Annals of Operations Research (2023) 327:659–682
https://doi.org/10.1007/s10479-022-05001-x

ORIGINAL RESEARCH

Role of fake news and misinformation in supply chain disruption: impact of technology competency as moderator

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Accepted: 19 September 2022 / Published online: 6 October 2022

Abstract

Studies show that COVID-19 has increased the effects of misinformation and fake news that proliferated during the continued crisis and related turbulent environment. Fake news and misinformation can come from various sources such as social media, print media, as well as from electronic media such as instant messaging services and other apps. There is a growing interest among researchers and practitioners on how fake news and misinformation impacts on supply chain disruption. But the limited research in this area leaves a gap. With this background, the purpose of this study is to determine the role of fake news and misinformation in supply chain disruption and the consequences to a firm's operational performance. This study also investigates the moderating role of technology competency in supply chain disruption and operational performance of the firm. With the help of theories and literature, a theoretical model has been developed. Later, the conceptual model has been validated using partial least squares structural equation modeling. The study finds that there is a significant impact of misinformation and fake news on supply chain disruption, which in turn negatively impacts firms' operational performance. The study also highlights that firms' technology competency can improve the supply chain situation that has been disrupted by misinformation and fake news.

Keywords Misinformation · Fake news · Supply chain resilience · Supply chain uncertainty · Operational performance · Technology competency

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1 Introduction

The World Health Organization declared COVID-19 pandemic as a global health emergency and introduced several health-related protocols for mitigating its fearful impacts (Baumeister, 2019). The ominous effects of the abrupt outbreak of the COVID-19 pandemic are perceived to have raised many economic as well as social changes throughout the world (Wang & Wang, 2020). Though preventive vaccines have already been developed, their inadequate supply and unequitable distribution have reportedly worsened the situation in some countries (Butt, 2021). UNICEF (2020) has observed that immunization is the principal mechanism for preventing viral transmission.

In this precarious situation, media platforms have perceived the necessity to properly educate people to ensure an effective and positive attitudinal change. This is because mass media are considered essential and vital sources of credible information (Zhong et al., 2020). But addressing the menace of myths and rumors that generate fake news and misinformation in the COVID-19 pandemic environment appears to have become one of the challenges for the media today (Chatterjee & Chaudhuri, 2021; Habes et al., 2020; Jayaseelan et al., 2020).

The misinformation during the COVID-19 pandemic environment has adversely affected individuals and the business community. Fake news has severely affected the supply chain resilience, and such news spreads faster than even the coronavirus spreads, making organizations' supply chain activities uncertain (Shafi et al., 2020). Fake news and misinformation spreads like wildfire—from tomorrow there will be a complete lockdown—and people rush to the market to stock up on essential items, resulting in stock shortages in shops, causing more demand, and consequently, breaking down the supply chain system (Parnell et al., 2020; Tamilmani et al., 2021). As a result, business organizations must figure out what to do, how to manage the situation, and when the situation will be normal (Ivanov, 2020).

The ultimate results of such fake news or misinformation have adversely affected organizations' performances due to the sudden disruption of the supply chain flow (Kovacs & Sigala, 2020). In the context of supply chain disruption, fact-checking information is necessary for building confidence in the supply chain stakeholders, businesses, and people (United Nations, 2020). From this perspective, emerging technologies like big data analytics (BDA), social media, blockchain, artificial intelligence (AI), and the internet of things (IoT) have become important to to keep this menace in check (Chaudhuri et al., 2021; Oyemomi et al., 2016). Studies have recognized that fake news and misinformation affect organizational performance by adversely impacting the supply chain flow (Kovaes & Sigala, 2020; Tamilmani et al., 2021). Studies have also demonstrated that the use of modern technology can address the adverse situation, which culminates from the rapid dissemination of fake news (Chaudhuri et al., 2021). But studies on how applications of modern technology could keep this menace in check have not been exhaustively investigated. Therefore, the aim of this study is to address the following objectives.

[i] To examine the role of fake news and misinformation during any turbulent environment like the COVID-19 pandemic on supply chain resilience.
[ii] To understand how supply chain resilience and uncertainty are affected by the dissemination of misinformation and fake news and could impact operational performance of the organization.
[iii] To investigate the moderating role of technology competency in impacting the relationship between supply chain disruption and operational performance of the organization.

The reminder of the paper is organized as follows. Section 2 deals with the literature review, followed by theoretical underpinning and the development of hypotheses in Sect. 3. Next, Sect. 4 presents the 13research methodology. After that, Sect. 5 describes the analysis of data and results followed by the discussion in Sect. 6, which contains implications of this study along with limitations and future scope for researchers.

2 Literature review

The unprecedented emergence of the COVID-19 pandemic has caused disruption to supply chain management throughout the world, affecting organizations' operational performance (Oh et al., 2020). The severity of the supply chain disruption has been multiplied by the frequent spreading of misinformation and fake news (Sodhi & Tang, 2020). The business community has started thinking how industry 4.0 technology could help to combat such an ominous situation, especially, how it could check such misinformation and fake news (Endsley, 2018; Jayawickrama et al., 2019; Mishra & Samu, 2021; Rana et al., 2021). The COVID-19 pandemic has adversely affected society, as well as businesses, and in such scenario, WHO has been continuously trying to mitigate and manage the impact of this pandemic on business activities, production and manufacturing systems, supply chain systems and so on (Parnell et al., 2020; WHO, 2020; Bezbaruah et al., 2021).

Studies have demonstrated that, in this turbulent situation, recipients of misinformation and fake news have been rendered skeptical of the information they used to obtain through mass media (Chatterjee, 2021; Kovacs & Sigala, 2020; Li et al., 2020). Scholars have argued that fake news may be disseminated through social media with higher velocity than genuine news (Viswanath, 2015). In the context of supply chain processes, fake news can impact imports and exports and production lines, and fake news can affect people's purchase behavior, affecting supply chain resilience and causing uncertainty in the system (Chatterjee et al., 2021; Papadopoulos et al., 2017; Petit et al., 2019). The spread of inauthentic information causes affects the supply chain system by causing more uncertainty in the supply chain process (Baabdullah et al., 2021; Roozenbeek & van der Linden, 2019; Sommariva et al., 2018).

In the COVID-19 pandemic situation, people learn everything through different media outlets, such as social media (e.g., Facebook, Twitter, and Instagram), print media (newspapers), and electronic media (television). If these media disseminate misinformation or fake news, people become confused and could doubt the genuine news from the mainstream media (DuHadway et al., 2019; Huang et al., 2021; Madnani et al., 2020). Since misinformation or fake news could adversely affect supply chain resilience and could cause supply chain uncertainty, the performance of the concerned organizations is perceived to be affected (Li et al., 2009; Mishra et al., 2016; Mofokeng & Chinomona, 2019; Panahifar et al., 2018). The COVID-19 pandemic and the spreading of fake news or misinformation have both impacted supply chain systems of many organizations, causing labor shortage and stockouts (Larue, 2020).

Scholars have opined that to survive this situation firms must use emerging technologies to weed out misinformation or fake news and to keep the supply chain flow active (Gachter et al., 2010; Jayawiakrama et al., 2019; Seifzadeh et al., 2021; Sharma et al., 2020a). However, only a few research studies have underpinned industry 4.0 technologies to combat fake news or misinformation during supply chain disruptions (Kim & Dennis, 2019). A turbulent scenario warrants the need to establish new understanding, theorization, as well as empirical findings on how industry 4.0 technologies could address challenges from misinformation and fake news that disrupt supply chains (Tandoc et al., 2018; Venkatraman et al., 2018).

3 Theoretical underpinning and development of hypotheses

3.1 Theoretical underpinning

The present study sets out to explain the role of fake news and misinformation in supply chain disruption, especially during the COVID-19 pandemic. In this context, the present study applied stimulus–response theory (De Fleur, 1956; Esser, 2008; Treisman, 1960) and resilience theory (Polk, 1997; Yates et al., 2015) to interpret the behavioral psychology and reactions of the recipients of fake news or misinformation. Also, the present study interpreted, using dynamic capability theory (Teece et al., 1997), how dislocation of business organizations' supply chains is affected and can be resolved.

During the COVID-19 pandemic, people have been mentally disturbed due to the threat to their health. In such a situation, how people respond and react to misinformation or fake news has been explained by stimulus–response theory and resilience theory, in line with a study by Barua et al. (2020). Misinformation or fake news includes false beliefs, which are considered stimuli in terms of stimulus–response theory. Thereafter, reactions to, as well as evaluations of, the credibility of information or news comes under the ambit of resilience, according to resilience theory. Stimulus–response theory is considered as an important theory in communication science (Bineham, 1988). It is cogitated as a general thought-reaction to the effects of media (Fakhruddin et al., 2020). The stimulus–response theory expounds that any information will act as a stimulus to the receiver regardless of its veracity. The receiver's behavioral psychology provokes the receiver to react and respond for that stimulus (Treisman, 1960). As the intensity of the stimulus increases, the level of intensity of the reaction-perception will be greater, which may be exhibited through the response (De Fleur, 1956).

In the context of the present study, it can be said that whenever a business organization receives misinformation or fake news, it reacts sharply to this stimulus, and apprehending that its supply chain could be hampered, the organization may hoard raw materials overnight. Consequently, the price of the items will increase, causing problems to the end consumers. The reaction can be interpreted in another way, following the concept of resilience theory (Djalante et al., 2020; Polk, 1997). The receiver of misinformation or fake news is sometimes inclined to evaluate such information. This reaction, known as resilience, depends on several factors including the receiver's problem-solving ability, attitude to take action, and concept to evaluate the ancillary situation (Fraser et al., 1999; Herrman et al., 2011). Thus, the recipient's reactions to such information depends on the individual's behavioral attitude, as envisaged in resilience theory. Those who receive the same information will have different levels of resilience.

Misinformation or fake news especially disrupts the supply chain system during any turbulent situation. Affected organizations need to address the quickly changing situations by utilizing their dynamic capabilities, as is enjoined in dynamic capability view theory (Teece et al., 1997). Dynamic capability (DC) is interpreted as the organizational "ability to integrate, build, reconfigure internal and external resources/competencies to address and possibly shape rapid changing business environments" (Teece, 2012, p.1395). The organizations need to possess abilities to sense threats as well as to efficiently seize business opportunities. Emerging technologies can help organizations to combat the situation and then to sharply reconfigure their resource base to capture and create business value from those opportunities (Wilden et al., 2013). Thus, the organizations must have the dynamic ability to sense, seize, and eventually reconfigure any untoward information to combat the situation (Wamba et al., 2019).

3.2 Development of hypotheses

After consulting the literature and the theories, it has been possible to identify the constructs. This section will discuss those constructs as well as how technology competency can moderate organizations' processes and practices. Attempts will be taken to formulate the hypotheses to develop a conceptual model.

3.2.1 Misinformation (MIS)

Incorrect information that is spread by any means, irrespective of whether it is associated with an intention to mislead or not, is interpreted as misinformation (MIS) (Scheufele & Krause, 2019). False information, which one shares without knowing if it is correct or incorrect and without intending to cause harm to anyone, is also interpreted as misinformation (Poland & Spier, 2010). From the healthcare perspective, in the COVID-19 scenario, misinformation has been interpreted as "health-related claims of fact that is currently false due to lack of scientific evidence" (Chou et al., 2018. p.2417). Literature has also documented how misinformation about the Zika virus adversely impacted society when it was spread through social media (Al-Kwifi et al., 2021; Sommariva et al., 2018). A recent study has highlighted how misinformation has been disseminated "among groups with influence of different misinformation refuting measures" (Shrivastava et al., 2020, p.1159). Misinformation during a turbulent situation can disrupt business activities and innovation (Di Domenico et al., 2021). In the context of supply chains, misinformation can halt an organization's imports and exports and production lines (Petit et al., 2019). Such information can impact on buyers' behavior, as they change their purchase intentions causing uncertainty in the supply chain and demand to fluctuate, which is all perceived to affect supply chain resilience (Kovacs & Sigala, 2021; Sodhi & Tang, 2020). Accordingly, the following hypotheses are formulated.

H1a Misinformation (MIS) negatively impacts supply chain resilience (SCR).

H1b Misinformation (MIS) positively impacts supply chain uncertainty (SCU).

3.2.2 Fake news (FAN)

Fake news (FAN) is news that is intentionally crafted, emotionally charged, sensational, totally fabricated, and misleading. It is news that closely mimics the mainstream news (Bronstein et al., 2019). Several studies have highlighted that fake news (FAN) is like wildfire in the velocity of its dissemination, which is than the spread of genuine news (Dwivedi et al., 2018; Vishwanath, 2015). In the context of the COVID-19 pandemic, fake news has resulted in the loss of lives, and it has misguided innovation as well as business activities (Di Domenico et al., 2021). The spreading of fake news in such a panicked situation could put a halt to a production line, severely affect import and export activities, and impact individuals to sharply change their buying behavior to panic buy, which is perceived to negatively impact supply chain flow (Ivanov, 2020; Sodhi & Tang, 2020). When a production line is interrupted, it creates fluctuations in demand, which might affect the organizations' ability to cope with unexpected and untoward issues impacting on the timely delivery of the products (Carvalho et al., 2012; Lotfi & Saghiri, 2018). The spread of fake news is perceived to induce an environment of uncertainty in the supply chain process (Khan et al., 2018). Accordingly, it is hypothesized as follows.

H2a Fake news (FAN) negatively impacts supply chain resilience (SCR).

H2b Fake news (FAN) positively impacts supply chain uncertainty (SCU).

3.2.3 Supply chain resilience (SCR)

In the turbulent environment of the COIVID-19 pandemic, markets constantly undergo change and threats evolve. But in this situation, if the menace of misinformation and fake news prevails, the business situation could rapidly change, interrupting the supply chain (Mandal, 2012). The dissemination of fake news and misinformation can have adverse repercussions on the existing design of the supply chain, and the challenge is to make it resilient to disruption (Pereira et al., 2014). This concept is in consonance with resilience theory. Resilience, in the context of the supply chain, is conceptualized as the organizational ability to ensure the supply chain can cope with unexpected disturbances (Carvalho et al., 2012). In fact, a higher level of resilience of the supply chain is expected to bring better operational performance in terms of recovery and delivery times (Lotfi & Saghiri, 2018). Supply chain resilience can be enhanced if it is possible to share accurate and timely information among the partners who are intimately involved in the supply chain, which will help to ensure supply chain operations are better managed (Simatupang & Sridharan, 2005). Apart from factors like information technology (IT) alignment, trust and information sharing are known to be critical predictors of better supply chain resilience, as Naghshineh and Lotfi (2019) found in their study. But due to the spread of misinformation or fake news, especially during turbulence, trust is hampered, and the flow of information sharing is impacted (Chong & Momin, 2021). As a result, supply chain resilience is affected, which is perceived to adversely impact organizations' supply chain agility and adaptability, adversely impacting on their practices and processes (Akter et al., 2016; Tan et al., 2017; Wamba et al., 2019). Accordingly, it is hypothesized as follows.

H3 Supply chain resilience (SCR) positively impacts operational performance (OPP) of an organization.

3.2.4 Supply chain uncertainty (SCU) and operational performance (OPP)

It has been discussed that, during any disruptive environment, misinformation and fake news may even lead to loss of lives, which could be prevented. Misinformation and fake news severely affect business activities and innovation with misguidance (Di Domenico et al., 2021). Misinformation and fake news interrupt the production chain, leading to considerable fluctuations and disruptions, resulting in uncertainty in the supply chain process (Koronios et al., 2020; Petit et al., 2019). This uncertainty is perceived to affect the organizations' supply chain agility and adaptability (Sodhi & Tang, 2020). Operations and supply chain management literature is found to have aptly recognized the role of agility and adaptability in organizations' operational performance (Aslam et al., 2018; Dubey et al., 2018). Creating strategic value through demand distribution, articulating operational efficiency, and planning are deemed to be critical components of operational performance of an organization (Caridi et al., 2010; Wei & Wang, 2010). Accordingly, it is hypothesized as follows.

H4 Supply chain uncertainty (SCU) negatively impacts operational performance (OPP) of an organization.

3.2.5 Moderating effects of technology competency (TC)

If the relationship between the two constructs is not fixed, a third variable can impact the relationship by facilitating the relationship or by retarding the relationship. In some cases, the third variable can change the direction of that relationship. This third variable is called the "moderating variable". In the context of an uncertain environment during the COVID-19 pandemic, this study discusses how misinformation and fake news could aggravate the apocalyptic situation, especially in the supply chain context. The role of industry 4.0 has been perceived to be critical in tackling the dissemination of misinformation and fake news that disrupts supply chains (Endsley, 2018). These emerging technologies are able to investigate to understand why, how, and when such types of information were spread and what are the exact contents of such misinformation or fake news (Jayawickrama et al., 2019). It is perceived that these emerging technologies will be able to mitigate the spread of fake news and to manage it during supply chain disruption (Oyemomi et al., 2016).

It is a fact that both traditional and digital media platforms are now easily accessible, and hence the work of curbing misinformation and fake news is perceived to be a challenge (Sharma et al., 2020b). However, it is possible to quickly share accurate information to all the stakeholders during supply chain practices using blockchain technology (Kumar et al., 2020). Since misinformation and fake news are perceived to adversely impact supply chain resilience and favor supply chain uncertainty, their impacts on operational performance of an organization are perceived to be influenced by the competence of technology which is expected to tackle the onslaught. Judged from this standpoint, the following hypotheses are developed.

H5a Technology competency (TC) moderates the relationship between supply chain resilience (SCR) and operational performance (OPP) of an organization.

H5b Technology competency (TC) moderates the relationship between supply chain uncertainty (SCU) and operational performance (OPP) of an organization.

With all these inputs, a model is proposed conceptually which is shown in Fig. 1.

4 Research methodology

For testing the hypothesis and validating the conceptual model, a survey was conducted to gather data. This process is suitable for those studies which aim to test hypotheses, describe a population, develop measurement scales, and build a theoretical research model (Lee & Shim, 2007).

A questionnaire was developed with relevant measures that were adopted from the extant literature in our literature review. The dimensions were measured basing on 5-point Likert scale with anchors ranging from 1 for "strongly disagree" (SD) to 5 for "strongly agree" (SA). The questionnaire was pretested on 15 business professionals, as well as academicians, and we also discussed the proposed questions for the survey with these professionals and academicians. During the questionnaire pretest, some questions were rectified and some of the formats of the questions were corrected to ensure that the questions were understandable

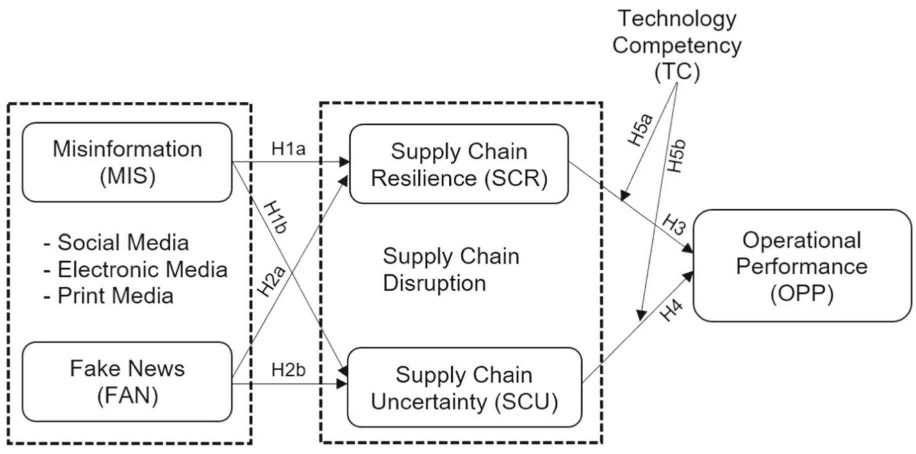

Fig. 1 The conceptual model

and not vague, ambiguous, leading, or difficult to answer (Dillman, 2007). After the pretest stage, a pilot test was conducted to assess the response rate and to confirm scale reliability (Mackenzie et al., 2011). The questionnaire was distributed to a sample that was smaller than the sample of the original survey. The sample in the pilot test contained a diverse group of respondents. With the inputs from the pilot test, some items were dropped in order to improve the relevant constructs' reliability. Through this refining procedure, 31 instruments were eventually prepared.

The present study investigates the role of misinformation and fake news in supply chain disruption and considers the moderating role of technology competency in combatting misinformation and fake news. To target usable respondents, it would have been better had it been possible to target some initiators of misinformation and fake news, as well as employees of those organizations who had been victims of it at least once. However, collecting data from the initiators of misinformation and fake news was not feasible, and as such, this idea was dropped.

Purposive sampling has been perceived to be effective in the context of this study (Apostolopoulos & Liargovas, 2016), because researchers can depend on their personal judgement to target respondents. The researchers in this context targeted those respondents who had a direct or indirect concept of the subject matter of the present study. Again, since the authors of this study are based in Asia and Europe, convenience sampling technique was applied to target organizations in those regions whose employees had some experience of being victims of misinformation and fake news. Thus, through this approach, covering a combination of purposive and convenience sampling techniques, 23 organizations were initially identified, with which the authors had some earlier contacts. The top executives of these 23 organizations were persuaded over telephone and through email more than once to permit their employees to take part in this survey. The top executives of these 23 organizations were appraised that the participants' confidentiality and anonymity would be completely preserved. They were also intimated that this research study was for academic purposes.

Eventually, top executives of 16 organizations agreed to allow their employees of different ranks to participate in the survey. They were pleased to supply the details of the contact persons of their respective organizations with whom the authors needed to contact. A response sheet containing 31 instruments was prepared. Each instrument was drafted in the form of a statement with five options. A guideline was provided with each response sheet that explained that respondents should put one tick mark in one of the five options against each instrument. All the contact persons of these 16 organizations were provided with these response sheets through email and requested to send the response sheets to their prospective respondents. In this way, it was learned that a total of 706 respondents agreed to participate in this survey. They were given three months (December 2020 to February 2021) to respond. Within the scheduled time, 322 respondents responded. The response rate was 45.6%. It is necessary to conduct a non-response bias test. To perform this test, recommendations, as laid down in Armstrong and Overton (1977), have been followed. The independent t-test and chi-square test have been conducted with the inputs of the first and the last 100 responses. No mentionable deviations in the two results were noted. Hence, non-response bias did not pose any major concern in this study. Scrutiny of the 322 responses revealed that 14 response sheets were incomplete, and they were not considered. Out of these 14 responses, it appeared that some of the concerned respondents left the response sheet completely vacant and some of the respondents put tick marks in more than one options against a particular question. That is why these 14 responses were disregarded. Therefore, analysis was done on the responses of 308 respondents against 31 instruments. This is within the allowable range (Deb & David, 2014). Be it mentioned here that the ratio of the number of items and number of usable respondents should lie between 1:4 and 1:10, which is construed to be the permissible range. Details of 308 responses are provided in Table 1.

5 Analysis of data and results

To test the hypotheses, the partial least squares (PLS)—structural equation modeling (SEM) technique was preferred. This technique is widely accepted and is used in operational and marketing management research (Peng & Lai, 2012). This technique helps to reduce the problems of convergence and factor indeterminacy (Henseler, 2010; Kock & Hadaya, 2018). It can analyze a small sample size, does not require data which are normally distributed, and provides more conservative measures for the path coefficients (Hair et al., 2011; Wamba et al., 2019). It is a two-stage process (Chin, 2010). The first stage evaluates the measurement model, and the second stage utilizes SEM for hypotheses testing (Kumar & Kushwaha, 2018).

5.1 Measurement model and discriminant validity test

To assess convergent validity, the loading factor (LF) of each instrument was estimated. Then, the average variance extracted (AVE), composite reliability (CR), and Cronbach's alpha (α) were assessed to verify validity, reliability, and internal consistency of each construct, respectively. All the estimated values are within the permissible range. The results are provided in Table 2.

It has been observed that square roots of all the AVEs are greater than the corresponding bifactor correlation coefficients, thus satisfying Fornell and Larcker criteria (Fornell & Larcker, 1981) and confirming discriminant validity. The significance of discriminant validity test is to check if the meaning of the different constructs is very close to each other. Because, in that case, it becomes difficult to analyze the results using the partial least squares structural equation modeling technique. The results are shown in Table 3.

Table 1 Demographic profile (N = 308)

Particulars	Category	Number	Percentage (%)
Gender	Male	158	52
	Female	150	48
Age	18–35 years	208	67
	36–55 years	100	33
Education	High school	37	12
	Graduate	216	70
	Postgraduate	55	18
Location	Asia	209	68
	Europe	99	32
Hierarchy	Employees	126	41
	Managers	105	34
	Leaders	77	25

Table 2 Measurement properties

Constructs/items	LF	AVE	CR	A	t-values
MIS		0.81	0.86	0.89	
MIS1	0.89				24.12
MIS2	0.92				27.34
MIS3	0.88				38.09
MIS4	0.86				34.16
MIS5	0.82				30.18
MIS6	0.90				19.17
MIS7	0.95				26.64
FAN		0.81	0.85	0.90	
FAN1	0.96				24.16
FAN2	0.95				32.26
FAN3	0.86				27.29
FAN4	0.82				31.81
FAN5	0.92				26.07
FAN6	0.89				25.39
SCR		0.84	0.87	0.92	
SCR1	0.92				33.71
SCR2	0.91				26.36
SCR3	0.87				34.19
SCR4	0.86				36.16
SCR5	0.91				39.11

Table 2 (continued)

Constructs/items	LF	AVE	CR	A	t-values
SCR6	0.97				26.34
SCU		0.85	0.88	0.94	
SCU1	0.95				26.22
SCU2	0.85				28.36
SCU3	0.90				34.27
SCU4	0.96				26.28
SCU5	0.88				31.72
SCU6	0.97				30.11
SCU7	0.92				34.16
OPP		0.86	0.91	0.95	
OPP1	0.95				26.01
OPP2	0.90				27.97
OPP3	0.96				26.11
OPP4	0.85				36.17
OPP5	0.97				31.12

Table 3 Discriminant validity (Fornell & Larcker criteria)

Constructs	MIS	FAN	SCR	SCU	OPP	AVE
MIS	0.90					0.81
FAN	0.16	0.90				0.81
SCR	0.22	0.29	0.91			0.84
SCU	0.31	0.26	0.34	0.92		0.85
OPP	0.29	0.17	0.29	0.33	0.93	0.86

Table 4 Discriminant validity test (HTMT)

Constructs	MIS	FAN	SCR	SCU	OPP
MIS					
FAN	0.46				
SCR	0.26	0.29			
SCU	0.19	0.34	0.22		
OPP	0.35	0.17	0.26	0.41	

To supplement the Fornell and Larcker criteria, the Heterotrait-Monotrait (HTMT) test has been conducted (Henseler et al., 2014), and it is found that the values are all less than 0.85 (Voorhees et al., 2016). The results are shown in Table 4.

5.2 Effect size f^2 test

To examine if exogenous variables contribute anything to the corresponding endogenous variables, we computed the effect size f^2 values. In terms of recommendations from Cohen (1988), the effect size is considered weak (W) if it is from 0.020 to 0.150, it is medium (M) if it is from 0.150 to 0.350, and it is considered large (L) if it is greater than 0.350. In the present study, the estimated f^2 values are as follows in Table 5.

Table 5 Effect size f^2

Construct	SCR	SCU	OPP
MIS	0.290 (M)	0.111 (W)	
FAN	0.387 (L)	0.417 (L)	
SCR			0.399 (L)
SCU			0.401 (L)

L large, *M* medium, *W* weak

Table 6 Moderator analysis (MGA)

Linkages	Hypotheses	p value differences	Remarks
(SCR → OPP) × TC	H5a	0.04	Significant
(SCU → OPP) × TC	H5b	0.01	Significant

5.3 Moderator analysis (multigroup analysis)

To verify the moderating effects of technology competency (TC) on the two linkages SCR → OPP (H3) and SCU → OPP(H4), multi group analysis (MGA) was adopted with consideration of the bootstrap procedure on 5000 resamples. It is known that if the p value difference of the effects of a moderator's two categories on a linkage is either greater than 0.95 or less than 0.05, then the effects of that moderator on that linkage are significant (Hair et al., 2016; Mishra et al., 2018). The results are shown in Table 6, where it is seen that the effects of the moderator TC on the two linkages H3 and H4 are significant.

5.4 Causality test

It is essential to conduct the causality test before hypotheses testing with the help of SEM (Guide & Ketokivi, 2015). Nonlinear bivariate causality direction ratio (NLBCDR) has been measured for each linkage, as recommended by Kock (2015), with an accepted value ≥ 0.7 (Wamba et al., 2019). NLBCDR has been estimated for all the linkages: for MIS → SCR (H1a), it is 0.992; for MIS → SCU (H1b), it is 0.999; for FAN → SCR (H2a), it is 1.003; for FAN → SCU (H2b), it is 1.000; for SCR → OPP (H3), it is 1.002; and for SCU → OPP (H4), it is 1.004. Thus, all the NLBCDR values are found to be greater than 0.7. The results indicate that support of reversed hypothesized relation is weak.

5.5 Hypotheses testing

To ascertain the model's predictive relevance, the bootstrapping procedure with 5000 resamples has been adopted considering a separation distance 7 to determine the cross-validated redundancy. Stone–Geisser Q^2 (Geisser, 1975; Stone, 1974) values for the exogenous variables have been estimated. The results show Q^2 values for SCR (0.821), SCU (0.448), and OPP (0.667). All the values are positive, which indicates that the model has predictive relevance (Peng & Lai, 2012).

To ascertain model fit, Henseler et al.'s (2014) recommendation has been followed. For this, standardized root mean square residual (SRMR) has been considered as a standard index, and its values have been estimated as 0.068 for PLS and 0.032 for PLSc. Both are less than 0.08 (Hu & Bentler, 1999). Hence the model is considered to be in order. By using this process, it has been possible to determine the path coefficients, p-values, and R^2 values. The results are shown in Table 7.

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

Table 7 Path coefficients, p values, R^2 values with remarks

Linkages	Hypotheses	R^2 values/path coefficients	p values	Remarks
Effects on SCR		$R^2 = 0.38$		
By MIS	H1a	− 0.32	p < 0.01(**)	Supported
By FAN	H2a	− 0.37	p < 0.001(***)	Supported
Effects on SCU		$R^2 = 0.45$		
By MIS	H1b	0.41	p < 0.001(***)	Supported
By FAN	H2b	0.44	p < 0.001(***)	Supported
Effects on OPP		$R^2 = 0.68$		
By SCR	H3	0.39	p < 0.01(**)	Supported
By SCU	H4	− 0.47	p < 0.001(***)	Supported
(SCR → OPP) × TC	H5a	0.19	p < 0.05(*)	Supported
(SCU → OPP) × TC	H5b	0.26	p < 0.01(**)	Supported

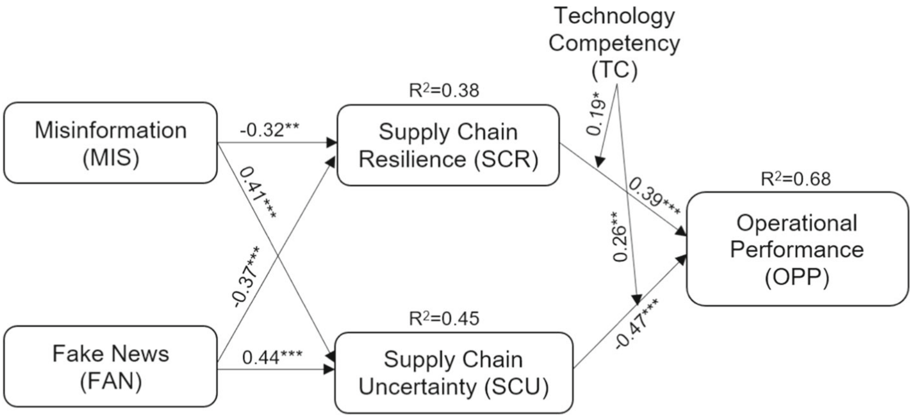

Fig. 2 Validated model (SEM)

5.6 Common method variance (CMV)

Since the results depend on survey data, there is chance of common method variance (CMV). For this, some procedural remedies have been taken. During the pretest stage, the items were simplified, and some formats of the questions were corrected to enhance their readability. Also, the participants were assured that their anonymity and confidentiality would be strictly preserved. Again, to assess the severity of CMV, Harman's Single Factor Test (SFT) has been conducted. The first factor emerged as 27.11% of the variance, which is less than the recommended highest value of 50% (Podsakoff et al., 2003). To supplement Harman's SFT, a marker correlation test (Lindell & Whitney, 2001) has been performed. The differences between CMV and marker-based correlations were very small (≤ 0.06) (Mishra et al., 2018). Hence, the CMV did not pose any major problem.

5.7 Results

The present study has formulated eight hypotheses, out of which two hypotheses, H5a and H5b, are concerned with the effects of the moderator TC on H3 and H4. After statistical analysis, it appears that all the hypotheses have been validated. The present study highlights that the impacts of MIS on SCR (H1a) and on SCU (H1b) are both significant, since the concerned path coefficients are found to be − 0.32 and 0.41, respectively, and each with levels of significance $p < 0.01$(**) and $p < 0.001$(***). This study demonstrates that the effects of FAN on SCR (H2a) and on SCU (H2b) are both significant, since the concerned path coefficients are − 0.37 and 0.44, with respective levels of significance as $p < 0.001$(***) and $p < 0.001$(***). The impacts of SCR and SCU on OPP are both significant, since the concerned path coefficients are 0.39 and − 0.47, respectively, and each having a level of significance as $p < 0.001$(***). The impacts of the moderator TC on H3 and H4 are also significant, since the respective path coefficients are 0.19 and 0.26, having respective levels of significance as $p < 0.05$(*) and $p < 0.01$(**). So far as coefficients of determinants are concerned, it appears that MIS and FAN could explain SCR and SCU to the tune of 38% ($R^2 = 0.38$) and 45% ($R^2 = 0.45$). Both SCR and SCU simultaneously impact OPP to the extent of 68% ($R^2 = 0.68$), which is the predictive power of the proposed theoretical model.

6 Discussion

Studies on the COVID-19 apocalypse have highlighted how misinformation and fake news proliferation could severely aggravate this cataclysm with colossal impact on the production and manufacturing supply lines, business activities, and the entire society (Parnell et al., 2020). Such continuous dissemination of misinformation and fake news have helped to develop distrust in the minds of the people, rendering them skeptical to any information they receive through social media (Li et al., 2020).

The present study has demonstrated, by developing a theoretical model, how misinformation and fake news adversely affect supply chain resilience and how such information enhances supply chain uncertainty. The present study has shown that misinformation and fake news negatively impact supply chain resilience (H1a and H2a) and they positively impact supply chain uncertainty (H1b and H2b). All these hypotheses simultaneously provide that misinformation and fake news have considerable impact on organizations' managing the supply chain during the pandemic, which received support from another study (Kovacs & Sigala, 2020). The present study has highlighted that supply chain resilience positively and significantly impacts on the firm's operational performance (H3), whereas supply chain uncertainty could negatively and significantly impact its operational performance (H4). These hypotheses have been supplemented by other studies (Petit et al., 2019; Sodhi & Tang, 2020). The present study has documented that to address such a crisis that is aggravated by the spread of misinformation and fake news in the context of supply chain, the help of emerging technology is indispensable (H5a and H5b). It has received support from another study (Venkatraman et al., 2018).

Here, the effects of the moderator technology competency (TC) on H3 and on H4 will be discussed through graphical representation. Figure 3 shows the effects of strong TC and weak TC on the linkage SCR → OPP (H3).

In Fig. 3, the continuous and dotted lines represent the effects of strong TC and weak TC, respectively, on H3. As SCR increases, it appears from the graph that the rate of increase of

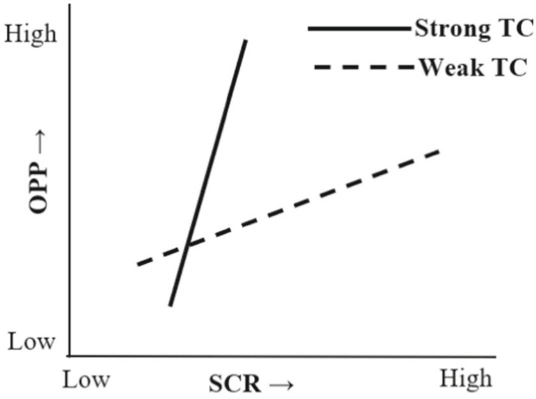

Fig. 3 Effects of TC on H3

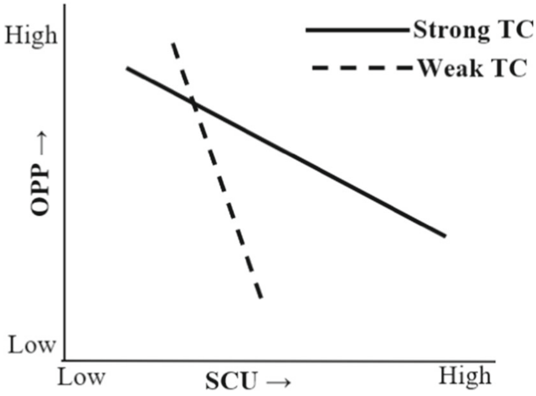

Fig. 4 Effects of TC on H4

OPP is more from the effects of strong TC on H3 compared to the effects of weak TC on H3, since the gradient of the continuous line is more than the gradient of the dotted line.

Again, Fig. 4 shows graphically the effects of strong TC and weak TC on the linkage SCU → OPP (H4).

In Fig. 4, the continuous and dotted lines show the effects of strong TC and weak TC on H4, respectively. Looking at the graph, it transpires that, as SCU increases, the rate of decrease of OPP is less from the effects of strong TC on H4 compared to the effects of weak TC on H4, since the gradient of the continuous line is more than the gradient of the dotted line. The gradient of a straight line is known as the trigonometrical tangent of the angle, which the straight line makes with the positive direction of the horizontal axis.

6.1 Theoretical contrapositions

The present study is perceived to have provided several theoretical implications to researchers as well as academicians, and to have added value to the body of extant literature. Evidence highlights those empirical studies on the consequences of sharing misinformation and fake news are lacking. This is because prior literature has not provided a theoretical framework or a model that could empirically highlight the consequences of sharing misinformation and fake news on social media. In this respect, we claim this study has made a special theoretical contribution to the body of literature. This study has been able to portray a theoretical model that highlights how misinformation and fake news could impact an organization's operational performance, mediating through supply chain resilience as well as through supply chain uncertainty. This is claimed to be a unique theoretical contribution of this study.

We observed that no previous studies had nurtured simultaneously the antecedents and consequences of misinformation and fake news or tried to project a laudable view of how emerging technology could help to mitigate unfounded and false information that might hoodwink people and could make correct decisions to tackle difficult issues (Jayawickrama et al., 2019). Since there are limited studies underpinning the use of emerging technology to deal with fake news and misinformation that disrupt supply chains, this study has attempted to provide a successful model that has a high explanative power. We claim that this present research has established a novel understanding through effective theorization and empirical findings of the important moderating role of emerging technology to address misinformation and fake news in a turbulent environment.

This study has also demonstrated how *mens rea* acts behind the sharing of fake news. Through stimulus–response theory and resilience theory, the present study has shown how the recipients of misinformation and fake news react with resilience and how, before acting, it is essential to evaluate the credibility of information. Besides, the study has detailed how misinformation and fake news could destabilize the supply chain process of an organization and how, with the organization's dynamic capabilities, it could restore its agility and adaptability to provide dividends to the operational performance of the organization. This is also claimed to be a theoretical contribution of this study.

6.2 Implication to practice

We claim that the present research study provides several implications to practice. This study has hypothesized that misinformation and fake news adversely impact supply chain resilience (H1a and H2a). This implies that the organizations should not overemphasize any information that might affect their processes and practices, and managers must check the credibility of the news. Besides, it is desirable that the organizations should strengthen their supply chain resilience so that, if for any reason the supply chain suffers, even due to misinformation or fake news, their agility and adaptability can help them to manage the situation. In such a situation, we suggest that organizations preserve the activity of their supply chain by having stock from the local suppliers as a stopgap arrangement.

Besides, the study highlights that misinformation and fake news enhance the uncertainty of the supply chain (H1b and H2b). Supply chain uncertainty impedes operational performance (H4). This implies that censorship should be imposed on the dissemination of misinformation and fake news. In this context, the role of media providers (social media, electronic media, and print media) is critical. Media providers must be held accountable for disseminating such fabricated information. Whenever the organization receives any information, it must check the authenticity of the information before making any decision. The managers looking after supply chain process must identify the probable locations where the flow is disrupted and get information from the stakeholders at the location who are involved in supply chain activities about the veracity of the information. Managers of organizations must be serious about any information regardless of its authenticity and they need to act after verifying the credibility of the news. If this is done carefully, the supply chain uncertainty will be mitigated to a great extent. The managers should utilize emerging technologies to verify the authenticity of that information to minimize disruption to the supply chain (H5a, H5b).

It will help the organization not to be overwhelmed by information without checking its authenticity. Moreover, it is important for the organization to use new technologies which could provide them the necessary updates regarding the authenticity of that information. The organization must have some operation guidelines for whenever such misinformation and fake news is spread. Policy makers and the leaders of the organizations should take active parts in formulating standard operating procedures for whenever any misinformation or fake news is spread in any location which could disrupt their normal supply chain operations, especially in any turbulent situation.

6.3 Limitations and future scope of research

Although the study has provided theoretical and practical implications; it is still not free from all limitations. The present study has used DCV theory. However, this theory is known to suffer from context insensitivity (Ling-Yee, 2007). DCV is not able to accurately identify the conditions where the organizational capabilities would be most valuable (Dubey et al., 2018; Schilke, 2014). It is suggested that future researchers explore the optimum conditions where the dynamic capability can provide best operational performance. This study did not analyze a rival model, which could have been compared with the proposed theoretical model to highlight the superiority and veracity of the proposed theoretical model. Future researchers may take up this issue.

This study is a survey-based research study. Hence, it has its own limitations, like common method variance (CMV) issues and endogeneity issues (Guide & Ketokivi, 2015). Of course, precautions have been taken to minimize the influence of bias. From this perspective, it is suggested that multiple informants from a sample or from longitudinal data might be helpful to address the CMV and endogeneity issues. Future researchers may take it up accordingly.

Data for this study have been collected from Asia and Europe. Hence external validity becomes an issue. The ability to generalize this result in other countries is a problem. Future researchers may collect data from respondents dispersed across the world. This might provide a generalized result. The predictive power of the model is 68%. Future researchers may think of including other constructs and boundary conditions to verify if, in such case, the strength of the proposed model can be increased.

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