bias (Kock 2019). It appears that in such case, path coefficients are found to weaken relating to their corresponding true values. Thus, the developed PLS-SEM technique considering factors is claimed to have bridged the gap between PLS-SEM technique and co-variance-based SEM (CB-SEM) (Sarstedt et al. 2014). However, PLS-SEM technique can analyze such data which are not normally distributed (Henseler 2009, 2010; Hair et al. 2011; Peng and Lai 2012). This technique also can analyze data without restriction of sample size (Kock and Hadaya 2018; Kumar and Kushwaha 2018).

4.1 Measurement instrument

To develop the scale, help of literature and concept of the constructs were taken. From the inputs of the standard scale, a set of questions (questionnaire) was prepared. Then, for ensuring the readability and comprehensiveness of the questionnaire, pre-test was performed. The results of the pre-test helped to eliminate some unproductive questions and to include some productive questions. Also, opinion of five experts having knowledge in the domain of this study was taken to refine the wordings of the questions. A pilot test was also conducted to finetune the questions. In such way, by step-by-step correctional procedure, the questionnaire was prepared (Carpenter 2018). The questions were prepared in such a way as the prospective respondents may not feel any problem to understand the questions and from the responses, the attitudes of the respondents regarding supply chain sustainability in turbulent environment could be understood. In this way, 34 questions in the form of statements were prepared. The questionnaire with the sources is provided in the appendix.

4.2 Collection of respondents

For collection of data, we selected firms from four cities of India. The cities are Mumbai, Bengaluru, Kolkata, and Chennai. In these cities, it is known that many firms have been operating (Duupdates Report 2020). We selected some manufacturing firms at random in these cities and selected 693 employees of these firms. These employees are known to have been engaged in supply chain management process of their respective firms. Details of these 693 employees

were collected. Each of them was provided with a response sheet. It contained the questionnaire with five options. Each respondent is needed to put a tick mark in one option out of five options against each question. With the response sheet, it was informed to the respondents a detailed guideline as to how to fill up the response sheet. Also, it was informed to the respondents that their anonymity and confidentiality will be preserved. They were requested to respond within two months (January and February 2021). Be it mentioned here that the responses have been quantified in 5-point Likert scale with marking 1 against Strongly Disagree (SD) to 5 against Strongly Agree (SA). However, within time, 327 respondents responded. The response rate was 47.19%. On scrutiny, out of 327 responses, 12 responses were found incomplete. These were not considered. Analysis was done with 315 responses against 34 items. This is within acceptable range (Deb and David 2014). It is pertinent to mention here that in terms of the observation of Deb and David (2014), it is stated that the allowable range concerning number of items and the number of respondents should bear the ratio between 1:4 to 1:10. In that respect, in this study since the number of items is 34, the number of respondents should be between 136 to 340. In this study, the number of respondents is 315 which lies between 136 and 340. The details of 315 respondents are provided in Table 1.

5 Analysis of data

5.1 Measurement properties

Loading factor (LF) of each item has been estimated for measuring convergent validity. Again, validity, reliability, and consistency of each construct have been assessed. For this, average variance extracted (AVE), composite reliability (CR), and Cronbach's alpha (α) of the constructs have been estimated. For verifying defects of multicollinearity, variance inflation factor (VIF) of each construct has been determined. All the parameters are within allowable range. The results are shown in Table 2.

Table 1 Details of respondents (N = 315)

Type of firms	Hierarchy of employees	Number (%)
Manufacturing Firms	Executives	22 (7.0%)
	Senior managers	61 (19.3%)
	Midlevel managers	101 (32.0%)
	Junior managers	131 (41.7%)

5.2 Discriminant validity test

The square roots of all the AVEs have been computed. It is found that all the values of square roots of AVEs are greater than the respective bifactor correlation coefficients. This satisfies Fornell and Larcker criteria (Fornell and Larcker 1981). It confirms discriminant validity. It is pertinent to mention here that the discriminant validity indicates how a construct is different from the other constructs (Hulland 1999). The results are shown in Table 3.

5.3 Verification of moderating effects

For verifying the effects of the moderator, government regulation (GR) on the linkage H6, the effects of Strong GR and Weak GR on the relationship (H6) have been verified. For this, Multi Group Analysis (MGA) has been performed with bootstrapping procedure considering 5000 resamples. It is known that if the p-value difference between the effects of Strong GR and Weak GR on a linkage is found either less than 0.05 or greater than 0.95, it is said that the effects of that moderator on that linkage are significant (Hair et al. 2016). The results show that in this case, the p-value difference for the effects of Strong GR and Weak GR is 0.02 on the linkage H6. Hence, the effects of the moderator, GR on H6 are significant.

5.4 Common method variance (CMV)

With the responses of the respondents, we have come to the findings. It is to be assessed if the responses are biased or not. As a preemptive measure, during survey, all the respondents were assured that their anonymity and confidentiality will be preserved. This was done as a preemptive measure so that the respondents could respond without any bias. However, to verify if there is still any bias, CMV has been performed. Harman's single factor test (SFT) has been done. It has been observed that the first factor emerged as 33.54% which is within the highest recommended value of 50% (Podsakoff et al. 2003). Hence, it is inferred that the data could not distort the results.

5.5 Hypotheses testing (SEM)

A two-stage approach has been undertaken for analyzing the results (Hair et al. 2013; Saura et al. 2019). In the first stage, we have evaluated the measurement model. In the second stage here, we will test the predictive abilities of the model. We shall also analyze the relationships between the constructs and their explanatory power. A bootstrapping procedure with consideration of 5000 resamples has been adopted to find out the results.

Table 2 Measurement properties

Construct	Item	LF	AVE	CR	α	VIF	No. of Items
TC			0.73	0.77	0.79	3.9	4
	TC1	0.89					
	TC2	0.76					
	TC3	0.84					
	TC4	0.82					
IC			0.80	0.83	0.86	4.2	5
	IC1	0.94					
	IC2	0.97					
	IC3	0.82					
	IC4	0.89					
	IC5	0.85					
RC			0.83	0.86	0.89	3.7	5
	RC1	0.91					
	RC2	0.88					
	RC3	0.90					
	RC4	0.95					
	RC5	0.90					
CP			0.84	0.87	0.91	4.6	5
	CP1	0.86					
	CP2	0.93					
	CP3	0.95					
	CP4	0.94					
	CP5	0.91					
LS			0.79	0.82	0.86	4.5	5
	LS1	0.96					
	LS2	0.89					
	LS3	0.92					
	LS4	0.80					
	LS5	0.88					
SS			0.90	0.93	0.96	3.9	5
	SS1	0.93					
	SS2	0.95					
	SS3	0.94					
	SS4	0.95					
	SS5	0.97					
ST			0.89	0.92	0.94	4.0	5
	ST1	0.88					
	ST2	0.94					
	ST3	0.97					
	ST4	0.95					
	ST5	0.97					

The structural model has been assessed by measuring collinearity, path coefficients with significance, and R^2 values. We have also computed Q^2 value for the predictive relevance (Roldan and Sanchz-Franco 2012). With consideration of separation distance 5, we have ascertained the cross-validated redundancy by computing Stone-Geisser Q^2 value for the concerned constructs (Stone 1974; Geisser 1975). The value was within the allowable range. It confirms the predictive relevance of the model. Besides, to test if the model is in order or not, we have also estimated the values of SRMR (Standard Root Mean Square Error Residual) considering it as standard index (Henseler et al. 2014) for PLS and PLSc. The SRMR values emerged as 0.062 for PLS and 0.033 for PLSc. Both these values are found to be less than the recommended highest value of 0.08 (Hu and Bentler 1998). Hence, the model is in order. The results are shown in Table 4.

Table 3 Discriminant validity test (Fornell and Larcker criteria)

Constructs	TC	IC	RC	CP	LS	SS	ST	AVE
TC	0.85							0.73
IC	0.17	0.89						0.80
RC	0.19***	0.19	0.91					0.83
CP	0.29	0.22	0.27	0.92				0.84
LS	0.32	0.30	0.26*	0.17	0.89			0.79
SS	0.25*	0.28**	0.34	0.26**	0.28	0.95		0.90
ST	0.18	0.22	0.30	0.29	0.31***	0.27*	0.91	0.89

$p < 0.001$(***), $p < 0.01$(**), $p < 0.05$(*)

5.6 Results

In this study, we have formulated seven hypotheses. Out of these seven hypotheses, one hypothesis (H7) is concerned with the impact of the moderator GR on H6. By PLS-SEM technique, it appears that all the hypotheses are supported. The results show that impacts of TC, IC, RC, CP, LS on SS (H1, H2, H3, H4, and H5) are all significant since the concerned path coefficients are 0.41, 0.47, 0.21, 0.19, and 0.17, respectively with respective levels of significance $p < 0.001$(***), $p < 0.001$(***), $p < 0.01$(**), $p < 0.01$(**), and $p < 0.05$(*). The effects of SS on ST are significant since the concerned path coefficient is 0.39 with level of significance $p < 0.001$ (***). The effects of the moderator GR on H6 are also significant as the concerned path coefficient is 0.29 with level of significance $p < 0.01$(**). So far as R^2 values are concerned, it appears that SS could be explained by TC, IC, RC, CP, and LS to the tune of 32% and SS could interpret ST to the extent of 67% which is the overall predictive power of the model.

6 Discussion of the results

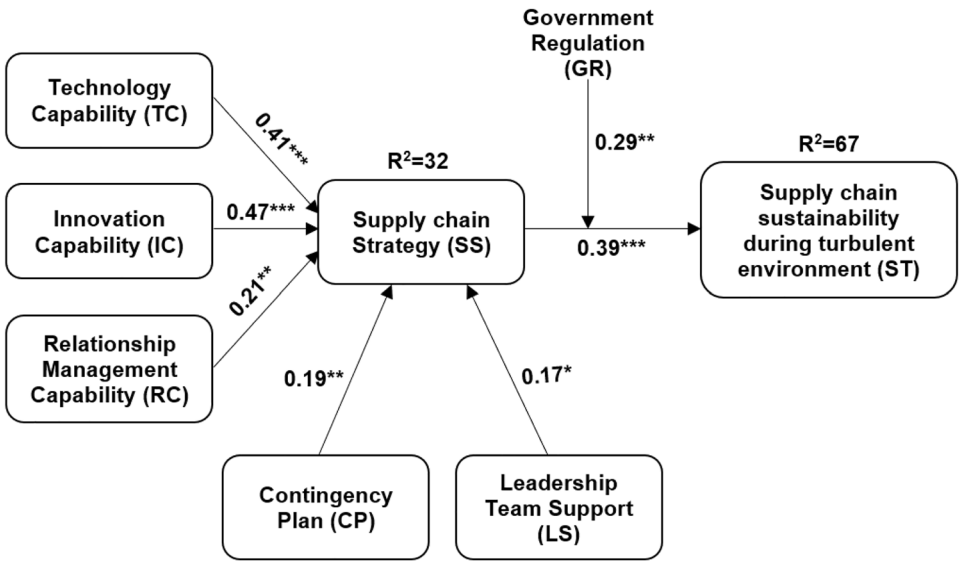
Environmental issues have posed severe challenges for the sustainability of supply chain management of the firms. The world had to face the menace of abrupt outbreak of COVID-19 pandemic. In this background, this study has taken a holistic attempt to provide a roadmap how during and after the turbulent environment the firms' capabilities and government regulation could impact the firms to sustain their supply chain resilience. In this context, this study has provided a model. The study has hypothesized that TC and IC could impact positively and significantly SS of the firms during turbulent environment (H1 and H2). These hypotheses received supports from other studies (Panahifar et al. 2018; Errassafi et al. 2019). In such turbulent environment, the firms need to emphasize to strengthen the relationship management among the stakeholders including the suppliers, customers, and so on. Also, the firms need to have an appropriate contingency plan to address the unforeseen situation (H3 and H4). These capabilities of the firms could help the firms to strategize for sustainability of supply chain management. These hypotheses (H3 and H4) received supports from other studies (Kale et al. 2000; Park 2015; Pratono 2016). The study has shown that leadership support would help the firms to develop better strategy for sustainability of supply chain management (H5). This concept has received support from another study (Zhang et al. 2018). This study has hypothesized that with better strategy, it is possible to ensure sustainability of supply chain management of the firms during any turbulent environment (H6). This relationship (H6) has shown that the ability of supply chain management is considered as a strategic weapon of a firm (Ketchen and Hult 2007). In this context, this hypothesis (H6) is seen to have received support from another study (Salam et al. 2017). This study has hypothesized that government regulation impedes the relationship between SS and ST. This hypothesis (H7) has received support from another study (Darnall et al. 2019). It is known that sustainability is comprised of three pillars which are economy, society, and environment. These pillars are conceptualized as profit, people, and planet. In the context of this study, it has been shown that firms capabilities as well as effective plan with support of leadership could help the firm to develop appropriate supply chain strategy for addressing supply chain management so that during the turbulent environment, the firms can effectively meet the present needs without compromising the firm's capability to address the needs for the future. Thus,

Table 4 Computation of path coefficients and p-values

Hypotheses	Path coefficients	p-values	Remarks
H1 (TC → SS)	0.41	$P < 0.001$(***)	Supported
H2 (IC → SS)	0.47	$P < 0.001$(***)	Supported
H3 (RC → SS)	0.21	$P < 0.01$(**)	Supported
H4 (CP → SS)	0.19	$P < 0.01$(**)	Supported
H5 (LS → SS)	0.17	$P < 0.05$(*)	Supported
H6 (SS → ST)	0.39	$P < 0.001$(***)	Supported
H7 [(SS → ST) × GR]	0.29	$P < 0.01$(**)	Supported

With all these inputs, the validated model is shown in Fig. 2

Fig. 2 Validated model (SEM)



this study has developed a model, duly statistically validated, that helps to ensure sustainability of supply chin during any hostile situation.

Here we shall discuss the effects of the moderating variable GR on the linkage H6 through a graphical representation. This is represented in Fig. 3.

In this Fig. 3, continuous and dotted lines represent effects of Strong GR and Weak GR, respectively. From the graph, it is seen that with the increase of SS, the rate of decrease of ST is more for the effects of Strong GR compared to the decrease of ST for the effects of Weak GR since the inclination of the continuous line is more than the inclination of the dotted line. This means that if the firms are to maintain strong regulatory practices during crisis, the supply chain sustainability of the firms will be more adversely affected compared to the situation when the firms need not adhere to such strict regulatory practices.

6.1 Theoretical contributions

This study has shown that firms' capabilities comprising of technology capability, innovation capability, and relationship management capability positively and significantly impact the supply chain strategy of the firm during any uncertain environment. This study has also shown that business contingency of the firms comprising of developing contingency plan with leadership support positively and significantly impact the supply chain strategy of the firms to address any turbulent environment. No extant literature is found to be exhaustively vocal to investigate how firms' capabilities and business contingency could eventually influence firms' sustainability in supply chain management during any turbulent environment mediated through supply chain strategy along with the influence of government regulation. In this context, this attempt is construed to be a unique effort. The study has shown that technological and innovation capability of the firms could help the firms to develop appropriate supply chain strategy for addressing any turbulent environment. This implies that developing digital supply chain system with the help of information technology (IT) knowledge and innovation capabilities, a firm could cope up with any turbulent environment by developing its strategy for supply chain management. This idea has contributed a new concept to the extant literature. Studies have revealed that technological and innovation abilities of the firms have maximum impacts on the supply chain strategy. It theorizes the idea that digital supply chain management should be considered as a long-time strategy to ensure a resilient supply chain

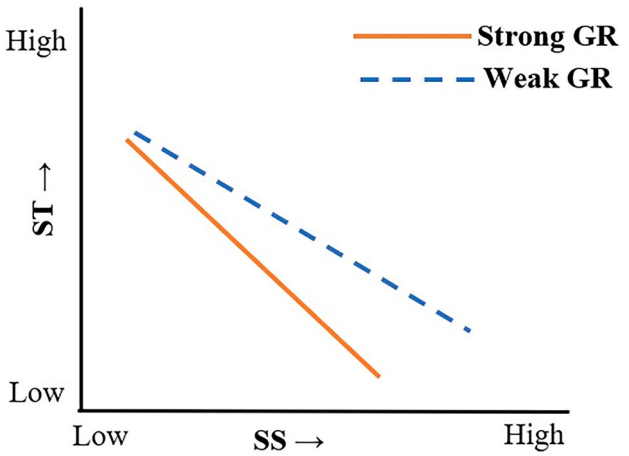


Fig. 3 Effects of the moderator on H6

management. This study has shown how by developing technological, innovation, as well as collaborative efficiency, a firm could strategize its supply chain resilience against any dynamic situation. While explain such issues, this study has successfully utilized the inputs derived from DCV theory. Besides, the study has shown that by adopting appropriate contingency plan, the firm can smoothly sustain its supply chain and for explaining this idea, this study has successfully utilized contingency theory which is also construed as a special theoretical contribution of this study. This study has shown that leadership support has an impact on sustainability of supply chain management during any turbulent environment. This idea has been lent from another study (Zhu and Kindarto 2016) which has investigated how government IT related projects in developing countries can be managed efficiently by the support of the leadership. The findings of the study of Zhu and Kindarto (2016) have been extended in our study to infer that leadership can help the firms to take appropriate strategy for sustaining supply chain even in any turbulent environment. This idea is also claimed as a unique idea and it should be considered to have an effective theoretical contribution of our study.

6.2 Practical implications

This study has several practical implications. This study highlighted that technological and innovation capabilities of a firm would significantly and positively impact supply chain strategy (H1 and H2). This implies that the practitioners should think of utilizing digital technology to develop supply chain resilience that would help to develop smart transactions. The firm management is needed to invest more to develop the infrastructure of the firms with the help of innovative technology like IoT, AI, blockchain, and so on for facilitating the communication process instrumental to smoothen the supply chain pipeline. This will also ensure intimate collaboration and develop relationship among the suppliers, manufacturers, customers, and distributers. This study has highlighted that relationship management capabilities of the firms positively and significantly impacts the supply chain strategy of the firms that prompts supply chain sustainability during the turbulent environment (H3 and H6). This implies that, through information exchange, the managers of the firms are needed to strengthen the relationship with the partners and to strategize that such relationship must not be weakened even in any conflicting situation. The managers are required to develop an integrated database to tighten the relationship to address any turbulent environment which would help for sustaining the supply chain through necessary information exchange with the help of online platforms. This study also highlighted that effective contingency plan would help the firms to develop supply chain strategy (H4) to address any turbulent environment. It implies that the managers should ensure supply chain visibility which would help the managers to become updated with latest information regarding supply chain activities. Through this, upstream and downstream activity-related information can be obtained by the managers in the real-time scenario. This would help the firm managers to have a quick information regarding any untoward accidental event. The leadership support impacts the supply chain strategy (H5) which implies that the leadership must try to ensure a conducive atmosphere in the firm that would help the employees to be more proactive to address any turbulent environment necessary for sustenance of supply chain management. During any turbulent environment, the government should enforce collaborative regulation to help the supply chain system of the firms so that compliance of such regulation in turbulent environment must not impede the supply chain sustainability.

6.3 Limitations and future scope of study

We have seen that this study has several theoretical and practical implications. Still this study is not free from all limitations. This study is cross sectional causing impediment to verify the causality between the constructs creating endogeneity problems. By longitudinal studies with appropriate econometric analysis, the future researchers may test the causal linkages of the model in a more accurate way. While analyzing the responses, the study has considered inputs of the employees of firms from the four cities of India. This does not represent the generic picture. Future researchers may consider responses of the employees from different parts of the world so that the results can be generalizable. The explanative power of the proposed model is 67%. To improve the strength of the model, the future researchers may consider other boundary conditions to ensure if such consideration may strengthen the model. This study has considered only three capabilities of a firm which are technological, innovative, and relational. Future researchers may extend this model with other supply chain related capabilities of a firm to address any uncertain situation. This study should have considered a rival model (alternative model). This should have helped to compare the rival model with the proposed model and could have helped to substantiate the veracity and effectiveness of the proposed model. But this has not been done in the present study. Future researchers may deal with this issue to enhance the quality of this study. Despite of all such limitations, this study is construed to help the managers and practitioners to realize how a firm can sustain its supply chain reliance even in any turbulent environment.

Appendix 1 Summary of Questionnaire

Items	Source	Statements	Response [SD][D][N][A][SA]
TC1	Teece et al. 1997; Li et al. 2009; Sungbae and Taesoo 2016; Panahifar et al. 2018; Errassafi et al. 2019; Mofokeng and Chinomona 2019	I believe that our firm has made adequate investment on improving its technology competency to deal with any turbulent situation	[1][2][3][4][5]
TC2		I believe that firm's technology capability helps in developing supply chain strategy	[1][2][3][4][5]
TC3		I believe that technology plays an important role for supply chain management system in the firm	[1][2][3][4][5]
TC4		I believe that applications of modern technology can sustain firms' supply chain operations during turbulent situation	[1][2][3][4][5]
IC1	Smart et al. 2017; Aigbogun et al. 2018; Desjardine et al. 2019; van Hoek 2019; Sarkis 2020; Kumar et al. 2020; Chatterjee et al. 2020a	I believe that innovative capability of firms helps in developing appropriate supply chain strategy	[1][2][3][4][5]
IC2		I think that Innovation is an important capability for any firm	[1][2][3][4][5]
IC3		I believe that during turbulent environment, firms' innovative capability helps in sustaining firms' supply chain operations	[1][2][3][4][5]
IC4		I believe our firm has better innovative capability in supply chain management process to deal with any turbulent situation	[1][2][3][4][5]
IC5		I believe that firms should invest adequately to improve their innovation capability	[1][2][3][4][5]
RC1	Kale et al. 2000; Paulraj et al. 2008; Wittmann et al. 2009; Zacharia et al. 2011; Wu et al. 2014; Park 2015	I believe that relationship management capability should be an integral part of firms' supply chain strategy	[1][2][3][4][5]
RC2		I believe that the firms which have better relationship management capability will do better during any turbulent situation	[1][2][3][4][5]
RC3		I believe all the firms should invest on improving their relationship management capability	[1][2][3][4][5]
RC4		I believe that technology plays an important role towards improving relationship management capability	[1][2][3][4][5]
RC5		I believe that our firm has a better relationship management capability	[1][2][3][4][5]
CP1	Fiedler 1999; Fredericks 2005; Pratono 2016; Pratono 2016; Salam et al. 2017	I believe that all the firms should possess appropriate contingency plan	[1][2][3][4][5]
CP2		I believe that contingency plan should be an integral part of supply chain strategy	[1][2][3][4][5]
CP3		I believe that during any turbulent environment, contingency plan helps in sustenance of firms' supply chain management process	[1][2][3][4][5]
CP4		I believe that firms should invest their resources to formulate robust contingency plan	[1][2][3][4][5]
CP5		I believe that our firm has a robust contingency plan	[1][2][3][4][5]
LS1	Venkatraman 1989; Fiedler 1993; Donate and Guadamillas 2011; Smart et al. 2017; Zhang et al. 2018; Le and Lei 2018	Our leadership team provides adequate support whenever needed	[1][2][3][4][5]
LS2		I believe that leadership support is essential to formulate a robust supply chain strategy	[1][2][3][4][5]
LS3		I believe that leadership support is essential to address any turbulent environment	[1][2][3][4][5]
LS4		I believe leadership team plays a vital role in decision making during any turbulent situation	[1][2][3][4][5]
LS5		I believe that we have an experienced leadership team to deal with any turbulent environment	[1][2][3][4][5]
SS1	Bowersox et al. 2002; Ketchen and Hult 2007; Schlittgen et al. 2016; Darnall et al. 2019	I believe that supply chain strategy should be an integral part of corporate strategy of the firm	[1][2][3][4][5]
SS2		I believe a robust supply chain strategy makes a difference to the firm when it experiences any crisis	[1][2][3][4][5]
SS3		I believe expert team should develop supply chain strategy	[1][2][3][4][5]
SS4		I believe technology plays essential role while developing the firm's supply chain strategy	[1][2][3][4][5]
SS5		I believe that our firm has a robust supply chain strategy	[1][2][3][4][5]
ST1	Chopra and Meindl 2013; Gupta and Piero 2013; Montabon et al. 2016; Ringle and Sarstedt 2016; Smart et al. 2017	It is essential to have supply chain sustenance during any turbulent situation	[1][2][3][4][5]
ST2		I believe that our firm can operate efficiently during any turbulent situation	[1][2][3][4][5]
ST3		I believe that organizations which have better trained human resources will be able to handle supply chain management system more efficiently	[1][2][3][4][5]
ST4		I believe that our organization has made adequate investment to remain sustainable during any turbulent situation	[1][2][3][4][5]
ST5		I believe that flexible government regulation plays vital role for achieving better sustainability during any crisis	[1][2][3][4][5]

SD Strongly Disagree, *D* Disagree *N* Neither agree nor disagree, *A* Agree, *SA* Strongly Agree

References

Aigbogun O, Ghazali Z, Razali R (2018) Collaborative Regulation and Supply Chain Resilience: A Conceptual Paper. SHS Web of Conference 56:05002. https://doi.org/10.1051/shsconf/20185605002

Altay N, Gunasekaran A, Dubey R, Childe SJ (2018) Agility and resilience as antecedents of supply chain performance under moderating effects of organizational culture within the humanitarian setting: a dynamic capability view. Product Plan Control 29(14):1158–1174. https://doi.org/10.1080/09537287.2018.1542174

Aslam H, Blome C, Roscoe S, Azhar TM (2018) Dynamic supply chain capabilities: How market sensing, supply chain agility and adaptability affect supply chain ambidexterity. Int J Oper Prod Manag 38(12):2266–2285. https://doi.org/10.1108/IJOPM-09-2017-0555

Basiouni A, Hafizi A, Akhtar N, Alojairi A (2019) Assessing Canadian Business IT Capabilities for Online Selling Adoption: A Net-Enabled Business Innovation Cycle (NEBIC) Perspective. Sustainability 11(13):3662. https://doi.org/10.3390/su11133662

Bowersox DJ, Closs DJ, Cooper MB (2002) Supply Chain Logistics Management; McGraw Hill: Irwin, NY, USA

Butt AS (2021) Strategies to mitigate the impact of COVID-19 on supply chain disruptions: a multiple case analysis of buyers and distributors. Intern J Logis Manag in Press. https://doi.org/10.1108/IJLM-11-2020-0455

Carpenter S (2018) Ten Steps in Scale Development and Reporting: A Guide for Researchers. Commun Methods Meas 12(1):25–44. https://doi.org/10.1080/19312458.2017.1396583

Chakravarty A, Grewal R, Sambamurthy V (2013) Information technology competencies, organizational agility, and firm performance: Enabling and facilitating roles. Inf Syst Res 24(4):976–997. https://doi.org/10.1287/isre.2013.0500

Chatterjee S (2020) AI strategy of India: policy framework, adoption challenges and actions for government. Transform Govern People Proc Policy 14(5):757–775. https://doi.org/10.1108/TG-05-2019-0031

Chatterjee S, Chaudhuri R, Vrontis A (2020a) Article title: Does data-driven culture impact innovation and performance of a firm? Annal Operation Res, In Press, An empirical examination. https://doi.org/10.1007/s10479-020-03887-z

Chatterjee S, Chaudhuri R, Vrontis D, Thrassou A, Ghosh S (2020b) ICT-enabled CRM System Adoption: A Dual Indian Qualitative Case Study and Conceptual Framework Development. J Asia Bus Stud in Press. https://doi.org/10.1108/JABS-05-2020-0198

Chopra S, Meindl P (2013) Supply Chain Management, 5th edn. Pearson, Chandler, AZ

Christopher M, Peck H (2004) Building the Resilient Supply Chain. Intern J Logist Manag 15(2):1–14. https://doi.org/10.1108/09574090410700275

Darnall N, Welch EW, Cho S (2019) Sustainable supply chains and regulatory policy. Handbook on the Sustainable Supply Chain. Edward Elgar, Publisher

Deb M, David EL (2014) An empirical examination of customers' adoption of m-banking in India. Journal of Marketing Intelligence & Planning 32(4):475–494. https://doi.org/10.1108/MIP-07-2013-0119

DesJardine M, Bansal P, Yang Y (2019) Bouncing back: building resilience through social and environmental practices in the context of the 2008 global financial crisis. J Manag 45(4):1434–1460. https://doi.org/10.1177/0149206317708854

Donate MJ, and Guadamillas F (2011) Organizational factors to support knowledge management and innovation. J Know Manag 15(6): 890–914. https://doi.org/10.1108/13673271111179271

Duupdates Report (2020) Top MNC companies in India. https://www.duupdates.in/top-mnc-companies-in-india/ (Accessed on 11 October 2020)

Eckstein D, Goellner M, Blome C, Henke M (2015) The performance impact of supply chain agility and supply chain adaptability: the moderating effect of product complexity. Int J Prod Res 53(10):3028–3046. https://doi.org/10.1080/00207543.2014.970707

Errassafi M, Abbar H, Benabbou Z (2019) The mediating effect of internal integration on the relationship between supply chain integration and operational performance: Evidence from Moroccan manufacturing companies. J Indust Engin Manag 12(2):254–273. https://doi.org/10.3926/jiem.2794

Felix A, Lamar P (2018) The behavioral and evolutionary roots of dynamic capabilities. Ind Corp Chang 27(2):413–424. https://doi.org/10.1093/icc/dtx050

Fiedler FE (1993) The contingency model: New directions for leadership utilization. In Matteson and Ivancevich (Eds.), Manag Organ Behav Class 333–345

Fiedler K (1999) Understanding conjunction effects in probability judgments: the role of implicit mental models. Eur J So Psychol 29(1):75-93. https://doi.org/10.1002/(SICI)1099-0992(199902)29:1<75::AID-EJSP916>3.0.CO;2-F

Fisher ML (1997) What is the right supply chain for your product? Harv Bus Rev 75:105–117

Fornell C, Larcker DF (1981) Evaluating structural equation models with unobservable variables and measurement error. J Mark Res 18(1):39–50. https://doi.org/10.1177/002224378101800104

Fredericks E (2005) Infusing flexibility into business-to-business firms: A contingency theory and resource-based view perspective and practical implications. Ind Mark Manage 34(6):555–565. https://doi.org/10.1016/j.indmarman.2004.09.022

Free C, Hecimovic A (2021) Global supply chains after COVID-19: the end of the road for neoliberal globalisation? Account Audit Accountabil J 34(1):58–84. https://doi.org/10.1108/AAAJ-06-2020-4634

Geisser S (1975) The predictive sample reuse method with applications. J Am Stat Assoc 70(350):320–328. https://doi.org/10.2307/2285815

Gregory L, Jon P (2011) A managerial perspective of dynamic capabilities in emerging markets: The case of the Russian steel industry. J East Euro Manag Stud 16(3):215–236. https://doi.org/10.2307/23281688

Gupta M, Piero T (2013) Environmental management is good business. Industrial Management 45(1):14–19

Hair JF, Ringle CM, Sarstedt M (2011) PLS-SEM: Indeed a silver bullet. J Marke Theory Practice 19(2):139–152. https://doi.org/10.2753/MTP1069-6679190202

Hair Jr JF, Hult GTM, Ringle C, Sarstedt M (2016) A primer on partial least squares structural equation modeling (PLS-SEM): Sage Publications

Hair JF, Ringle CM, Sarstedt M (2013) Partial least squares structural equation modeling: rigorous applications, better results and higher acceptance. Long Range Plan 46(1/2): 1–12. https://ssrn.com/abstract=223379

Hallinger P (2020) Analyzing the intellectual structure of the Knowledge base on managing for sustainability, 1982–2019: a meta-analysis. Sustain Dev 28(5):1493–1506. https://doi.org/10.1002/sd.2071

Handfield RB, Graham G, Burns L (2020) Corona virus, tariffs, trade wars and supply chain evolutionary design. Int J Oper Prod Manag 40(10):1649–1660. https://doi.org/10.1108/IJOPM-03-2020-0171

Henseler J (2010) On the convergence of the partial least squares path modelling algorithm. Comput Statistics 25(1):107–120. https://doi.org/10.1007/s00180-009-0164-x

Henseler J, Ringle CM, Sinkovics RR (2009) The use of partial least squares path modelling in international marketing. Adv Int Mark 20:277–319. https://doi.org/10.1108/S1474-7979(2009)0000020014

Henseler J, Dijkstra TK, Sarstedt M, Ringle CM, Diamantopoulos A, Straub DW, Calantone RJ (2014) Common beliefs and reality about PLS: Comments on Rönkkö and Evermann. Organ Res Methods 17(2):182–209. https://doi.org/10.1177/1094428114526928

Hulland J (1999) Use of partial least squares (PLS) in strategic management research: a review of four recent studies. Strategic Manag 20(2): 195–204. https://doi.org/10.1002/(SICI)1097-0266(200003)21:33.3.CO;2-P

Hu L-t, Bentler PM (1998) Fit indices in covariance structure modeling: Sensitivity to under parameterized model misspecification. Psychol Methods 3(4):424–453. https://doi.org/10.1037/1082-989X.3.4.424

Hult GTM, Ketchen DJ, Slater SF (2004) Information processing, knowledge development, and strategic supply chain performance. Acad Manag 47:241–253. https://doi.org/10.5465/20159575

Hult GTM, Ketchen DJ, Arrfelt M (2007) Strategic supply chain management: Improving performance through a culture of competitiveness and knowledge development. Strategegic Manag 28(10):1035–1052. https://doi.org/10.1002/smj.627

Kalaitzi D, Matopoulos A, Bourlakis M, Tate WL (2017) Supply chain strategies in an era of natural resource scarcity. Int J Oper Prod Manag 38(3):784–809. https://doi.org/10.1108/IJOPM-05-2017-0309

Kale P, Singh H, Perlmutter H (2000) Learning and protection of proprietary assets in strategic alliances: Building relational capital. Strategic Manag 21(3):217–237. https://doi.org/10.1002/(SICI)1097-0266(200003)21:33.3.CO;2-P

Ketchen DJ, Hult GTM (2007) Bridging organization theory and supply chain management: The case of best value supply chains. J Oper Manag 25(2):573–580. https://doi.org/10.1016/j.jom.2006.05.010

Kim SW, Park K (2017) Effects of Supply Chain Management Practices, Integration and Competition Capability on Performance. Supply Chain Manag 11(3):241–248. https://doi.org/10.1108/13598540610662149

Kock N (2019) From composites to factors: Bridging the gap between PLS and covariance based structural equation modelling. Inf Syst J 29(3):674–706. https://doi.org/10.1111/isj.12228

Kock N, Hadaya P (2018) Minimum sample size estimation in PLS-SEM: The inverse square root and gamma-exponential methods. Inf Syst J 28(1):227–261. https://doi.org/10.1111/isj.12131

Kumar A, Kushwaha GS (2018) Supply chain management practices and operational performance of fair price shops in India: An empirical study. Scientif J Logist 14(1): 85–99. https://doi.org/10.17270/J.LOG.2018.237

Kumar A, Sharma K, Singh H, Naugriya SG, Gill SS, Buyya R (2020) A drone-based networked system and methods for combating coronavirus disease (COVID-19) pandemic. Futur Gener Comput Syst 115:1–19. https://doi.org/10.1016/j.future.2020.08.046

Larue B (2020) Labour Issues and COVID-19. Can J Agric Econ 68(2):231–237. https://doi.org/10.1111/cjag.12233

Le PB, Lei H (2018) The mediating role of trust in stimulating the relationship between transformational leadership and knowledge sharing processes. J Knowl Manag 22(3):521–537. https://doi.org/10.1108/JKM-10-2016-0463

Lee HL (2004) The triple-A supply chain. Harv Bus Rev 82(10):102–113

Lei H, Phouvong S, Le PB (2018) How to foster innovative culture and capable champions for Chinese firms: an empirical research. Chin Manag Stud 13(1):51–69. https://doi.org/10.1108/CMS-05-2018-0502

Li G, Yang H, Sun L, Sohal AS (2009) The impact of IT implementation on supply chain integration and performance. Int J Prod Econ 120(1):125–138. https://doi.org/10.1016/j.ijpe.2008.07.017

Linton JD, Klassen R, Jayaraman V (2007) Sustainable supply chains: An introduction. J Oper Manag 25(6):1075–1082. https://doi.org/10.1016/j.jom.2007.01.012

Manning S, Boons F, Von Hagen O, Reinecke J (2012) National contexts matter: the co-evolution of sustainability standards in global value chains. Ecol Econ 83:197–209. https://doi.org/10.1016/j.ecolecon.2011.08.029

Min S, Zhang X, Li G (2020) A snapshot of food supply chain in Wuhan under the COVID-19 pandemic. China Agric Econ Rev 12(4), 689–704. https://doi.org/10.1108/CAER-04-2020-0056

Mishra D, Sharma RRK, Kumar S, Dubey R (2016) Bridging and buffering: Strategies for mitigating supply risk and improving supply chain performance. Int J Prod Econ 180:183–197. https://doi.org/10.1016/j.ijpe.2016.08.005

Mofokeng TM, Chinomona R (2019) Supply chain partnership, supply chain collaboration and supply chain integration as the antecedents of supply chain performance. South African J Bus Manag 50(1):1–10. https://doi.org/10.4102/sajbm.v50i1.193

Montabon F, Pagell M, Wu Z (2016) Making sustainability sustainable. J Supply Chain Manag 52(2):11–27. https://doi.org/10.1111/jscm.12103

Nandi S, Sarkis J, Hervani AA, Helms MM (2021) Redesigning supply chains using blockchain-enabled circular economy and COVID-19 experiences. Sustain Product Consump 27:10–22. https://doi.org/10.1016/j.spc.2020.10.019

Nath V, Agrawal R (2020) Agility and lean practices as antecedents of supply chain social sustainability. Int J Oper Prod Manag 40(10):1589–1611. https://doi.org/10.1108/IJOPM-09-2019-0642

Oh S, Moon HC, Zhong Y (2020) Contingency Management and Supply Chain Performance in Korea: A COVID-19 Pandemic Approach. Sustainability 12(23). https://doi.org/10.3390/su12239823

Panahifar F, Byrne PJ, Salam MA, Heavey C (2018) Supply chain collaboration and firm's performance: The critical role of information sharing and trust. J Enterp Inf Manag 31(3):358–379. https://doi.org/10.1108/JEIM-08-2017-0114

Park C (2015) Emergence of Inter-organizational Collaboration Networks: Relational Capability Perspective. J Korean Opera Res Manag Sci Soc 40:1–18. https://doi.org/10.7737/JKORMS.2015.40.4.001

Paulraj A, Lado AA, Chen IJ (2008) Inter-organizational communication as a relational competency: Antecedents and performance outcomes in collaborative buyer–supplier relationships. J Oper Manag 26(1):45–64. https://doi.org/10.1016/j.jom.2007.04.001

Peng DX, Lai F (2012) Using partial least squares in operations management research: A practical guideline and summary of past research. J Oper Manag 30(6):467–480. https://doi.org/10.1016/j.jom.2012.06.002

Peter N (2007) Contingency Theory. Leadership: theory and practice. Thousand Oaks: SAGE Publishing. 74–87

Podsakoff PM, MacKenzie SB, Lee JY, Podsakoff NP (2003) Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies. J Appl Psychol 88(5): 879-903. https://doi.org/10.1037/0021-9010.88.5.879

Pratono AH (2016) Strategic orientation and information technological turbulence: Contingency perspective in SMEs. Bus Process Manag J 22(2):368–382. https://doi.org/10.1108/BPMJ-05-2015-0066

Ringle CM, Sarstedt M (2016) Gain more insight from your PLS-SEM results: The importance-performance map analysis. Ind Manag Data Syst 116(9):1865–1886. https://doi.org/10.1108/IMDS-10-2015-0449

Roh J, Hong P, Min H (2014) Implementation of a responsive supply chain strategy in global complexity: The case of manufacturing firms. Intern J Product Econ 147(B):198–210. https://doi.org/10.1016/j.ijpe.2013.04.013

Rojo A, Stevenson M, Lloréns Montes FJ, Perez-Arostegui MN (2018) Supply chain flexibility in dynamic environments: The enabling role of operational absorptive capacity and organizational

learning. Int J Oper Prod Manag 38(3):636–666. https://doi.org/10.1108/IJOPM-08-2016-0450

Roldan JL, Sanchez-Franco MJ (2012) Variance Based structural equation modeling: Guidelines for using partial least squares in information systems research. in Manuel Mora, O.G. (Ed.), Research Methodologies, Innovations and Philosophies in Software Systems Engineering and Information Systems, IGI Global, Pennsylvania

Saberi S, Kouhizadeh M, Sarkis J, Shen L (2019) Blockchain technology and its relationships to sustainable supply chain management. Int J Prod Res 57(7):2117–2135. https://doi.org/10.1080/00207543.2018.1533261

Salam MA, Seny Kan KA (2017) Analyzing Supply Chain Uncertainty to Deliver Sustainable Operational Performance: Symmetrical and Asymmetrical Modeling Approaches. Sustainability 9(12). https://doi.org/10.3390/su9122217

Sarkis J (2020) Supply chain sustainability: learning from the COVID-19 pandemic. Int J Oper Prod Manag 41(1):63–73. https://doi.org/10.1108/IJOPM-08-2020-0568

Sarkis J (2021) Supply chain sustainability: learning from the COVID-19 pandemic. Int J Oper Prod Manag 41(1):63–73. https://doi.org/10.1108/IJOPM-08-2020-0568

Sarstedt M, Ringle CM, Henseler J, Hair JF (2014) On the emancipation of PLSSEM: A commentary on Rigdon. Long Range Plan 47(3):154–160. https://doi.org/10.1016/j.lrp.2014.02.007

Saura JR, Palos-Sanchez P, Blanco-González A (2019) The importance of information service offerings of collaborative CRMs on decision-making in B2B marketing. J Bus Indust Market 35(3):470–482. https://doi.org/10.1108/JBIM-12-2018-0412

Schilke O (2014) Second-order dynamic capabilities: How do they matter? Acad Manag Perspect 28(4):368–380. https://doi.org/10.5465/amp.2013.0093

Schlittgen R, Ringle CM, Sarstedt M, Becker J-M (2016) Segmentation of PLS Path Models by Iterative Reweighted Regressions. J Bus Res 69(10):4583–4592. https://doi.org/10.1016/j.jbusres.2016.04.009

Sharma R, Shishodia A, Kambl S, Gunasekaran A, Belhadi A (2020) Agriculture supply chain risks and COVID-19: Mitigation strategies and implications for the practitioners. Intern J Logist Res App In Press. https://doi.org/10.1080/13675567.2020.1830049.

Smart P, Hemel S, Lettice F, Adams R, Evans S (2017) Pre-paradigmatic status of industrial sustainability: a systematic review. Int J Oper Prod Manag 37(10):1425–1450. https://doi.org/10.1108/IJOPM-02-2016-0058

Stone M (1974) Cross validatory choice and assessment of statistical predictions. J Roy Stat Soc 36(2):111–147. https://doi.org/10.1111/j.2517-6161.1974.tb00994.x

Sungbae K, Taesoo M (2016) Supply chain integration and collaboration for improving supply chain performance: A dynamic capability theory perspective. In Proceedings of the 49th Hawaii International Conference on System Sciences (HICSS), Koloa, HI, USA 5–8. 307–316

Teece DJ (2014) A dynamic capabilities-based entrepreneurial theory of multinational enterprise. J Int Bus Stud 45(1):8–37. https://doi.org/10.1057/jibs.2013.54

Teece D, Pisano G, Shuen A (1997) Dynamic Capabilities and Strategic Management. Strateg Manag J 18(7):509–533

Tokman M, Davis LM, Lemon KN (2007) The WOW factor: Creating value through win-back offers to reacquire lost customers. J Retail 83(1), 47–64. https://doi.org/10.1016/j.jretai.2006.10.005

van Hoek R (2019) Exploring blockchain implementation in the supply chain. Intern J Opera Product Manag 39(6/7/8):829–859. https://doi.org/10.1108/IJOPM-01-2019-0022

Venkatraman N (1989) The concept of fit in strategy research: Toward verbal and statistical correspondence. Acad Manag Rev 14(3): 423-444. https://doi.org/10.2307/258177

Walker H, Seuring S, Sarkis J, Klassen R (2014) Sustainable operations management: recent trends and future directions. Intern J Operat Product Manag 34(5). https://doi.org/10.1108/IJOPM-12-2013-0557

Wamba SF, Dubey R, Gunasekaran A, Akter S (2020) The performance effects of big data analytics and supply chain ambidexterity: The moderating effect of environmental dynamism. Intern J Product Econ 222(4):107498. https://doi.org/10.1016/j.ijpe.2019.09.019

Wieland A, Wallenburg CM (2012) Dealing with supply chain risks: Linking risk management practices and strategies to performance. Int J Phys Distrib Logist Manag 42(10):887–905. https://doi.org/10.1108/09600031211281411

Wittmann CM, Hunt SD, Arnett DB (2009) Explaining alliance success: Competences, resources, relational factors, and resource-advantage theory. Ind Mark Manage 38(7):743–756. https://doi.org/10.1016/j.indmarman.2008.02.007

Wu L, Chuang CH, Hsu CH (2014) Information sharing and collaborative behaviors in enabling supply chain performance: A social exchange perspective. Int J Prod Econ 148:122–132. https://doi.org/10.1016/j.ijpe.2013.09.016

Zacharia ZG, Nix NW, Lusch RF (2011) Capabilities that enhance outcomes of an episodic supply chain collaboration. J Oper Manag 29(6):591–603. https://doi.org/10.1016/j.jom.2011.02.001

Zhang M, Zhao X, Lyles M (2018) Effects of absorptive capacity, trust and information systems on product innovation. Int J Oper Prod Manag 38(2):493–512. https://doi.org/10.1108/IJOPM-11-2015-0687

Zhu YQ, Kindarto A (2016) A garbage can model of government IT project failures in developing countries: The effects of leadership, decision structure and team competence. Gov Inf Q 33(4):629–637. https://doi.org/10.1016/j.giq.2016.08.002

Zhu Q, Sarkis J (2006) An inter-sectoral comparison of green supply chain management in China: Drivers and practices. J Clean Prod 14(5): 472–486.https://doi.org/10.1016/j.jclepro.2005.01.003

Zimon D, Madzík P (2019) Standardized management systems and risk management in the supply chain. Int J Qual Reliab Manag 37(2):305–327. https://doi.org/10.1108/IJQRM-04-2019-0121

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.