

# Did COVID-19 change the rules of the game for supply chain resilience? The effects of learning culture and supplier trust

Effects of  
learning  
culture and  
supplier trust

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## Abstract

**Purpose** – This paper aims to clarify the effects of learning culture and trust on supply chain resilience (SCR) and to investigate their role specifically during COVID-19 pandemic to aid decision-makers. For this, a conceptual model proposing relations between variables was developed. The focal point of this research is to investigate the relationship between organizational learning culture (OLC) and SCR, and the mediating effect of supplier trust (ST) in the relationship before and during a pandemic.

**Design/methodology/approach** – This study relies on a unique dataset collected through two separate cross-sectional surveys corresponding to pre- and during-pandemic times that were conducted at the same time. The questionnaire was collected from 245 medium- to senior-level managers, to ensure a thorough understanding about the company's inner workings and supply chain (SC). To test the proposed research model, the authors processed their data and model using lavaan package in R.

**Findings** – The findings show that OLC and ST have positive and significant effects on SCR. Furthermore, learning culture also triggers ST. Thus, it is ST that explained, as a mediator, the positive effects of OLC on SCR. All these findings are similar for both before and after the pandemic. A critical finding is about the effect of size (small vs. large) and ownership (local vs. multinational). The analysis suggests that during pandemic multinational companies and larger organizations exhibit higher SCR than their counterparts.

**Research limitations/implications** – First, responses to the questionnaire were collected from only one country. Cross-cultural comparisons can be made by collecting data from different countries in future research. Second, the data were obtained from companies operating in different sectors, with a majority in manufacturing. It is possible to obtain more specific findings by analyzing responses from a specific industry. Third, results of this study reflect responses of only SC and manufacturing managers, but other departments such as marketing or finance can also complement the findings. Finally, several other organizational variables may be factored in as moderators to enrich the conceptual model.

**Practical implications** – The authors believe that findings of this research will guide shareholders and managers to develop effective strategies in order to prevent SC disruptions during similar risk/shock scenarios.

**Originality/value** – Similar to earlier research, this study considers the importance of ST on SCR. But this study differs in analyzing the effects of OLC on SCR directly and in taking the mediating effect of ST into account. The authors test the strengths of these relationships individually before and during COVID-19 pandemic. Under pandemic conditions, the authors present empirical evidence on the effects of organizational learning and ST on SCR. In contrast to previous research on SCR, this study connotes the importance of an organization's internal dynamic capabilities in developing resilience.

**Keywords** Supply chain resilience, COVID-19, Learning culture, Trust, Structural equation modeling, SEM

**Paper type** Research paper



## 1. Introduction

Today's dynamic and globalized business ecosystem requires organizations to develop flexible and adaptive managements to be able to respond and handle risks (Iqbal and Ahmad, 2020) that can affect the operational performance of organizations (Jüttner and Maklan, 2011). Supply chains (SCs) experience constant problems and unpredictable outages especially during unpredictable outages, such as today's COVID-19 pandemic, which has revealed the necessity of having sustainable and flexible production systems for companies.

Coping with crises requires flexibility and sustainable operations (Cohen, 2020; Kumar *et al.*, 2020; Sarkis *et al.*, 2020). In this study, we construct a theoretical model that emphasizes the critical role of organizational learning culture (OLC) and supplier trust (ST) for supply chain resilience (SCR). We anticipate that OLC will have a positive effect on SCR both pre- and post-pandemic. Additionally, this research assumes that ST acts as a mediator between OLC and SCR in the constructed theoretical model. Additionally, we assume that the strength of these relationships varies between pre- and post-pandemic periods, since OLC and trust across firms might vary during risk periods.

OLC enables organizations to adapt to conditions and circumstances of dynamic ecosystems, and learning helps organizations meet their customer needs and demands rapidly by considering production planning (Santos-Vijande *et al.*, 2012). OLC, within SC, is regarded as one of the essential factors required to sustain performance (Spicer and Smith, 2006).

As stressed in the literature, buyer–seller cooperation strengthens the competitiveness of the SC and is contingent upon their mutual trust (Vlachos and Bourlakis, 2006; Zhang and Huo, 2013). Trust within SCs enables better controls in times of crisis (WeForum, 2022), and enhances SCR through rapid response development, accurate forecasting and better inventory management (Min and Mentzer, 2004).

Thus, the study investigates how SCR can be increased by examining the concepts of OLC and ST. The main questions of the research are as follows: (1) To explore the effect of OLC and ST on SCR, and (2) To examine the strengths of these relationships for before- and during-COVID-19 pandemic periods. The research model is tested with covariance-based structural equation modeling (SEM). The findings point to the existence of positive effects of OLC and TS on SCR.

The rest of this paper is organized as follows. Section 2 provides an extensive literature review about OLC, ST and SCR. Section 3 presents the theoretical background and the development of the hypotheses. Section 4 and Section 5 give detailed information about the methodology and analysis, respectively. We discuss the analysis results in Section 6. The last section provides concluding remarks and future research directions.

## 2. Literature review, theoretical background and hypotheses development

Ali and Gölgeci (2019) argued that there is still need for empirical research on various subjects considering SCR. While SCR has been well identified in the literature, there is currently a paucity of robust theoretical understanding about the concept in relation to ST and OLC. Our focal point is to investigate the relationship between OLC and SCR, and the mediating effect of ST before and during the pandemic.

In this study, we apply the dynamic capabilities framework, similar to prior studies (e.g. Modgil *et al.*, 2021; Polater, 2021; Yu *et al.*, 2019; Mwangola, 2018). Dynamic capabilities are considered as higher-order capabilities that affect the development of operational capabilities (Winter, 2003) and competitive advantage (Teece and Pisano, 1994). Accordingly, this study regards both OLC and ST as dynamic capabilities that build up SCR as an organizational competitive advantage. Using dynamic capabilities, organizations can increase performance (Laaksonen and Peltoniemi, 2018). In this regard, we contend that to

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ensure resilience within the SC, organizations need to adapt OLC and ST, which include dynamic routines that may change over time. As resilience can be considered as a concept of being able to respond to the changes within the environment, we can explain its antecedents with dynamic capabilities, as OLC and trust, which help the organization to address those changes timely and effectively.

### 2.1 Supply chain resilience (SCR)

In volatile and turbulent environments, organizations need to develop resilient supply networks (Coliccia and Strozzi, 2012). Numerous studies (e.g. Purvis *et al.*, 2016; Dolgui *et al.*, 2018) have shown that SCR has become crucial under such conditions. According to Ali and Gölgeci (2019), SCR has established itself as a major research area within the current SC management studies.

SCR includes meeting objectives during disruption periods and ensuring the required performance after the disruption (Sawyer and Harrison, 2020). While there is a tendency within the literature to regard SCR with respect to the whole chain including most notably the timely delivery of goods to customers (e.g. Ambulkar *et al.*, 2015), this present research takes a viewpoint on supplier relationship management when considering SCR, and so adds ST similar to Dubey *et al.* (2021).

According to Belhadi *et al.* (2021), the literature on the antecedents of SCR have adopted mainly two approaches: proactive and reactive strategies. Proactive strategies are about foreseeing, mitigating or avoiding upcoming disruptions anticipatorily (Hofmann *et al.*, 2019), whereas reactive strategies refer to the real-time actions during or after the disruptions. In this study, we hold the perspective of proactive behavior by deploying OLC and ST as antecedents. This means, that embedding learning as a culture and cultivating trust-based relationships with suppliers would contribute to SCR as a precautionary measure in the face of future uncertainty.

### 2.2 OLC and supply chain resilience (SCR)

Schein (1992) regards organizational culture as, being developed while learning to cope with the problems of internal integration and external adaptation. The external adaptation capability implies resilience and is therefore linked to OLC. OLC is mainly identified as a set of values supporting systematic approaches to achieve higher-level learning through information acquisition, interpretation and the resulting behavioral changes (Skerlavaj *et al.*, 2007).

Organizations with strong OLC are good at acquiring new knowledge and altering their behaviors accordingly (Huber, 1991; Kalyar and Rafi, 2013). In fact, in their study Ali *et al.* (2021a) referred to the importance of knowledge management for SCR with respect to knowledge acquisition, assimilation and application. Our study is quite relatable in this sense as learning also requires knowledge management practices (Ali *et al.*, 2018). The extant literature emphasizes on cultivating an OLC and scrutinizes its effects on organizational change. Many studies also identify environmental alignment as critical for OL (Love and Gunasekaran, 1999). In line with this, Norman (2004) claims that collective learning within the organization contributes to the organization's ability to survive, thus, contributes to its resilience. Therefore, OLC can be regarded as a precondition for developing resilience.

Lengnick-Hall *et al.* (2011) regard resilience as the development of new capabilities and an ability to creating new opportunities. We contend that OLC can help enhance these capabilities and opportunities. Purushothaman (2015) argues that information sharing within organizations improves employees' capabilities and thus facilitates resilience. OLC embodies information sharing. The acquired knowledge can be helpful for organizations to build SCR

(Mubarik *et al.*, 2021). While no study in the extant literature addresses the association between OLC and SCR specifically, two studies (Malik and Garg, 2017; Mousa *et al.*, 2020) state the link between resilience and OLC. The main assumption here is that having learning embedded as a culture throughout the organization helps organizations acquire new information and adapt to the changes and negative events. This study postulates that OLC contributes to collective learning, including mutual learning within the SC. In this study, we contend that OLC as a dynamic capability is critical for SCR, in both pre- and especially during-pandemic periods. Studying OLC both before- and during-pandemic period also can shed light on understanding the difference. During the pandemic, strong OLC can help to learn and disseminate knowledge and adapt to current conditions faster. Amidst raw material shortages and logistics issues OLC can mitigate the negative effects by facilitating timely interventions. Learning can help organizations be open to the environmental signals and act accordingly. Accordingly, our first hypothesis is as follows:

- H1. There is a significant and positive direct relationship between OLC and SCR in the (a) pre-pandemic period and (b) during the pandemic.

### 2.3 OLC and supplier trust (ST)

By definition, ST is regarded as the confidence and commitment of an organization to rely on its suppliers (Zhang and Huo, 2013). It is established when buyers believe in the suppliers' commitments to their promises and their ability to deliver necessary performance (Gao *et al.*, 2005).

While there are studies on associations between OLC and organizational trust within the literature (e.g. Wahda *et al.*, 2020; Mahmud, 2020), OLC has not been related to ST. In this study, we analyze the link between ST and OLC. Extant definitions of learning within an inter-organizational setting (Hamel, 1991; Senge, 1992) can be extended to SC setting, as parties are critical actors within the same organizational environments. At this point, it is highly relevant to refer to "relationship learning", which mainly identifies a mutual activity between an organization and its supplier, where information is shared and integrated into a shared memory (Selnes and Sallis, 2003). Information exchange, a form of inter-organizational relationship, is critical for developing trust (Voss *et al.*, 2019), and trust can be observed in the culture (Savolainen and Lopez-Fresno, 2013). As learning culture encourages acquisition and sharing of information among SC parties, organizations with superior OLC would be expected to establish deeper trust with their SC partners. Being informed on this discussion, this study maintains that OLC adds to ST. In this study, we contend that OLC has an impact on ST, in both pre- and during-pandemic periods. While learning is important for both conditions, higher levels of uncertainty and vulnerability are associated with the pandemic period, and better learning may facilitate the establishment of trust-based relationship. Through acknowledging the supplier facing similar challenges, a learning culture may aid in sharing information. We conduct the analysis for both periods to compare and contrast the importance of learning culture under different settings. We state the second hypothesis as:

- H2. There is a significant and positive direct relationship between OLC and ST in the (a) pre-pandemic period and (b) during the pandemic.

### 2.4 ST and supply chain resilience (SCR)

SCs may face uncertainties stemming from supplier parties (Mason-Jones and Towill, 1998). Supplier relationship management aims at reducing risks and costs of transaction (Li *et al.*, 2007), entails being robust to change, which is entwined with strategic resilience. Trust building activities can help lower risk exposures (Hashim and Tan, 2015), and trust-based business relations increase organizational performance (Tundunaung *et al.*, 2021).

We contend that for an organization to ensure resilience within its SC, continual relations and making sure that correct information is obtained are critical. This idea can be based on the social–ecological perspective of resilience, as suggested by [Wieland and Durach \(2021\)](#), as SC is a complex social–ecological system ([Wieland, 2021](#)). Accordingly, we attempt to emphasize this complexity and suggest a trust-based relationship among the partners as a tool to manage this complexity. An organization within a partnership can gain knowledge from its supplier to improve its competitive advantage ([Richter and Vettel, 1995](#)), which contributes to organizational resilience. [Mandal and Sarathy \(2018\)](#) suggested that SCR is highly dependent on SC partners cooperating to respond to uncertainty. According to [Christopher and Peck \(2004a, b\)](#), SCR can be achieved through high-level collaborations by identifying and managing risks. [Faruquee et al. \(2021\)](#) noted that during SC disruptions the informal safeguards ensured via trust becomes critical. Based on the relevant literature, this study contends that having trust-based supplier relationships facilitates information sharing and can help organizations develop SCR. In this study, we contend that ST as a dynamic capability is critical for SCR, in both pre- and during-pandemic periods. While trust is important under both conditions, pandemic periods entail higher levels of uncertainties. During the pandemic, having established ST can help parties gain consensus, collaborate on solutions and save time. We analyze each period individually to assess the importance of ST under varying stress levels. Therefore, the third hypothesis of this study is as follows:

- H3.* There is a significant and positive direct relationship between ST and SCR in the (a) pre-pandemic period and (b) during the pandemic.

### *2.5 ST as a mediator of OLC and SCR*

According to [Morgan and Hunt \(1994\)](#), establishing trust with suppliers helps develop information exchanges and consequently establishes long-lasting relationships. ST is influential on SC performance ([Panayides and Lun, 2009](#)) and affects suppliers' ability to integrate the SC activities ([Yeung et al., 2009](#)). High levels of trust help foresee partner behavior and better cope with unexpected changes within environment by sharing knowledge among partners ([Liu, 2012](#)). In line with this, the level of cooperation and coordination in a relationship is a critical factor in organizational sources and capabilities ([Naor et al., 2014](#)), enabling SC partners understand and help each other for developing solutions ([Khan and Wisner, 2019](#)). In this regard, ST can be postulated as a mechanism that contributes to the cooperation and leads to organizational capability, that is SCR. Accordingly, the supplier's commitment to service and relationship continuity bolsters the organization's SC performance in adverse conditions. Problems on supply–demand mismatch often raise due to misinformation and fragmentation among SC partners ([Ali et al., 2021b](#)). A good relationship with suppliers based on trust can further contribute to SCR as a result of well-established learning practices. An ingrained OLC can help organization establish a sustainable relationship with its supplier, as it can easily learn from the supplier and adapt accordingly, ensuring both the supplier and the organization can trust one another. To the best of our knowledge, no study has investigated the suggested relationship between OLC and SCR and the explanatory role of ST in this relationship. Sparked by this gap, we suggest the fourth hypothesis of this study as:

- H4.* ST mediates the relationship between OLC and SCR in the (a) pre-pandemic period and (b) during the pandemic.

### *2.6 Ownership and company size as control variables*

In this study, we also contend that ownership of the companies would make a difference on the suggested relationship between OLC and SCR. It is assumed that being a multinational

company would strengthen this relationship, as multinationals would be more used to learning from other cultures which may result in higher levels of resilience. Multinational companies may have accumulated more experience in crisis management, and questionably already have better learning and trust practices established, compared to their domestic counterparts.

On the other hand, smaller businesses can be expected to be agile, adapt and learn more quickly, due to their ability to become more resilient (Polyviou *et al.*, 2020). According to Parker and Ameen (2018), smaller businesses can build the necessary resilience capabilities rather effortlessly. Besides, when adapting OLC, smaller organizations face fewer challenges thanks to their ability to remove bureaucracies (Sadler-Smith *et al.*, 2001). Accordingly, being a smaller company can strengthen the connection between OLC and resilience. Therefore, we include two control variables, ownership type (OT) (domestic or multinational) and company size (CS), moderating the relationship between OLC and SCR. This moderation hypothesis can be considered as one of the key contributions of this study, as there has been no study so far suggesting a difference based on ownership and size of the organization with regard to a relationship between OLC and SCR. Considering the suggested hypotheses (see in Figure 1), this study contributes to the resilience literature by focusing SCR regarding ST and OLC as organizational resources contributing to resilience.

### 3. Methodology

#### 3.1 Sample and data collection

This study relies on a unique dataset collected through two separate cross-sectional surveys conducted simultaneously in Turkey. Data collection took place during October 2020–January 2021 during COVID-19. We develop measurement items and the design following the guidelines presented in prior research (Dillman, 2007), and design the survey to assess the fundamentals of SCR using SCR, ST and OLC as constructs. To assess and ensure the content validity of the survey instrument, we conducted a pre-test with a set of experts in SC field. We then modified the questionnaire accordingly, ensuring the completeness and succinctness. The revised and refined survey was then translated into Turkish. This translated survey was then mailed to a random sample of medium- and large-sized companies.

While our research is on SCR within SCs, our unit of analysis is single key respondents for each firm in their respective SCs. Although using several respondents from each SC might be a better approach, due to practical reasons, the extant literature supports having single key respondents (see Krause *et al.*, 2018). To ensure that the link between key respondents' knowledge, abilities and expertise and the study's constructs was meaningful and aligned,

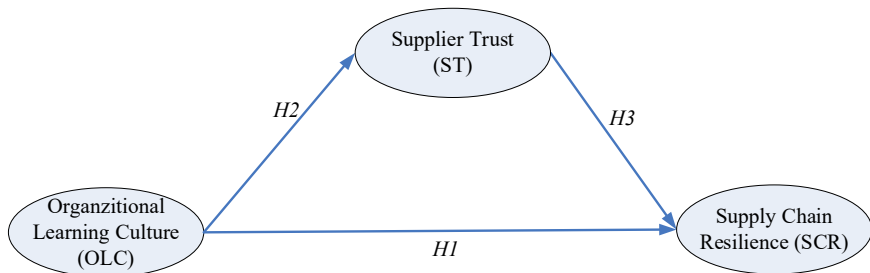


Figure 1.  
Proposed  
research model

**Mediating Hypothesis**  
 $H4 = OLC \rightarrow ST \rightarrow SCR$

we included only SC and manufacturing managers in our sample. These respondents are among the most well-informed about their respective SCs within their institutions.

We also restricted the respondents to medium- to senior-level managers to ensure a thorough understanding about the company's inner workings and its external relationships within their SCs. [Armstrong and Overton \(1977\)](#) suggest measuring a potential non-response bias by comparing the results of the early and late respondents. In our case, out of 402 pairs of surveys initially sent, a total of 245 pre- and during-COVID-19 response pairs were found useable, representing an effective response rate of 61%. For the dataset, we tested for non-response bias after marking the respondents who filled out the survey immediately after receiving the survey invitation as "early" and marking those who filled out after receiving our final reminder as "late". We then conducted a *t*-test between the randomly selected respondents and the late respondents which revealed no significant difference between the early and the late respondent groups ( $p < 0.05$ ) for each of the variables in our constructs, indicating no evidence for non-response bias. We provide a brief summary of our survey sample in [Table 1](#).

### 3.2 Measurement of variables

Our study consists of three main constructs ([Figure 1](#)). The two identical surveys corresponding to before the pandemic period and during included three main constructs that are measured through 7-point Likert scales, and two control variables (CS and OT). For all three constructs, the scale ranged from 1 ("strongly disagree") to 7 ("strongly agree").

*OLC*: Developed by [Yang \(2003\)](#), this scale is the shorter version of the one used by [Marsick and Watkins \(2003\)](#) and is widely used. The scale is also well-established within the relevant literature on OLC (e.g. [Egan et al., 2004](#); [Joo, 2010](#); [Eldor and Harpaz, 2016](#)).

*ST*: We adapted the items comprising ST from [Coote et al. \(2003\)](#). The scale has largely been applied in the context of industrial relationships in the extant literature (e.g. [Seppänen et al., 2007](#); [Leonidou et al., 2008](#); [Rezaei et al., 2015](#)).

*SCR*: We use the 7 items scale developed by [Brandon-Jones et al. \(2014\)](#). In SC resilience related research, this relatively new scale has been commonly used (e.g. [KamalAhmadi and Parast, 2016](#); [Gunasekaran et al., 2017](#); [Dubey et al., 2021](#)).

Variable	Categories	Frequency	Percent
Ownership	Foreign	59	24.08
	Domestic	186	75.92
Size	0–249	110	44.9
	250-more	135	55.1
Position	Quality control officer	12	4.90
	Planning officer	28	11.43
	Purchasing manager	81	33.06
	Supply chain supervisor	39	15.92
	Production manager	32	13.06
	Senior management	16	6.53
	Other	37	15.10
Sector	Food/Agriculture	30	12.24
	Service	55	22.45
	Metal	42	17.14
	Automotive	21	8.57
	Textile	16	6.53
	Other production	81	33.06
	<i>Total</i>		<i>245</i>

**Table 1.**  
Sample summary

*COVID-19 pandemic:* The COVID-19 crisis has affected both the internal and the external relations of companies. We, therefore, create two models corresponding to the COVID-19 pandemic. We test the significance of all hypotheses in the theoretical model for both before and during pandemic periods.

In the current study, to provide alternative explanations for the associations suggested in the model, we use two control variables: OT and CS.

*Ownership type (OT) (Control variable):* Ownership type points to whether the company is a local or a multinational one. The sample consists of Turkish companies and subsidiaries of multinational corporations (MNC) located in Turkey. A categorical variable where 0 corresponds to domestic and 1 corresponds to multinational company is used.

*Company size (CS) (Control variable):* We measured firm size using the total employee count. The employee count was collected using five categories in ordinal form, then converted into two categories using equi-width binning as shown in Table 1. Accordingly, companies with 250 and more employees are labeled as large and small otherwise.

#### 4. Data analysis and results

To test our proposed research model (Figure 1), we processed our data and model using lavaan package in R. We first conducted a confirmatory factor analysis (CFA) to verify the reflective constructs. Following that, we conducted reliability tests on each of the constructs. We then checked convergent and discriminant validity for data validation. Validity was determined using SEM (Byrne, 2010), which determined whether the model fit our dataset while taking our moderators into account.

We checked for the highly collinear items and low factor loadings (Anderson and Gerbing, 1988). Our result did not necessitate the elimination of any items from our constructs due to high collinearity problems and low factor loadings. Our results in Table 2 exhibit a good fit and presents the CFA results with satisfactory fit indices within commonly accepted parameters. The value of  $\chi^2/df$  is expected to be within 0–5 range, with lower values denoting a stronger fit. In addition, the values of comparative fit index (CFI) and Tucker–Lewis index (TLI) are all acceptable (all near 1.0) (Janssens et al., 2008). Likewise, the adjusted goodness-of-fit index (AGFI) index is between 0.80 and 0.90 exhibiting an acceptable level of fit. The root mean square error of approximation (RMSEA) also shows an excellent fit. In addition, all items are significantly associated with their related constructs where their standardized loadings are greater than 0.60 ( $p < 0.01$ ).

##### 4.1 Reliability and validity

We computed the Cronbach’s alpha values for each of the constructs. The Cronbach’s alpha values of reliability for OLC, ST and SRC constructs were computed as 0.90, 0.91 and 0.88 before pandemic, respectively (0.90, 0.93 and 0.90 during pandemic). This indicated satisfactory construct reliabilities (Table 3). It also shows the reliability and validity of the OLC, ST and SCR constructs along with Cronbach’s alpha values. All of the underlying dimensions of these constructs has high scores for the composite reliability scores well over

**Table 2.**  
Individual model fit results

Dataset	Control V.	$\chi^2$	df	$\chi^2/df$	GFI	AGFI	CFI	TLI	RMSEA
Before	–	271.83	101	2.69	0.856	0.836	0.937	0.93	0.078
During		199.4	101	1.97	0.906	0.874	0.966	0.96	0.063
Before	International	304.89	116	2.62	0.865	0.822	0.931	0.919	0.082
During		242.47	116	2.09	0.89	0.855	0.957	0.949	0.066
Before	Large	308.72	116	2.661	0.862	0.818	0.929	0.917	0.080
During		226.96	116	1.956	0.894	0.86	0.962	0.955	0.062

Construct	Items	Before pandemic period			During pandemic period				
		Model SRW <sup>a</sup>	AVE <sup>b</sup>	CR <sup>c</sup>	Cronbach's alpha	Model SRW <sup>a</sup>	AVE <sup>b</sup>	CR <sup>c</sup>	Cronbach's alpha
<i>OLC (Coote et al., 2003)</i>	<i>OLC</i>		0.57	0.90	0.90		0.57	0.90	0.90
My organization makes its lessons learned available to all employees	OLC1	0.67				0.63			
My organization recognizes people for taking initiative	OLC2	0.66				0.66			
My organization works together with the outside community to meet mutual needs	OLC3	0.66				0.67			
In my organization, leaders continually look for opportunities to learn	OLC4	0.84				0.84			
In my organization, people are rewarded for learning	OLC5	0.72				0.76			
In my organization, people spend time building trust with each other	OLC6	0.82				0.79			
In my organization, teams/groups revise their thinking as a result of group discussions or information collected	OLC7	0.85				0.89			
<i>ST (Yang, 2003)</i>	<i>ST</i>		0.69	0.91	0.91		0.68	0.93	0.93
To what extent do the following statements describe the trust you have in this supplier									

**Table 3.** Assessment of measurement model for before- and during-pandemic periods  
(continued)

Construct	Items	Before pandemic period			During pandemic period				
		Model SRW <sup>a</sup>	AVE <sup>b</sup>	CR <sup>c</sup>	Cronbach's alpha	Model SRW <sup>a</sup>	AVE <sup>b</sup>	CR <sup>c</sup>	Cronbach's alpha
(a) This supplier is honest and truthful	ST1	0.81				0.86			
(b) Promises made by this supplier are reliable	ST2	0.85				0.87			
(c) This supplier is open in dealing with me	ST3	0.65				0.73			
(d) I have great confidence in this supplier	ST4	0.90				0.88			
(e) This supplier has a high degree of integrity	ST5	0.89				0.91			
<i>SCR</i> <i>(Brandon-Jones et al., 2014)</i>	<i>SCR</i>		0.66	0.89	0.88		0.67	0.91	0.90
Material flow would be quickly restored	SCR1	0.69				0.75			
It would not take long to recover normal operating performance	SCR2	0.90				0.94			
The SC would easily recover to its original state	SCR3	0.80				0.84			
Disruptions would be dealt with quickly	SCR4	0.84				0.86			
<i>Decentralization</i> <i>(Zahra et al., 2004)</i>	<i>DEC</i>		0.59	0.85	0.85		0.58	0.84	0.84
Our company is open to change	DEC1	0.84				0.82			
Our company encourages employees to challenge the status quo	DEC2	0.64				0.64			
Our company is decentralized in its decision-making	DEC3	0.72				0.74			
Our company maintains open communications channels in its operations	DEC4	0.86				0.83			

**Table 3.** Note(s): <sup>a</sup>Model standardized regression weights are significant at  $p < 0.001$ ; <sup>b</sup>AVE; <sup>c</sup>Composite reliability

the threshold value of 0.70 indicating acceptable construct reliability levels (Bagozzi and Yi, 1988; Fornell and Larcker, 1981). Convergent validity is established when a test of a concept is substantially correlated with other tests measuring theoretically similar concepts. Table 3 also verify the convergent validity of the construct as average variance extracted (AVE) values are higher than a threshold value of 0.50. Furthermore, highly significant standardized regression weights of the individual variables ( $p < 0.01$ ) (Table 3) also indicate the convergent validity (Anderson and Gerbing, 1988). Table 4 exhibits that the square roots of all AVE values (diagonal elements) were greater than their respective values of the correlations between constructs indicating the discriminant validity of the study's constructs (Fornell and Larcker, 1981).

#### 4.2 Common method bias (CMB) and endogeneity

We addressed common method bias (CMB) issue using both Harmon's single factor test and marker variable methods. Following Malhotra *et al.* (2006), we first conducted Harman's single factor test on our aggregate dataset (both before- and during-pandemic) to examine whether a single factor could explain the majority of the variance using CFA. In this single factor test, all items in this study were subjected to CFA (Podsakoff and Organ, 1986; Malhotra *et al.*, 2006). The number of factors extracted from the CFA was forced to one. If there is considerable common variance, the single factor is expected to generate the majority of the covariance among all factors. The results revealed that the common method variance accounted for 0.102. We then followed Lindell and Whitney (2001) and employed an unused construct, "Supplier Collaboration" as a marker variable. We constructed three separate models to address CMB (Cote and Buckley, 1987). These models correspond to (1) the original CF model, (2) Harman single factor with CFA model (the model with a common latent factor that links all the indicators) and (3) Harman single factor CFA with marker, respectively. The comparison of these models revealed that there is no significant difference in terms of model fit and correlations among the constructs.

Before testing the hypotheses, we also considered that it is necessary to check if endogeneity is a serious concern due to reverse causality (Lu *et al.*, 2018) between OLC and ST. Therefore, we conducted a number of tests to determine whether endogeneity is likely to pose a serious threat. We performed a two-stage least squares (2SLS) regression using four instrumental variables using decentralization (DC) construct (Zahra *et al.*, 2004). According to 2SLS, we first regressed OLC on DC variables. All four variables were found to be statistically significant in the first-stage regression. We then used the residuals of this regression as an additional regressor in our hypothesized equations. The parameter estimates for the residual were not found to be significant, indicating that OLC was not endogenous in our setting,

Variables	Definition (pre-pandemic)	OLC	ST	SCR
1	OLC	<i>0.76</i>	0.45*	0.68*
2	ST		<i>0.83</i>	0.66*
3	SCR			<i>0.81</i>
Variables	Definition (during pandemics)	OLC	ST	SCR
1	OLC	<i>0.76</i>	0.44*	0.67*
2	ST		<i>0.82</i>	0.65*
3	SCR			<i>0.82</i>

**Note(s):** <sup>a</sup>Italicized values on the diagonal are the square root of the AVE values \* $p < 0.01$

**Table 4.**  
Discriminant validity table

consistent with our conceptualization. We also conducted the Durbin–Wu–Hausman endogeneity test to determine if the exogenous variables are endogenous. The null hypothesis is that the estimator of the true population parameter is an efficient (and consistent) estimator of the true population parameters. A suitable instrumental variable has a strong correlation with one or more of the explanatory variables but is uncorrelated with the errors. When an endogenous regressor has just a weak relationship with the instrumental variables, its coefficient will be computed inaccurately. We hope for a small  $p$ -value in the diagnostic test for weak instruments. The  $p$ -value was for Wu-Hausman was 0.201.

When there are more instrumental variables than coefficients to estimate in an over-identified regression equation, it is conceivable that the instrumental variables convey contradictory information regarding the coefficient values. The Sargan test is used to address this issue. A small Sargan test  $p$ -value indicates that the model is misspecified. In our case, we obtained a large  $p$ -value of 0.761. Our results are not likely to be influenced by endogeneity, and our instruments are valid. Thus, we concluded that the test results confirm the validity of instruments indicating that our results are unlikely to be influenced by endogeneity.

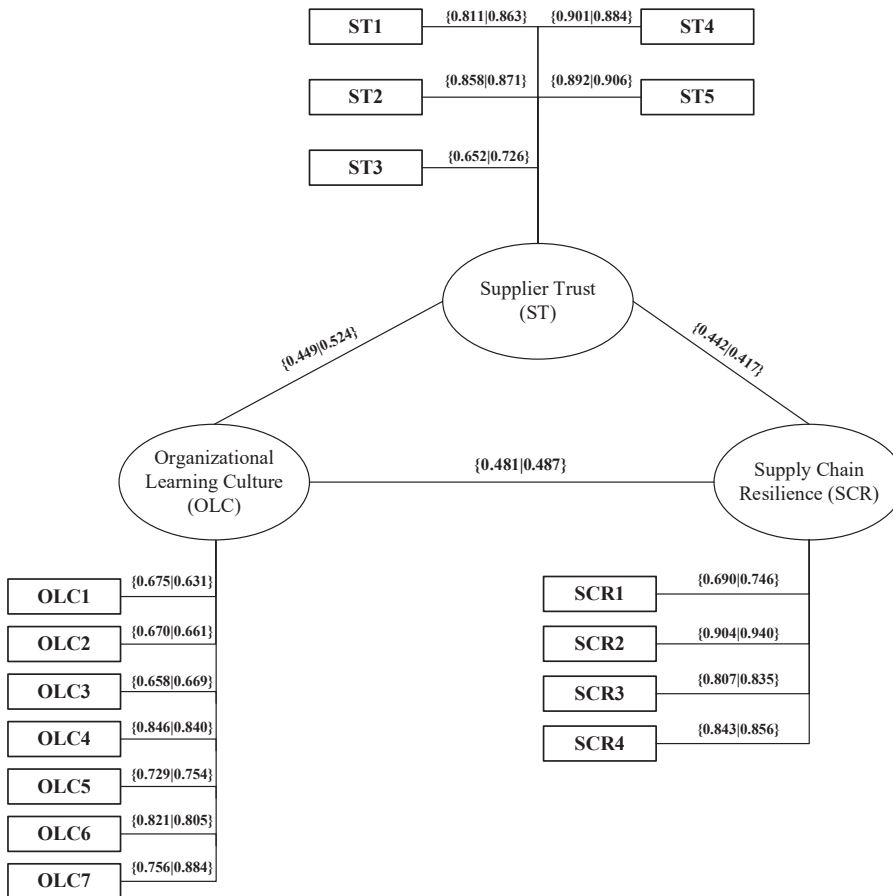
#### 4.3 Hypotheses testing

Our results suggest that both OLC and ST have an impact on SCR. Furthermore, mean scores corresponding to each of the constructs were found to be high, implying the positive attitude toward the meaning of the constructs (Hair *et al.*, 2006). The structural relationships considering the mediating effect of ST explored via maximum likelihood method to calculate the model parameters. Figure 2 shows the results of our hypothesis tests for both before- and during-pandemic models. Along with the three constructs, we included two control variables (CS and OT) in our model for before and during pandemics, resulting in a total of six models. We observed satisfactory model fit scores such as goodness-of-fit index scores [0.856, 0.906], AGFI = [0.818–0.874], TLI = [0.917–0.955], CFI = [0.929–0.966], RMSEA = [0.062–0.080]. These maximum–minimum intervals substantiate that our model implies a good fit to the data.

Our hypothesis testing results are provided in Table 5. We found strong support for our first hypotheses (H1a and H1b) corresponding to the direct link between OLC and SCR ( $\beta = 0.481$  and  $0.487$ , respectively,  $p < 0.01$ ). Similarly, for the hypotheses H2a, H2b, the relationship between OLC and ST was found to be statistically significant indicating that OLC is positively linked to the ST ( $\beta = 0.449$  and  $0.524$  respectively,  $p < 0.01$ ). Hypotheses H3a, H3b, which postulate that ST and SCR are linked, revealed a positive relationship and found to be significant ( $\beta = 0.442$  and  $0.417$  respectively,  $p < 0.01$ ).

The mediation hypotheses, H4a and H4b, posit that the relationship between OLC and SCR is mediated by ST. We follow Hair *et al.* (2014) to examine the indirect effects (via mediator). Sobel test (Baron and Kenny, 1986) is used to check the mediation effects of ST on the link between OLC and SCR on the mediation hypotheses (H4a–H4b). ST partially mediates the link between OLC and SCR in pre-pandemic period, according to our results (Sobel test statistics = 3.62;  $p < 0.01$ ). ST is also observed to have a partial mediating effect on the relationship between OLC and SCR during the pandemic (Sobel test statistics = 2.459;  $p < 0.01$ ). In summary, the results demonstrate that OLC's impact on SCR is partially mediated by ST, confirming both H4a, H4b (OLC  $\rightarrow$  ST  $\rightarrow$  SCR).

Our model has two control variables: OT and CS. For larger companies, CS is set to one (and zero for smaller companies with less than 250 employees), while OT is set to one for local companies (and zero for international). Our results show that both OT and CS has no statistically significant effect on SCR in before pandemic times. On the other hand, for the during-pandemic time period both control variables have statistically significant effect on



**Figure 2.** Results of the structural model for before and during the pandemic

**Note(s):** \*Results follow [before pandemic|after pandemic] notation

SCR. For OT, our results suggest that multinational companies and larger companies exhibit higher SCR than their counterparts ( $\beta = -0.108, p < 0.01$  for OT and  $\beta = 0.084, p < 0.1$ ).

## 5. Discussion and implications

### 5.1 Discussion

The current study points out the critical effects of OLC and ST for SC research. As the application of OLC and especially ST in SC management is so limited (John *et al.*, 2001; Liu *et al.*, 2010), we attempt to fill this gap for the operations management literature. From this perspective, the present research broadens our understanding of resilience. Our findings corroborate OLC's positive effects on SCR, and the mediation effect of ST on this relationship, suggesting prioritization of the development of these competencies to increase resilience to shocks and crises, and complements the extant literature (Khazanchi *et al.*, 2007; Stock *et al.*, 2007; Liu *et al.*, 2010).

**Table 5.**  
Hypotheses testing  
results

Hypotheses	H1a	H1b	H2a	H2b	H3a	H3b	H4a	H4b	Control before	Control after
Aggregate										
Total effect	0.678 <sup>***</sup>	0.705 <sup>***</sup>					0.678 <sup>***</sup>	0.705 <sup>***</sup>		
Direct effect	0.481 <sup>***</sup>	0.487 <sup>***</sup>	0.449 <sup>***</sup>	0.524 <sup>***</sup>	0.442 <sup>***</sup>	0.417 <sup>***</sup>	0.198 <sup>***</sup>	0.218 <sup>***</sup>		
Indirect effect	0.198 <sup>***</sup>	0.218 <sup>***</sup>	Sup.	Sup.	Sup.	Sup.	Sup.	Sup.		
Level of support	Sup.	Sup.	Sup.	Sup.	Sup.	Sup.	Sup.	Sup.		
OT: Local										
Total effect	0.674 <sup>***</sup>	0.698 <sup>***</sup>	0.449 <sup>***</sup>	0.524 <sup>***</sup>	0.444 <sup>***</sup>	0.418 <sup>***</sup>	0.674 <sup>***</sup>	0.698 <sup>***</sup>		
Direct effect	0.475 <sup>***</sup>	0.479 <sup>***</sup>	0.449 <sup>***</sup>	0.524 <sup>***</sup>	0.444 <sup>***</sup>	0.418 <sup>***</sup>	0.199 <sup>*</sup>	0.219 <sup>*</sup>		
Indirect effect	0.199 <sup>***</sup>	0.219 <sup>***</sup>	Sup.	Sup.	Sup.	Sup.	Sup.	Sup.		
Level of support	Sup.	Sup.	Sup.	Sup.	Sup.	Sup.	Sup.	Sup.	No sup.	Sup.
CS: Large										
Total effect	0.672 <sup>***</sup>	0.482 <sup>***</sup>	0.449 <sup>***</sup>	0.524 <sup>***</sup>	0.449 <sup>***</sup>	0.417 <sup>***</sup>	0.672 <sup>*</sup>	0.672 <sup>*</sup>	0.072	0.084
Direct effect	0.471 <sup>***</sup>	0.482 <sup>***</sup>	0.449 <sup>***</sup>	0.524 <sup>***</sup>	0.449 <sup>***</sup>	0.417 <sup>***</sup>	0.201 <sup>*</sup>	0.201 <sup>*</sup>		
Indirect effect	0.201 <sup>***</sup>	Sup.	Sup.	Sup.	Sup.	Sup.	Sup.	Sup.	No sup.	Sup.
Level of support	Sup.	Sup.	Sup.	Sup.	Sup.	Sup.	Sup.	Sup.	No sup.	Sup.

**Note(s):** H1a: OLC → SCR (before pandemic)  
H1b: OLC → SCR (during pandemic)  
H2a: OLC → ST (before pandemic)  
H2b: OLC → ST (during pandemic)  
H3a: ST → SCR (before pandemic)  
H3b: ST → SCR (during pandemic)  
H4a: OLC → ST → SCR (before pandemic)  
H4b: OLC → ST → SCR (during pandemic)  
\*  $p < 0.05$ ; \*\*  $p < 0.01$  (two-tailed)  
Bootstrapping  $N = 5,000$ , CI = Upper and lower limits of 99% confidence interval

### 5.2 Theoretical implications

This study reveals that contrary to the previous literature (Polyviou *et al.*, 2020; Parker and Ameen, 2018), additional analysis by controlling for CS and OT suggests that large multinationals are better at SCR than their local small counterparts during the pandemic period. This can be explained with their enhanced operational flexibility and financial strength of multinationals, thanks to operating in multiple economies. Larger companies have scored higher on SCR after the start of the pandemic.

### 5.3 Practical implications

Our results suggest that learning culture helps organizations achieve SCR due to the improved adaptation capabilities at the organizational level. This study further reveals that building ST mediates the link between OLC and SCR. This implies that a clear understanding of knowledge sharing and exchange through trust will strengthen their SCR. Issues as the uninterrupted logistics gain importance during the times of crisis, necessitating the organizational need to develop trust with its suppliers.

## 6. Conclusion

After a detailed literature review, we proposed a theoretical model including different relevant organizational dimensions to examine the antecedents of SCR. The model, based on SEM, yielded positive effects of the suggested variables on SCR, which are proven vital for firms during crisis times.

This study examined OLC and ST and their link to SCR for both before and during the pandemic. The research model was validated empirically by applying a questionnaire to 245 participants. All hypotheses were tested both for before and after the pandemic period. The findings show that OLC and ST have positive and significant effects on SCR. Furthermore, OLC also trigger ST. Thus, it is the ST that explained, as a mediator, the positive effect of OLC on SCR. All these findings are similar for both before and after the pandemic. A critical finding is that during the pandemic period, the size and ownership of firms play a control variable role for SCR. Finally, we find that during pandemic, the SCR level of international companies during the pandemic is not the same as for local ones. Additionally, the SCR level is also higher for larger firms rather than small ones during pandemic period. In this regard, we claim that larger and international companies are better equipped to cope with the COVID-19 pandemic crisis.

As with all studies, this study has some limitations which may serve as directions for future research. First, responses to the questionnaire were collected from only one country. Cross-cultural comparisons can be made by collecting data from different countries in future research. Second, results of this study reflect responses of only SC and manufacturing managers. Thus, opinions of managers of different departments such as marketing or finance can also complement the findings.

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