

Procurement system for resilient supply chain amid the COVID-19 pandemic: systematic literature review

Resilient
supply chain

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Abstract

Purpose – This study aims to provide a rich learning opportunity from COVID-19 crisis for making resilient supply chain by adopting new strategies for the procurement system.

Design/methodology/approach – The systematic literature review has been conducted from the year 2012 to 2022 with the objective of developing procurement system for resilient supply chain. Fifty-four research papers are selected for this study.

Findings – The study exhibits that procurement function makes a significant contribution in creating supply chain resilience in the time of COVID-19 pandemic. The COVID-19 emergency has enforced companies to operate in new ways to face supply chain disruptions. The new strategies and actions appropriate for resilient procurement system have been identified.

Research limitations/implications – This study is limited to the papers that were indexed in the Scopus database. It has also been limited to the procurement function and supply chain resilience.

Practical implications – This research highlights strategies for supply chain resilience to improve the business performance in COVID-19 or similar types of crisis.

Originality/value – The originality of this paper is to identify the strategies and new practices followed in procurement function to improve the supply chain resilience. This study suggests directions for future research on the integration of procurement and manufacturing for making resilience in the supply chain.

Keywords Procurement system, Supply chain, Resilience, Disruptions, COVID-19

Paper type Literature review

1. Introduction

The COVID-19 has brought many challenges for manufacturing firms, and some firms have converted it into opportunities by timely restoring the production. The current disruption due to COVID-19 in supply chain has created complexity in the procurement system of supply chains. Simultaneously, the tough competition has enforced organisations to enhance customer value, improve product quality, reduce cost and enhance the overall performance of organisations (Stecke and Kumar, 2009; Carvalho *et al.*, 2012; Das *et al.*, 2021a, 2021b). The



disruptions in the flow of material have impacted the procurement system and supply chain of organisations (Kaur and Singh, 2019; Xu *et al.*, 2020; Yoon *et al.*, 2020). Procurement in the disruptive supply chain must adopt new strategies to improve their response for quick and cost-efficient system to unpredictable changes in high level of environmental turbulence. Procurement system in supply chain needs to have resilience and an agile strategy to deal with all kinds of disruptions. In addition to changes in supply chain operation due to COVID, the procurement activities are very important for business continuity (Namdar *et al.*, 2018).

Messina *et al.* (2020) presented an information management model to identify information which an organisation uses to recover from a variety of disruptive events in supply chain. The current disruption due to COVID-19 halted all businesses not only in the country but across the globe. As a result of this unfortunate time, the flow of raw material supplies, manufacturing and dispatches from manufacturing organisations has been interrupted, and all the automotive companies across the globe experienced a shortage of electronic chips in their manufacturing system. Due to interdependency across all companies, the system has become complex in terms of networking for supply chain in the current sourcing scenario (Chowdhury *et al.*, 2021). Although it has been highlighted to improve manufacturing costs (Shivajee *et al.*, 2019), but such disruptions in the material supply can impact the supply chain performance of all organisations (Queiroz *et al.*, 2020). In addition to COVID-19 impact, the trend to variability in demand and reduction in product life cycle and change in expectations of the end consumer have impacted the resilience in supply chain, which is resulting in more unstable and unpredictable. The manufacturing environment has also been impacted drastically with the current COVID-19 pandemic resulting in social conflicts, logistics, economic crises and supply chain disruptions. The procurement system of any organisation has become a critical activity in supply chain. COVID-19 has impacted business performance due to inconsistency of material supply and organisations has demonstrated the important need in changing the traditional procurement strategies. It has motivated the practitioners and researchers to explore how companies are making strategy to overcome the impacts arising from COVID-19 pandemic, and unforeseen effect of event for practices are being used for supply chain resilience (Ruiz-Benitez *et al.*, 2018). Several researchers have elaborated on the different ways to overcome such disruptions by investigating the conditions which can enhance the resilience capabilities in supply chain (Cheng and Lu, 2017; Pettit *et al.*, 2019; Ralston and Blackhurst, 2020; Modgil *et al.*, 2021). Activities to address the organisational issues related to procurement functions are planned to manage the smooth material and information flow in the supply chain (Pereira *et al.*, 2014). Traditionally business organisations consider manufacturing and procurement decisions independently in supply chain. In production system, the decision is made on product mix strategy and procurement plan is developed on basis of requirement. However, procurement for all the dependent material is planned and timely arranged for production to fulfil the customer demands.

There is a need to explore in detail the importance of procurement function in creating supply chain resilience during COVID-19 pandemic. The different dimensions have been considered to address the supply chain disruptions arising from extreme COVID-19 pandemic. The purpose of this study is to understand the procurement function in identifying the barriers, enablers, threats and opportunities which could moderate the supply chain resilience. The study attempted a systematic literature review on procurement system for resilience supply chain, and we have considered learning from COVID-19 event. The study provides a detailed synthesise of the key study areas of concern. In this article, we

have framed the following research questions to bridge the existing research gap in literature of resilient procurement system:

- RQ1.* How procurement system impact resilience of supply chain through past literature?
- RQ2.* What are the learnings from COVID-19 for making resilient procurement system?
- RQ3.* What are major strategies for resilient procurement system?

The organisation of remaining part of the study is as follows: Section 2 deals with the concept of supply chain resilience and procurement system, Section 3 deals with research methodology, Section 4 discusses findings and Section 5 describes top strategies for procurement function for resilient supply chain. Finally, Section 6 concludes with future research directions.

2. Supply chain resilience and procurement system

Purchasing and supply chain management started to develop and explored as an area of significant academic research in the early 1990s. Previously, the resilience in supply chain was not considered a well-known concept for study, and to some extent, the meaning of supply chain resilience was still limited to research for practitioners and researchers within the business world. In the business environment, the resilience concept was considered by researchers and academicians when different types of supply chain disruption had to face, i.e. the mouth and foot and disease in February 2001, the fuel protest in mid of 2000 in the UK and the terrorist attack in September 2001 in the USA (Christopher and Peck, 2004). As a result of such unfortunate events in supply chain had to face disruption threats. The managers were enforced to think the different alternative ways to develop and deploy strategies for mitigating with such types of supply chain disruptions. The researchers and academicians have seen the great opportunity of selecting such topics for study to explore the area of supply chain resilience further. Pettit *et al.* (2010) identified 14 capability factors in their study which contribute in increasing the resilience in supply chain. Since the resilience in supply chain as well as disruptions are the rich and emerging area for study and developing the literature (Tukamuhabwa *et al.*, 2015). Some area like procurement functions is still not discussed in comparison with the study available on supply chain management.

The procurement function has played a pivotal role between supplier and manufacturing in organisation for responsible to purchase specific material to support in the manufacturing process. In the literature, purchasing and procurement are discussed by authors as interchangeable terms (Miernczyk *et al.*, 2012; Rehman Khan and Yu, 2019). The procurement was considered as the evolution of material procuring function used to focus on cost-reduction fundamentally (Klunder *et al.*, 2019). Consequently, procurement function is not only considered as a simple business function that is accountable for material planning, implementing, evaluating the requirement and controlling the purchase decisions (Tarigan and Siagian, 2021), but it is also an enabler for better management of suppliers and organisations resources (Lindgreen *et al.*, 2013; Dong *et al.*, 2022). For this reason, the procurement function has been considered with its bigger area to achieve the competitive edge in this supply chain disruption. The procurement function is responsible for overall cost reduction of product and service, timely delivery of product and maintaining quality and specific decisions for best supplier selection and building relationships with suppliers (Kurpjuweit *et al.*, 2021). The procurement activities and support by suppliers do make a significant contribution in organisation for making it competitive at the time of supply chain

disruptions. The COVID-19 pandemic is one of the most severe events that caused supply chain disruptions in history. This has challenged practitioners and scholars to improve the resilience of supply chains. There are several enablers and barriers identified for making resilience in supply chain (Pereira *et al.*, 2014; Ali, 2017; Han *et al.*, 2020). The authors have investigated relevant issues and barriers responsible for enhancing the capabilities in making resilience in supply chain. The procurement issues in procurement function activities have not been discussed, which are considered for managing the seamless flow of material and timely availability in time of COVID-19. Since procurement, supply chain resilience and COVID-19 are the emerging key area for developing the rich and growing body of literature. Supply chain resilience is considered as a bounce back from disruption by many researchers (Agarwal *et al.*, 2020; Ali *et al.*, 2017; Pereira *et al.*, 2014).

3. Research methodology

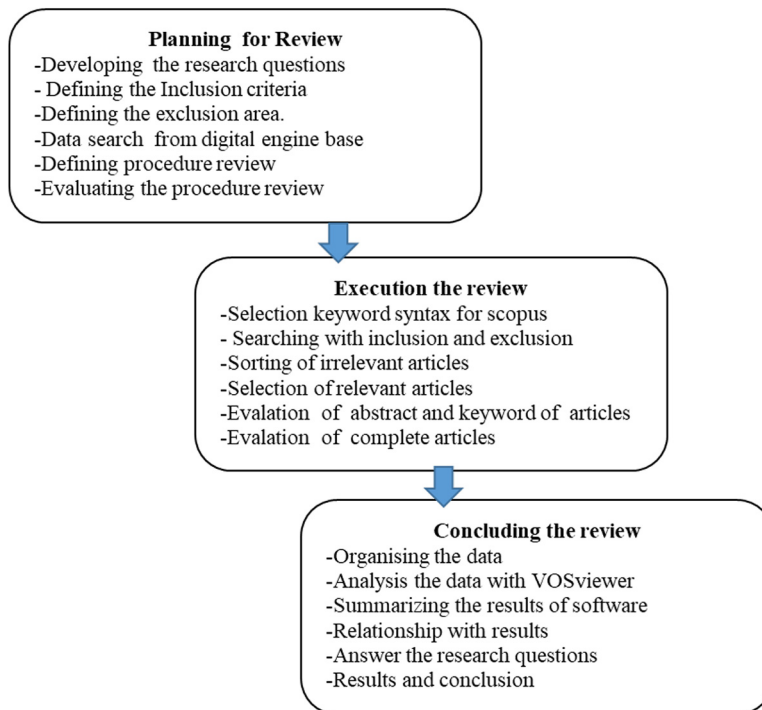
Systematic literature review articles can be broadly classified as method-based, domain-based and theory-based (Paul and Feliciano-Cestero, 2020). The systematic literature review has been used by many researchers in the supply chain context (Mustafa Kamal and Irani, 2014; Roberta Pereira *et al.*, 2014; Tachizawa and Wong, 2014; Queiroz *et al.*, 2019; Birkel and Müller, 2021). It is evident that, due to its systematic approach of systematic literature review (SLR), is considered a rigorous method in conducting literature reviews.

As per Paul and Criado (2020), a systematic review approach can be classified in a different way such as structured literature review (Canabal and White, 2008; Dhaliwal *et al.*, 2020; Kahiya, 2018; Hao *et al.*, 2019), framework-based review (Paul and Benito, 2018; Paul and Mas, 2019; Paul and Rosado-Serrano, 2019), bibliometric review (Goyal and Kumar, 2020; Rialp *et al.*, 2019) and meta-analytical review (Barari *et al.*, 2020; Rana and Paul, 2020; Schmid and Morschett, 2020). The literature of defined topic and keywords can be reviewed by identifying the trends, highlighting existing literature gaps in the selected studies and finally suggesting future research directions (Paul and Singh, 2017; Canabal and White, 2008; Paul and Feliciano-Cestero, 2020; Rosado-Serrano *et al.*, 2018; Kahiya, 2018).

Studying these literature review methods, the structured literature review approach is considered for this study as the objective and aim of our paper meets to develop by an understanding of procurement system for resilience supply chain. Despite different study by different researchers, all SLRs have a thread of commonality. This flow of literature review comprises three phases, i.e. planning of review, execution of review and reporting of the review. In this review of procurement system for resilient supply chain, we have designed a research protocol in phases and guidelines determined by Tranfield *et al.* (2003), which is explained in Figure 1. Three major phases were used, i.e. planning of review, execution of review and conducting the review.

3.1 Planning the review

In the initial stages of systematic reviews, we have considered as planning which is an iterative process of definition, clarification and refinement. We have defined the objective of this research and research questions in introduction part. As Tranfield *et al.* (2003) explained in their study, within management, it would be very important to conduct scoping studies to find the relevance and area of the literature and to limit the area of study. Such studies need to support our study of the set of articles identified to elaborate the field of procurement system in supply chain, and we tried to address four major areas to support our study, namely, the research context; the type of methodology used for research; the focal industry; the key factors explored to learning from COVID situation for procurement system. The review-planning phase includes all defining the keywords,



Source: Adapted from Tranfield *et al.*, 2003

Figure 1.
Three steps of an SLR

the selection of electronic database, usage of inclusion and exclusion criteria for selected articles and review protocol definition. The flowchart for the review process is elaborated in [Figure 2](#).

3.2 Execution of the review

We have used the Scopus database and google scholar for literature search because it is the most reliable, having a wide range of articles and are one of the most popular electronic databases (Geraldini *et al.*, 2011). To ensure the extensive and thorough coverage of papers, we have used a citation-chaining approach to search on the downloaded articles by using a forward and backward approach. This structured literature review started with the search of the existing literature on selected topics that was collected from an electronic database (Cheung and Thadani, 2012; Rosado-Serrano *et al.*, 2018). The collection of comprehensive and high-quality articles for the review has been ensured during the selection process using specific combinations of keywords. This enabled the identification of articles in database that focused exclusively on topics relevant to our research. The keywords were used in combinations for search in Scopus database using syntax to synthesis the literature of procurement system for supply chain resilience and the keywords “covid” OR “pandemic” added to get more research papers to know the impact on procurement system in resilient supply chain.

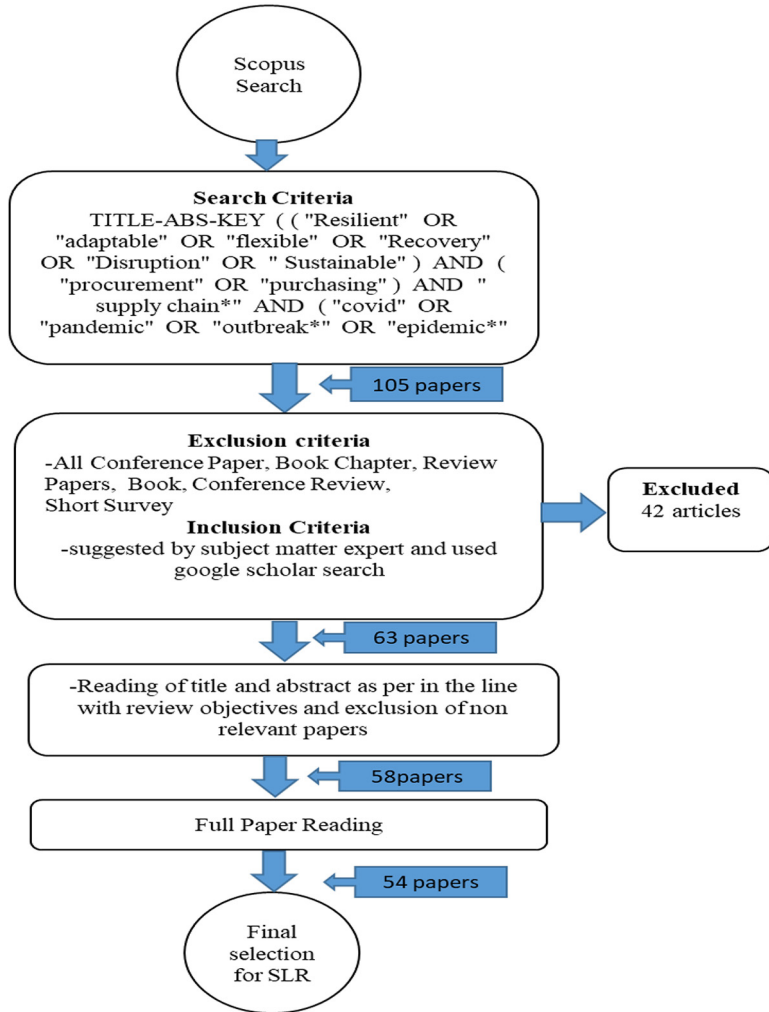


Figure 2.
Systematic literature review flow chart

3.3 Application of methodological screening criteria

As per the set protocol for methodological qualitative synthesis technique, we have used main keywords, i.e. procurement, supply chain and COVID-19, by using the syntax in the advanced search for preceding subsection in the Scopus electronic databases. The very initial search produced the results of 105 articles. We have added the keyword covid to ensure the relevant to the learning from COVID in procurement system were included, and we analysed the papers by thoroughly reading the abstracts with keywords. This was done to double cross-checking of all the identified articles to meet the purpose of review. In the results of screening process, we identified 63 articles which are relevant to the procurement system for resilience supply chain and learning from COVID. We applied the defined exclusion criteria on the remaining articles for further segregation, which left 58 articles

including nine articles removing COVID-19 from specified syntax to get articles before COVID-19 start point. We performed a thorough reading of the title, abstracts and keywords for arriving at a final count of articles as 54 articles.

The selected articles focused on various aspects of procurement system, which are further reviewed in the next section. A review protocol was developed for the analysis of contents of the selected articles (Stechemesser and Guenther, 2012). An initial analysis and sorting were conducted on downloaded excel sheet to get overall insights of subject from the selected papers. The articles were categorised by analysing each dimension of all categories, and the contents of paper was further evaluated using descriptive analysis approach with respect to pre-defined key criteria. To ensure the reliability of process, six different articles were offered to senior academics to read and classify these papers based on defined criteria and to ensure consensus (McDonald *et al.*, 2019). The validity has been ensured by discussing this study to another senior academics and feedback, suggestions and insights incorporated. As an additional and last step, we have used the snowballing methodology that aims to get the relevant result based on its citation in already selected papers (Gaikwad *et al.*, 2021).

4. Findings and analysis

This section is structured according to the keywords and code given in Table 1 and review protocol given in Table 2. As per bibliographic analysis, we have explained the background details of the publication. Finally, we have focused on explicit and implicit importance of procurement system for resilient supply chain based on learnings from COVID-19 disruption.

4.1 Underpinning approach

It is important to understand the current situation of environment in which organisations are surrounded and then how it is approaching to mitigate the adverse situations. A simple observation and description were used for researchers and academicians to explore in-depth, diverse range of theories (Chicksand *et al.*, 2012). Developing capabilities for making resilience in supply chain is very important (Sabahi and Parast, 2020). It is exhibited that as

Construct	Keywords	Code	Syntax for Scopus
Supply chain resilience	Supply chain resilience, flexibility in supply chain Resilience, resilient Supply chain vulnerability Vulnerability risk in supply chain	Resilient/ adaptable/ flexible/ Recovery/ Disruption/risk/ vulnerable	TITLE-ABS-KEY (("Resilient" OR "adaptable" OR "flexible" OR "Recovery" OR "Disruption" OR "risk" OR "vulnerable") AND ("procurement" OR "purchasing" OR "Buyer") AND "supply chain*" AND ("covid" OR "pandemic" OR "outbreak*" OR "epidemic*" OR "disease*"))
Procurement system	Procurement system, purchasing, Buyer	Procurement/ purchasing/Buyer	
COVID-19	COVID-19, Pandemic, Epidemic and diseases	Covid/ pandemic/ outbreak/ epidemic/disease	

Table 1.
Keywords and their
code used in the
study

<i>Bibliographic data</i>	
Author(s)	The author detail
Journal	The name of the journal where the paper published
Year of publication	The article publishing year
Geographical focus	The area where data was collected in these studies
Impact factor	The impact factor of journals?
<i>Background of publication</i>	
Type of research article	What is the nature of the research article?
Industry focus	The targeted industries for data collection
<i>Procurement system for resilience supply chain</i>	
Data collection method	The method of data collection used
Major themes	The major themes of procurement studies
Procurement system and learning from COVID	What is the procurement system is used for making resilience supply chain and what are the learning from COVID?
<i>Focus on contents of publication</i>	
Variables	The independent and dependent variables explored in the study
Focus area	What is the main focus area of publications
Procurement System	What is the different procurement system
COVID	What are opportunities and learning from COVID

Table 2.
Review protocol

Source: [Stechemesser and Guenther \(2012\)](#)

the ability of firm to build, integrate and reconfigure external and internal competences to accommodate changed environments ([Tallman, 2015](#); [Teece et al., 2014](#); [Teece et al., 1997](#)). Therefore, the dynamic capabilities of an organisation can develop sustainable competitive advantage during supply chain disruption, suggesting that the processes rely on the adoption of new strategy and execution in operation function to get desirable output ([Salvato and Vassolo, 2018](#)). The adoption of desirable competences by managers may support companies to use their resources wisely to create value in the system ([De los Rios and Charnley, 2017](#)). The foundation of such approach is to develop the distinct skills, organisational structures, use of Internet of Things (IOTs) processes, decision-making and disciplines in an organisation ([Brous et al., 2020](#); [Stephan et al., 2016](#); [Teece, 2007](#); [Eisenhardt and Martin, 2000](#)). The organisations need to adopt the new capabilities to mitigate with such events like COVID-19 and to respond quickly by adapting the capabilities and new strategies. It is therefore, the subject is considered how the procurement system as a capability of an organisation can be used for creating the supply chain resilience in prospective the learning from COVID-19 crisis. The existing literature make a correlation between different capability used by an organisation for creating supply chain resilience and underpinning to support the academicians in understanding of the topic.

4.2 Descriptive analysis

As the trend in [Figure 3](#) shows, there is a steadily increasing number of publications with the highest number of papers being published in 2021, when COVID-19 was at the highest peak related to procurement system and COVID-19.

Thus, it appears that the topic related to procurement system and strategy for resilient supply chain is becoming more and more important and of increasing interest among the

researcher and academicians. The publications are distributed with research core area from the Business, Management and Accounting (30%), the Social Sciences disciplines (15%) and Engineering (15%). There are also contributions from researchers of the Decision Sciences (16%), Computer Science (10%), Economics, Econometrics and Finance (9%) and Environmental Science and others (5%). The study mainly comes from the USA (35%), India (28%) and the UK (15%). The Netherland (9%), France (6%), UAE (2%) and others (16%). This literature review includes papers published in scopus indexed journals only. The only journals are considered for good quality of study material because of the crucial role of journal articles and analyse them in more detail. Overall, we count 54 different journals from logistic management to public administration (Table 3). There are six studies are published in different six journals related to supply chain management. Four journal articles each have been published in *Logistic Management* and *Journal of Production Research*; three articles are published in *Sustainability* journal; three articles are published in the *Public Procurement* journal. We count two articles each from the following journal, *Purchasing and Supply Management*; *Production Research*, *Engineering Management*. The other articles are published in *Manufacturing System*, *Operation Management*, *Operations and Strategic Sourcing*, *Management Information and Decision Sciences*, *Logistics Research and Applications*, etc. The impact factor is also considered to evaluate the set of study for references. *Cleaner Engineering and Technology* is having highest impact factor of 9.2, *Journal of Manufacturing Systems* having 8.6 and *Journal of Production Research* is having second highest impact factor, i.e. 8.43, respectively.

Overall, the most cited references are Ivanov and Dolgui (2020), Sharma et al. (2020), Butt (2021a, 2021b, 2021c) and Zhu and Krikke (2020). Each of these articles has the average citation: Azadegan et al. (2021), Barbosa (2021) and Omar (2021). The bibliographic analysis section is concluded with a citation analysis across all publications using VOSviewer software to analyse the interconnections between the references. The software generates a relation graph that shows a network diagram of the publications and their relationship to each other. The most cited reference is Ivanov and Dolgui (2020), followed by Sharma et al. (2020), Butt (2021a, 2021b, 2021c) and Zhu and Krikke (2020), respectively.

4.3 Background of the publication

Table 3 shows the number of papers published in each of the journals. The journals covered the procurement, supply chain and COVID-19 disruption topped the chart. Moreover, *Logistic Management*, *Sustainability*, *Public Procurement* and *Supply Chain Management* journals have the majority of publications. They include the publications such as *Supply Chain Management*, *Manufacturing*, *Procurement*, *Operations Management*, *Logistic*

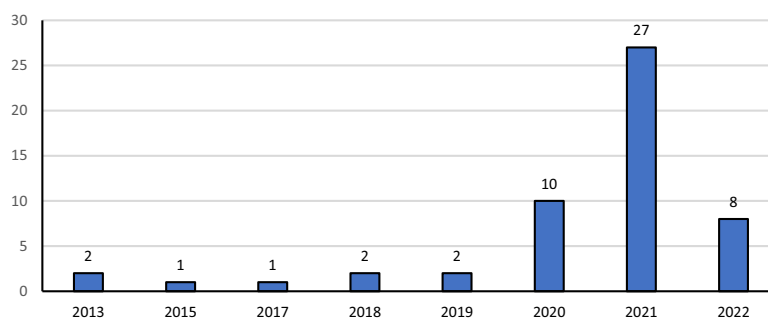


Figure 3.
Year-wise
publications

Journal name	No. of articles
<i>International Journal of Logistics Management</i>	4
<i>International Journal of Production Research</i>	4
<i>Sustainability (Switzerland)</i>	3
<i>Journal of Public Procurement</i>	3
<i>Transportation Journal</i>	2
<i>Journal of Supply Chain Management</i>	2
<i>Journal of Purchasing and Supply Management</i>	2
<i>IEEE Engineering Management Review</i>	2
<i>International Journal of Supply Chain Management</i>	2
<i>Sustainable Production and Consumption</i>	1
<i>Global Journal of Flexible Systems Management</i>	1
<i>International Journal of Disaster Risk Reduction</i>	1
<i>Computers and Industrial Engineering</i>	1
<i>Supply Chain Management</i>	1
<i>Research in Transportation Business and Management</i>	1
<i>Operations Management Research</i>	1
<i>Marine Policy</i>	1
<i>Journal of Transport and Supply Chain Management</i>	1
<i>Journal of Manufacturing Systems</i>	1
<i>Journal of Management Information and Decision Sciences</i>	1
<i>Journal of Global Operations and Strategic Sourcing</i>	1
<i>Journal of Financial Reporting and Accounting</i>	1
<i>Journal of Disaster Research</i>	1
<i>Journal of Business and Industrial Marketing</i>	1
<i>International Journal of Sustainable Agricultural Management and Informatics</i>	1
<i>International Journal of Production Economics</i>	1
<i>International Journal of Physical Distribution and Logistics Management</i>	1
<i>International Journal of Mathematical, Engineering and Management Sciences</i>	1
<i>International Journal of Logistics Research and Applications</i>	1
<i>IEEE Access</i>	1
<i>Global Food Security</i>	1
<i>Extractive Industries and Society</i>	1
<i>European Journal of Industrial Engineering</i>	1
<i>Computers and Industrial Engineering</i>	1
<i>Cleaner Engineering and Technology</i>	1
<i>Business Process Management Journal</i>	1
<i>Benchmarking</i>	1
<i>American Review of Public Administration</i>	1

Table 3.
Journals and the
number of articles
considered

Research and Strategic Sourcing, among others. However, there are also some influential business/financial journals such as *Financial Reporting and Accounting*.

4.4 Content analysis

4.4.1 Key learnings from COVID-19 pandemic. The recent example of coronavirus COVID-19 outbreak clearly shows the necessity of this new perspective of business continuity, and it is required for organisations long-term survival. Key learnings from COVID-19 are summarised in [Table 4](#) and enablers for resilient system are given in [Table 5](#). The analysis for organisation survivability at the level of procurement function requires deliberation at a large level in resilience of supply chain ([Ivanov and Dolgui, 2020](#)). Therefore, firms are now trying to identify the new strategies for improving survivability of supply chains in terms of sustainability ([Sharma et al., 2020](#)). The COVID-19 pandemic has enforced a restrictive

Key strategies	Definition	Reference
Need for survivability	COVID-19 pandemic clearly shows the urgent necessity of business survival and supply chain sustainability	Ivanov and Dolgui, (2020), Sharma <i>et al.</i> (2020)
Business continuity	Creating warehouses for required inventory for feeding to production for business continuity	Butt (2021a, 2021b, 2021c), Ino and Watanabe (2021)
Mitigating high demand	Right information flow to mitigate high demand in product hoarding by customer	Zhu and Krikke (2020)
Automation in existing system	Automation in exiting supply chain for benefit of cost savings, and timely delivery of product and mitigation of shortage of manpower due to health issues	Omar <i>et al.</i> (2021), Sobhani <i>et al.</i> (2019), Modgil <i>et al.</i> (2021), Joseph Jerome <i>et al.</i> (2022)
Product diversification	This strategy is used to mitigate the disruption in business and used existing product line when a business that has been experiencing stagnant	Vecchi <i>et al.</i> (2020)
Health work environment	Creating safe work environment where employees feel safe and healthy	Sobhani <i>et al.</i> (2019)
Disruption recovery strategy	The organisations are adopting new strategy of changing the product to recover the business loss	Chen <i>et al.</i> (2021)
Decentralisation	If suppliers or department are connected to each other that can trigger the chain reactions and results in different issues for other suppliers	Nikookar <i>et al.</i> (2021)
Lead time reduction	Lead time reduction by relocating the suppliers closer to manufacturing facilities, and manufacturing facilities closer to the end customer	(Swanson and Suzuki, 2020); Priyan <i>et al.</i> (2022)

Table 4.
Key learning from
COVID-19 crisis

working system because of social distancing and organisation has taken decision for remote working, and flexible hours for employees all around the world; thus, it is transforming into a platform of economy that may reduce further unemployment and increase job opportunities (Sharma *et al.*, 2020). It is significantly easier to make clear, consistent predictions from a cohesive theory by combining several known ideas. Nagurney (2021) used a game-theoretical study to investigate the role of labour constraint in a supply chain network during the COVID-19 pandemic. Kursan Milaković (2021) explains thorough social cognitive theory the significance of resilience, customer vulnerability and adaptability for purchase fulfilment and repurchase during the COVID-19 pandemic.

The product shortages are one of the phenomena were seen amid outbreak of COVID-19 pandemic. It is often observed that customers are seeking alternative sources of getting products and possibly with a tendency of hoarding, resulting into even high demand uncertainty after the shortage period (Zhu and Krikke, 2020). The shortage of products have two reasons: first, excessive consumption of product or hoarding, and second, low production in organisation because of employee health issues. The COVID-19 health protocol needs to be in place to make healthy and safe environment.

The healthy working environment refers to all working conditions that influence a workplace and related human health in time of COVID-19. Human has become critical resources of competitive advantage that improve the performance of an organisation. Since humans are involved in all the operations in an organisation. The health of employees has

Procurement enablers	Definition	References
Buyer-supplier collaboration	Buyer and supplier relation with coordination and collaborative approach	Ivanov and Dolgui (2020), Sharma <i>et al.</i> (2020), Hosseini <i>et al.</i> (2019), Ferreira <i>et al.</i> (2018), Demirel and Danisman (2019), Spieske (2022), Asfahani (2021), Macdonald (2021), Meyer <i>et al.</i> (2021), Rutkowski <i>et al.</i> (2022)
Information flow	Right information flow to the right decision for the right quantity of supply	Zhu and Krikke (2020), Hosnavi <i>et al.</i> (2019)
Reverse logistic	Reverse logistics is a type of supply chain management that moves goods from customers back to the sellers or manufacturers	Barbosa (2021), Hosnavi <i>et al.</i> (2019)
Technologies integration	Automation in group purchasing concepts benefit with volume discounts, cost savings and vendor selection and usage of e-procurement	Omar <i>et al.</i> (2021), Modgil <i>et al.</i> (2021), Rejeb <i>et al.</i> (2018), Joseph Jerome <i>et al.</i> (2022), Hu (2022), Bag <i>et al.</i> (2021a); Gomera and Mafini (2020)
Strategic Procurement	To identify proactive and reliable suppliers, the importance of stimulating the market to supply to diversified production	Vecchi <i>et al.</i> (2020), Frederico <i>et al.</i> (2021), Tip <i>et al.</i> (2022), Zunk <i>et al.</i> (2020), Hosnavi <i>et al.</i> (2019)
Inventory decision	Optimising inventory at vendor-buyer for business continuity	Sobhani <i>et al.</i> (2019), Butt (2021a, 2021b, 2021c)
Gaining visibility	Greater visibility to enhance information sharing, faster communication and better decisions for the entire organisation	Chicot and Matt (2018), Kosasih and Brintrup (2021), Namdar <i>et al.</i> (2018)
Independent suppliers	Interdependent suppliers can affect chain reactions and cause of supply issues for other suppliers, eventually disruption the whole supply chain	Nikookar <i>et al.</i> (2021)
Backup suppliers approach	Alternate supply agent or supply contractors (SCON) to manage the supply of items when traditional supply networks almost inoperative to fulfil buyer requirements	Das <i>et al.</i> (2021), Difrancesco <i>et al.</i> (2021), Hosnavi <i>et al.</i> (2019)
Alternate logistic	Alternate logistic was demonstrating a high level of adaptability to meet consumer and business demands	Rutkowski <i>et al.</i> (2022), Trivedi <i>et al.</i> (2020)

Table 5.
Procurement enablers for resilient supply chain

become major concern in COVID-19 crisis that is impacting the performance of inventory systems because of absenteeism due to health issues. A poor work environment design impact on production, defect generation, which subsequently deteriorates the performance of an inventory system (Sobhani *et al.*, 2019).

Key strategies for resilient supply chain are summarised in Table 6. The organisations are adopting a new strategy of changing the product to recover from the business loss in disruption due to COVID-19 crisis. The recovery strategy adoption by organisations is the new approach in COVID time. The recovery strategy adoption with the intention of replacing or changing the existing product type to mitigate the business loss and to increase the overall profit from changing the products. All three-area covered the emergency procurement process on the supply side and product changes manufacturing by operation

Resilience strategy	Definition	References
Supply chain network viability	Resiliency, robustness and stability are the newly identified construct which have a very positive impact on supply chain resilience	Ivanov and Dolgui (2020), Adobor (2019), Hosseini <i>et al.</i> (2019), Ferreira <i>et al.</i> (2018), Demirel and Danisman (2019)
Supplier risk mitigation	Enhancing the inbound material visibility and support Tier-1 and Tier-2 supplier and creating potential supplier	Butt (2021a, 2021b, 2021c), Sabouhi <i>et al.</i> (2018)
Decision-making	Organisation always need to share the right information to procurement function to facilitate decision-making	Zhu and Krikke (2020), Mahmoudi <i>et al.</i> (2021), Selvaraju <i>et al.</i> (2017), Haraguchi and Lall (2015)
Technology adoption	New technologies adoptions include contract, blockchain, Internet of Things, to make supply chain resilient and green	Barbosa (2021), Kaur and Singh (2019), Omar <i>et al.</i> (2021), Modgil <i>et al.</i> (2021), Joseph Jerome <i>et al.</i> (2022), Tran <i>et al.</i> (2020), Gomera and Mafini (2020), Kim <i>et al.</i> (2013)
Agile production	Organisations shifted production in a matter of weeks to meet new and evolving demands	Sharma <i>et al.</i> (2020), Tiwari <i>et al.</i> (2013), Gunasekaran <i>et al.</i> (2019), Patrucco and Kähkönen (2021), Zhukov (2019)
Production diversification	Diversification in product to meet high demand materials to ensure business risk	Vecchi <i>et al.</i> (2020)
Safe work environment	Creating safe work environment where employees feel safe and healthy for high productivity	Sobhani <i>et al.</i> (2019)
Standardised management system	Standardised management system for procurement and production continuity for creating resilience in supply chain	Ino and Watanabe (2021)
Sustainability	Sustainability in restoring the manufacturing facilities	Pereira <i>et al.</i> (2021), Milewska (2022), Da Ponte <i>et al.</i> (2020)
Antifragility	Getting benefitted in volatility, randomness, disorder, stressors, risk and uncertainty	Nikookar <i>et al.</i> (2021)
Synchronicity management	Mitigation of supply chain risks by systematically accepting the demand changes as starting point	Schiele <i>et al.</i> (2020)

Table 6.
Key strategies for resilient supply chain

function as well as backorder price recovery on the demand side. This disruption recovery process can reduce the loss of profit in the organisation due to delayed delivery and same time of order cancellation. It is experienced by organisations that the severity of supply chain disruptions is minimised by introducing diversified product, and this strategy can be used for optimal recovery of business loss whenever the supply chain faces a sudden massive disruption (Chen *et al.*, 2021). An analysis report for manufacturing by the National Association of Manufacturers has highlighted that 78% of manufacturing organisations have been severely impacted because of the COVID-19 pandemic. There are many lessons can be learned about the sources of supply chain fragility during this pandemic which can motivate manufacturing firms to understand the strategy to build an antifragile supply chain and procurement system (Nikookar *et al.*, 2021). Table 7 maps different studies in context to Covid 19 and key takeaways from these studies.

Table 7.
Mapping the impact
of COVID-19
pandemic and key
learnings

References	Outbreak/disease	Purpose	Method/theoretical approach	Key takeaway from study
Trivedi <i>et al.</i> (2020)	COVID-19	Proposed the solutions for resilient supply chain to overcome up with the pandemic situations now and in future	Data collected through structured interview of concerned and analysed data	Integrating the information and communication technology in operations to easily cope up with the uncertainties
Vecchi <i>et al.</i> (2020)	COVID-19	To differentiate the conventional procurement and strategic procurement during COVID-19 crisis	Analysing the strategic procurement system traits, i.e. best value selection criteria, prioritising innovation, partnership-based contractor relationship	The strategic role of sourcing, empowerment of procurement officials, coordinative mechanisms system, critical role of public-private integration to ensure responsiveness and resilience
Ivanov and Dolgui (2020)	COVID-19	The study of supply chain resilience at the level of interconnected supply networks	The study uses a dynamic game-theoretic model of a biological system that resembles interconnected supply networks to demonstrate viability formation	The study elaborates how integrity of the interconnected supply networks needs to be considered at the scale of viability
Sharma <i>et al.</i> (2021)	COVID-19	To understand the overall impact of COVID-19 pandemic on the sustainable business function of the firm such as procurement	A quantitative technique was used for data collection from 708 respondents. Structural equation modelling (SEM) was used to test the hypothesis	Understand the changing dynamics of the business equations which can help them in making own strategic for business evolution through considerations of manufacturers and suppliers
Meyer (2021)	COVID-19	Examined the public institutions behaviour during a COVID-19 pandemic to ensure the security of supplied material	Distinct focus on how and why public institutions need to adopt additive manufacturing (AM) – a 3D printing technology used for production	Introduced the behavioural solution approach for solving the supply disruption with changed forms of collaboration and cooperation in public procurement
Cariappa <i>et al.</i> (2021)	COVID-19	Tracking and estimating the effects of prices on consumer behaviour from discussing the implications for food waste and loss	An interrupted time series analysis on lockdown effects through a survey result of 729 consumers including 225 farmers and summarised the literature evidence on food waste as well as food loss	Exhibiting the resilience in Indian agriculture to address the unprecedented purchase that led to the food wastage by promoting the collective and capacity resilience of production systems through policies, institutions and reforms

(continued)

Table 7.

References	Outbreak/disease	Purpose	Method/theoretical approach	Key takeaway from study
Mushtaq <i>et al.</i> (2021)	COVID-19	To mitigate the special situation of COVID-19 pandemic where demand exceeds from supply	Multi criteria decision analysis has been performed to prioritise the customer-selection criteria and customers with respect to selection criteria	Supplier selection for procurement and supply chain to prioritise customers
Kosasih and Brintrup (2021)	COVID-19	Getting the visibility into procurement function between suppliers to develop contingency plans for gaining the business	Propose the usage of an automated process to detect links which is unknown to the buyer with graph neural networks	Developing an automated, graph neural networks-based approach that predicts links that are not visible in a procurement function
Modgil <i>et al.</i> (2021)	COVID-19	This study exhibits how organisations uses AI and adopt the opportunities to improve supply chain resilience by increasing sourcing system	A systematic approach of using open, coding and coding axial and some selective methods to identify and map the themes	To improve the supply chain resilience by developing demand visibility, sourcing, identify the risk and distribution capabilities
Butt (2021a, 2021b, 2021c)	COVID-19	To analyse the disruptions in supply chains due to COVID-19 pandemic and its mitigation	Study has been done through semi-structured interviews with managers of the four distribution centres and three buying firms and four supplying firms	Assessing the Tier-1 supplier's risk and activating the relationship with secondary suppliers to address the procurement issues
Mahmoudi <i>et al.</i> (2021)	COVID-19	To develop an innovative technology for decision-making of supplier selection problems	The study the deployment of two-fold decomposition, one for attributes and the other for alternatives	The study for providing an innovative technology for decision-making in supply chain to help procurement managers for evaluating the suppliers
Harland (2021), Mason <i>et al.</i> (2020)	COVID-19	Approach for supply chain management to handle current and future global crises	Understanding strategy for preparedness, mitigation, recovery and response to global crises	Purchasing and supply management and firm-based SCM have focused more on firms' decision-making
Chen <i>et al.</i> (2021)	COVID-19	To mitigate the supply chain disruption for recovery and developing the strategy of changing the original product	Maximise the total profit of business by changing the product, an integer linear programming (MILP) approach and model developed	Integrating the emergency procurement of material supply with product changes by the manufacturer and price compensation for backorder on the demand side
Derqui <i>et al.</i> (2021)	COVID-19	Exhibited the area for improvement for adoption the green procurement practices across the supply chain	Exploratory measurement of engagement with sustainability practices through analysis of 95 organisations and assessed these practices in context of the COVID-19 pandemic	Resilience to mitigate future crises and the implementation of best sustainable practices in the procurement system and emphasised on aiming on policies to improve the sustainability

Table 7.

References	Outbreak/disease	Purpose	Method/theoretical approach	Key takeaway from study
<i>Frederico et al. (2021)</i>	COVID-19	Analysis on the impact of the sourcing process strategy for supply chain response to COVID-19 crisis	To analyse the impact of the strategic sources on supply chain management through a descriptive survey methodology	Respondents have the majority of considered that a high and very high impact of five different phases of identified strategic sourcing process
<i>Bag et al. (2021c)</i>		The aim of this study is to research various approaches that may be taken to ensure the sustainability of supply chains	The important success factors derived from the existing body of research, which were then used into an interpretive structural modelling (ISM) technique	Organisations must foster a collaborative culture because a more robust supply chain necessitates greater collaboration across value chain partners
<i>Bag et al. (2021b)</i>	COVID-19	Investigates the impact of big data analytics (BDA) has on the innovation, resilience and responsiveness, of the health-care supply chain (HSC)	Both the scanning interpretation–action–performance model and the organisation information processing theory are used to explain the links among constructs	The capabilities of BDA play a pivotal role in constructing a responsive HSC and enhancing innovation, and both contributed to resilience. The influence of BDA capabilities on HSC innovation is strengthened when high innovation leadership is present
<i>Rahman et al. (2022)</i>	COVID-19	Studying the impact of strategic tools on SMEs' survival strategies using an integrated framework	Fuzzy sets qualitative comparative analysis (fsQCA) and structural equation modelling (SEM) are used to analyse the factors affecting the strategies for survival in the time of COVID-19 pandemic	The organisation business agility and optimisation of innovation capability are the important strategies for SMEs' survival
<i>Spieske et al. (2022)</i>	COVID-19	Analysis on how to increase supply chain resilience and understanding of the criticality of supplies of material during disruptions	Used resource dependence theory, author investigated procurement-related strategies to improve material availability	Traditional and new buffering measures to establish flows of supplies and leveraging long-term buyer-supplier relationships
<i>Chia-Nan et al. (2022)</i>	COVID-19	Lowering down the procurement cost to be more competitive	Hybrid MCDM model using the Fuzzy Analytical Hierarchy Process (F-AHP) model	Supplier selection for lowering procurement costs and increased profits without increasing the cost of quality and product

(continued)

References	Outbreak/disease	Purpose	Method/theoretical approach	Key takeaway from study
Joseph Jerome et al. (2022)	COVID-19	To analyse the effect on raw material movement due to COVID-19 and how it is time of innovation need for the procurement function	Structural modelling is used with the approach of Matric des Impacts Croises Multiplication Applique a un Classement' (MICMAC)	Application of the concept of Industry 4.0 into the procurement function to make it more resilient and efficient
Milewska (2022)	COVID-19	To mitigate shortages of materials and packaging; delays in delivery	Own elaboration based and data collection basis of interview with company executives	Building up inventory to supply from stocks at the time of risk during supply disruptions
Alam et al. (2022)	COVID-19	To analyses several aspects of the vulnerability of floating workers in urban in the context of COVID-19	The vulnerability of the informal floating workers was evaluated in two phases before the pandemic and during COVID-19 to evaluate the lives and livelihoods of those involved	The pandemic has impacted the existing vulnerability of the floating workers in multifield that include food crisis, job losses, education, shelter insecurity, social and well-being
Mohan et al. (2009)	Avian influenza	Risk management in the supply chain	Author has used risk-trust hierarchy model approach for risk management in the supply chain	Created several warehouses for redundant inventory, which keeps safety stock for business continuity to use the stock whenever demand of its products exceeds

Table 7.

Since the pandemic, there is more rhetoric about restoring supply chains to minimise the risk of disruption by having relocated the suppliers closer to manufacturing facilities, and manufacturing facilities closer to end customers (Swanson and Suzuki, 2020). Manufacturing across the globe is facing difficulties in restoring the production due to a shortage of manpower, difficulties in employee walkouts, lack of raw material supply and surprising supply-demand shifts. Sharma *et al.* (2021) suggest in their study that sourcing practices in manufacturers are affected because of COVID-19 pandemic to a high extent, but this pandemic has also led supply chain to understand and analyse the multidimensions of changing dynamics of the current business scenario to make own strategic and business evolution.

4.4.2 Procurement system new prospective. The COVID-19 pandemic caused the disruption in supply chain and discontinuity in material supply due to fluctuation in supply-demand of product and the need to reshape their material procurement strategy. An intertwined supply chain network is a set of interconnected supply chains, which is an open system which has a structural dynamic and organisations may exhibit multiple dimensions of business by changing the buyer-supplier responsibility in an interconnected supply chain (Sharma *et al.*, 2020). Supply chain network in terms of viability can be the main reason for managing buyer-supplier strong relationship and increasing the survivability of business in an organisation during and post such pandemic situations (Sharma *et al.*, 2020). The organisations are focusing on only Tier-1 supplier risk, increasing the visibility of inbound material and improving production facilities to mitigate the challenges amid COVID-19 pandemic. Furthermore, warehouses are being modified by organisations to keep high inventory as emergency buffer, evaluating alternative routes for outbound logistics as sources of supply to continue their business operations (Butt, 2021a, 2021b, 2021c). The manufacturing organisations are refining their production schedules based on basis of available inventory, getting better visibility to performance of their suppliers and developing new inbound logistics routes to meet the production challenges. They are also assessing the risk of Tier-1 suppliers and activating the interaction with alternate suppliers to mitigate the procurement issues. Secondly, distributors and dealers are modifying inventory norms to meet the inventory shortage. Finally, organisations are developing alternative outbound logistics resources to meet the growing demand (Butt, 2021a, 2021b, 2021c).

The product shortages are one of the phenomena were seen amid outbreak of COVID-19 pandemic. To manage a sustainable and resilient procurement system during COVID-19, the organisation has to use and share the right business information to facilitate the team for decision-making for right quantity at the right time (Zhu and Krikke, 2020). Group purchasing organisations (GPOs) are also a new important dimension for organisation to make resilience in supply chain and which help in volume discounts, cost savings and vendor selection. However, the current GPOs contract process and that could be more time-consuming and lack of efficiency. Hence, if it is integrated with decentralised storage and some advanced technologies like blockchain technology may promote transparency, minimise the procurement timeline and streamlines communication with stakeholders while avoiding pricing discrepancies and inaccuracies (Omar *et al.* (2021). Mahmoudi *et al.* (2021) has discussed in their research the usage of innovative technology for decision-making to organise the supplier selection issues for making supply chain resilience. This research also suggests to use the same decision-making technology for green supply chain to help procurement executives to evaluate the suppliers. The advanced technologies can contribute to enhance supply chain resilience through transparency, ensuring last-mile delivery, offering personalised solutions to both upstream and downstream supply chain

stakeholders, great visibility in procurement planning, minimising the impact of disruption and facilitating an agile procurement strategy (Modgil *et al.*, 2021). The several methodologies have been proposed to enhance the visibility in the procurement process. These are categorised into three categories; acquiring manufacturers information from Tier-1 suppliers and imposing management control over their supply contributions from approved supplier, subscription for advanced technologies to third party databases and deployment of process and product tracking system using radio-frequency identification technologies (Kosasih and Brintrup, 2021).

The practitioner-derived lessons have been used by some authors for improving procurement function in times of disaster. They have used the need to identify the strategic role of procurement function, empowering procurement managers, formalised the coordinative mechanisms with governance officials, reliable and proactive suppliers, the importance of stimulating the market demand for diversification of the product to fulfil the urgently in demand materials and to make strategy for resilient supply chain and identify the role of public-private integration to ensure quick responsiveness and resilience in supply chain system (Vecchi *et al.*, 2020; Frederico *et al.*, 2021). The suppliers of an organisation have an important role in sustainability aspects. The suppliers initially developed their sustainability initiatives at the time of outbreak without any support from buyers, any certification bodies or government. In spite of this, stronger relationships between buyer-supplier emerged facilitating greater supply chain sustainability. Consequently, by using both exploration and exploitation learning capabilities in the context of sustainability, multiple levels of learning were enhanced in the context of planning, social awareness and new procedures (Pereira *et al.*, 2021).

We must address the major disruption in transportation facilities observed during the pandemic, due in large part to changes in supply-demand, changes in the types of transportation services needed and unexpected market shutdowns and restrictions. The transportation capacity is typically sized appropriately to match the market; the unusual demand for essential items has exhausted capacity to transport discretionary goods like paper towels, hand sanitiser and bottled water. The transportation facilities have also been impacted by the types of demand spikes to deliver highly sought consumer goods. There have also been some drastic changes in the realm of purchasing. The supply has been threatened during the pandemic, and organisations sought to secure the supply of their most selling products to sustain the business. The long-term purchasing agreements with suppliers helped organisations to ensure deliveries, and to reserve capacity rather than own inventory (Swanson and Suzuki, 2020). Researchers may continue to explore how such long-term commitments with suppliers can impact supply chain agility. The governments and key administrative corporations were involved in the mitigation effort for sourcing difficulties seen during routine supply acquisition throughout the COVID-19 crisis,

4.4.3 New strategies for supply chain resilience. A new angle in supply chain resilience, a conceptualisation of quick decision-making culture with integrity of the supply chain and viability when a resistance of response to supply chain disruptions needs to be taken under consideration at the scale of viability (Ivanov and Dolgui, 2020). Therefore, organisations are now making efforts to identify the different ways for increasing the survivability of achieved sustainable supply chains. The significant sustainability factors (social, environmental and economic performance) and supply chain network viability for increasing the survivability of already sustainable supply chain has already been focused by organisations in such pandemic situation (Sharma *et al.*, 2020; Portuguez Castro and Gómez Zermelo, 2021).

The supply chain network viability is considered as an important criterion and its factors of resiliency, robustness and stability for enhancing survivability and managing supplier-buyer relationship for supply chain during of an origination in COVID-19 disruption. The organisations are moving to agile production system and working on enhancing the capacity to keep high inventories to feed the production line without interruption (Butt, 2021a, 2021b, 2021c). The organisations are using the right information flow for appropriate decisions for production and procurement to fulfil customer demands in timely as customer tends to product hoarding during COVID-19 crisis (Zhu and Krikke, 2020). The consumption of products, inventory and daily production can be tracked on real time basis through advanced technologies. Thus, it is creating the need of technologies for the procurement function to be more innovative (Joseph Jerome *et al.*, 2022; Curtis and Sarc, 2021). The technology of artificial intelligence (AI) is one of the mechanisms that is being used to enhance the resilience in supply chain by improving business operation capabilities (Modgil *et al.*, 2021). They examine how organisations adopt AI as an advanced technology and consider the opportunities in business to improve the supply chain resilience by developing procurement and distribution capabilities through enhancing visibility and risk prediction. The advanced technologies adoption contributes to make readiness for supply chains to mitigate the risk of disruption through improving the resilience. The resilience can be achieved through improve and strong collaboration between the firm and its chain of suppliers (Joseph Jerome *et al.*, 2022). There is the new strategy discussed the integration of resilience and green aspects of supply chain and conceptualised it with name as gresilience (Mahmoudi *et al.*, 2021). In the view of this new construct and based on a manufacturing firm, the study deploys for problem-solving of supplier selection and to understand the new concept of gresilient suppliers in the context of the supply chain disruptions. The organisations are adopting new strategy other than green supply chain integration, changing the product to recover the business loss in supply chain disruption (Chen *et al.*, 2021).

There is one more dimension for supply chain management; antifragility is beyond resilience or robustness (Nikookar *et al.*, 2021; Taleb and Douady, 2013). The authors have considered antifragility as the exact opposite of fragility, rather than robustness and resilience to be the antonym in supply chain as they may appear to be at first glance.

The resilient or robust has never been harmed nor helped by disorder and volatility when the antifragile benefits make supply chain resilient. Many supply chains are tightly connected to each other and dependent on one another that the failure at one supplier end can impact the cause problems and chain reactions for other suppliers and manufacturing operations, eventually chance of shutting down the entire supply chain. Examples include the massive disruptions in the automobile supply chain due to the earthquake of 2011 and tsunami in Japan, which impacted the other markets and resulted in affecting the supply chain partners worldwide (Lee and Rha, 2016).

4.4.4 Key takeaway from COVID-19 pandemic. The COVID-19 crisis has thrown supply chains into disruption worldwide including procurement function to conserve cost and material inventory from their Tier1 and Tier2 suppliers and push for tough collaboration with suppliers and logistics due to uncertainty in business. The movement of raw materials has been affected due to COVID-19, thus creating the need for the procurement function to be innovative technologically to make procurement activities more resilient and efficient (Joseph Jerome *et al.*, 2022). Trivedi *et al.* (2020) reveal in their study that integrating the communication and information technology in operations and as a strategic role of procurement function to easily cope up with the uncertainty adopting this as a solution for resilient supply chain now and in future. The strategic role of procurement can be defined as

empowering procurement officials, coordinative mechanisms with suppliers, critical role of supplier and buyer collaborations to ensure responsiveness and resilience (Vecchi *et al.*, 2020). It is important to understand responsiveness in changing dynamics of the business scenario, which can help organisations to make their own strategic and business evolution through considerations of manufacturers and suppliers (Sharma *et al.*, 2021). The assessing the supplier at Tier-1 for risk assessment and improving the relationship with Tier-2 suppliers to resolve the procurement issues for decision-making (Butt, 2021a, 2021b, 2021c). The supplier selection through an innovative way can help for decision-making by procurement executives to improve their supplies (Mahmoudi *et al.*, 2021; Wong, 2020).

For the resilience in supply chain in such a future crisis, it is important to implement the sustainable practices in procurement system and emphasise on policies development to improve the supply chain sustainability (Derqui *et al.*, 2021).

5. Top strategies for procurement function for resilient supply chain

We can summarise here the top strategies in the wake of COVID-19 and other disruptions; supply chain managers have to balance resilience and procurement efficiency to continue their business to optimise cost and operational efficiency with greater supply chain resilience (Emenike and Falcone, 2020). We have discussed key strategy adopted by organisations during COVID-19 crisis in Table 4. The COVID-19 pandemic clearly enforces the organisation to think on the necessity of business survival and supply chain sustainability, and now it is the need for survivability for organisation (Ivanov and Dolgui, 2020; Sharma *et al.*, 2020). The organisations are not able to deliver the product timely to the end of customers because of high demand and halt in production. It is time to focus on building the strategies to mitigate the high demand (Butt, 2021a, 2021b, 2021c; Ino and Watanabe, 2021). There are two major concerns for organisation; one is business continuity and procurement of raw material for regular supply to manufacturing at optimum quantity and cost in disrupted supply chain due to COVID-19 pandemic situation. The organisations are adopting new strategies and enablers for procurement operation for resilience supply chain, learned from COVID-19 pandemic crisis. In this study, we have summarised procurement enablers for resilient supply chain in Table 5. Ivanov and Dolgui (2020) reveal in their study that resiliency, robustness and stability are the newly identified construct which have a positive effect on supply chain resilience. Technologies adoption is one of major strategy identified in the study which include automated guided vehicles, blockchain, IOTs, to make supply chain resilient and green (Barbosa, 2021; Kaur and Singh, 2019; Omar *et al.*, 2021; Modgil *et al.*, 2021; Joseph Jerome *et al.*, 2022; Tran *et al.*, 2020; Gomera and Mafini, 2020; Kim *et al.*, 2013). The COVID-19 crisis has given the opportunity of adopting the strategic information flow to the suppliers and others who are concerned with business (Qiu *et al.*, 2022; Zhu and Krikke, 2020; Hosnavi *et al.*, 2019). We have summarised the key learning from COVID-19 crisis in Table 7. The COVID-19 is considered as barrier, threat and opportunity for some organisations because of having high demand (Moynihan *et al.*, 2020).

In this literature review, there are following procurement strategies were discussed in most of selected articles for resilience supply chain in this time of COVID-19.

5.1 Buyer-supplier collaboration

Supplier-buyer collaboration is identified as a very important activity that increases the capabilities of the supplier to make resilience in supply chain, in context of cost management, process improvement and technological innovation (Ampe-N'DA *et al.*, 2020).

The relationship between buyers and suppliers is considered a crucial factor for any organisation that is willing to be resilience and adapts to these disruptions. Resilience in supply chain becomes tough to attain if the buyer-supplier relationships (BSR) are restricted. [Sharma et al. \(2020\)](#) reveal in their study that the supply chain network viability criterion can be a major factor for improving the relationship of buyer-supplier and improving survivability to the next level during COVID-19 pandemic situation. Strategic information sharing strengthens BSR and selection of appropriate suppliers makes supply chains resilient ([Zhu and Krikke, 2020](#); [Hosnavi et al., 2019](#)). The traditional inventory and new buffering stocks can establish the flow of supplies and leveraging the long-term strong BSR ([Spieske et al., 2022](#)). In this systematic literature review, BSR improvement strategy during the COVID-19 pandemic are identified the main strategy as factors required for improving the survivability of business. [Mitra et al. \(2019\)](#) exhibited using the game theory that buyer and supplier collaboration can be impacted when they are involved in cooperative investment for improving quality in presence of uncertainty.

5.2 Technologies adoption

The COVID-19 pandemic crisis has resulted in major chaos in material supply globally that created massive disruption in supply chain management. The manufacturing industries have been working for business continuity to ensure that they can regain the business to minimise the loss. The restrictions being imposed to society and industries to prevent the spreading of COVID-19 virus among employees, the logistic and movement of raw materials and logistic has been affected, thus organisations are creating the need for upgradation the procurement system to be technologically innovative to make supply chain more resilient and efficient ([Omar et al., 2021](#); [Modgil et al., 2021](#); [Rejeb et al., 2018](#); [Joseph Jerome et al., 2022](#); [Hu, 2022](#); [Bag et al., 2021a](#); [Gomera and Mafini, 2020](#)). Resilience in supply chain can be achieved through the coordination and collaboration between the organisation and chain of suppliers throughout supply chain ([Joseph Jerome et al., 2022](#)). Rapid advancements in advanced technologies are reshaping global supply chains and transforming the current model of the procurement function within organisations. Broadly, procurement function and logistics involve information flow for the exchange of a wide variety of data and fast communication between suppliers and procurement team. As this COVID-19 pandemic, the needs of companies have become more complex. The technological innovations are adopted to mitigate the disruption and support to make advancements in procurement system in terms of predictability, transactional automation and proactivity of supplier relationship management. These emerging technologies consists big data analytics, robotics, IoT, blockchain and smart contracts ([Rejeb et al., 2018](#)). The blockchain technology can be used to improve supply chain resilience in terms of alignment, adaptability and agility, which lead to better firm performance and competitive advantage ([Sheel and Nath, 2019](#); [Barbosa, 2021](#); [Kaur and Singh, 2019](#)). However, the COVID-19 pandemic has enforced everyone to work-from-home and rely completely on technology and employees also learned to use technology as a way of life which is supporting organisations in adopting technologies not only procurement function but all operations. For organisations to keep moving forward in competitive environment, it became essential to implement innovative technology for procurement, information flow and project management ([Trivedi et al., 2020](#)).

5.3 Supplier risk mitigation

A majority of organisations across the globe were caught as they had little to no visibility beyond their Tier-1 supplier because of disruption in material supply. The Tier-2 and Tier-3 suppliers were not able to feed the supply to the operation unit due to lockdowns or due to

longer payment issue terms, which resulted in a major cash flow crunch in supply chain, eventually force them to halt production unit. Butt (2021a, 2021b, 2021c) has revealed in their study that supplier risk can be mitigated by enhancing inbound material visibility and support Tier-1 and Tier-2 supplier. Milewska (2022) suggests in their study that building up larger supply stocks can be considered as a risk mitigation plan for supplier risk during supply disruptions.

5.4 Inventory and stock buffer

The building inventory is the most straightforward way to enhance resilience in procurement function, whether in the form of underutilised production facilities or inventory in excess of safety stock requirements (Milewska, 2022). The challenge is that buffers are expensive and cost to business, and supply chain leaders may have a hard time justifying to keep excessive inventory. The creation of warehouses for redundant inventory to keep safety stock to mitigate the shortage whenever demand of products exceeds (Mohan *et al.*, 2009). The inventory decision can be taken to keep the stock at supplier end or warehouse created by procurement function (Sobhani *et al.*, 2019; Butt, 2021a, 2021b, 2021c).

6. Proposed framework for future ready procurement system

Based on the above analysis, we are proposing a future ready procurement system as shown in Figure 4. This framework can be adopted by any organisation that is experiencing supply chain disruption due to a pandemic as a starting point for not just restoring procurement activity but also creating a future-ready procurement system. The framework proposes four dimensions, which include assessing the existing situation, assessing the impact of the pandemic not only on procurement systems but also on the entire supply chain from raw material to dealer, and taking into consideration the challenges and opportunities that are present in procurement system and business. The second building component of the framework is the restoration of the procurement system to support business, which includes the creation of a business continuity plan that considers possibilities, difficulties and employee working standards. There is a third important dimension of framework, adoption of new technologies keeping in mind the requirement of future ready procurement system to address such disruptions in future.

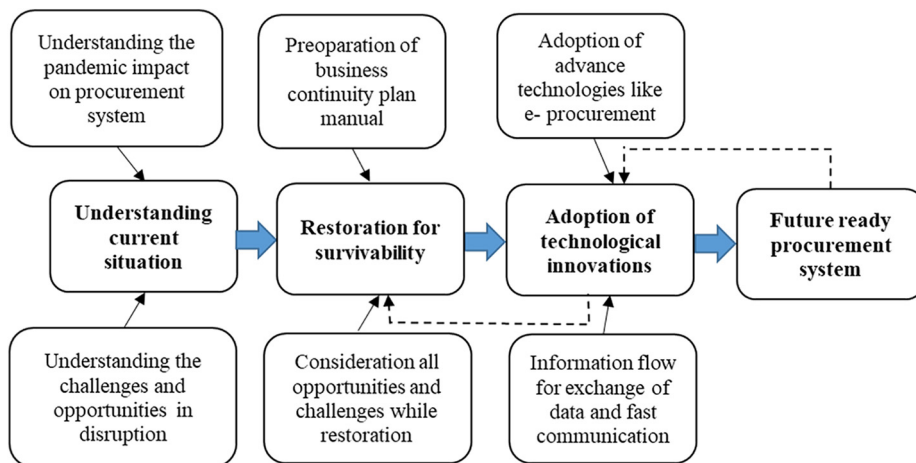


Figure 4. Framework for future ready procurement system

7. Conclusions and future research directions

Our study reveals a strong relationship between procurement system and resilience in supply chain. In terms of general perspective of procurement system, this literature review has found significant conceptual theory in existing research through observing and analysing the concepts of procurement functions and its strategies. Therefore, more rigorous empirical and exploratory studies are required to justify the identified strategies of procurement for business continuity and resilience in supply chain with practical evidences. This study will encourage researchers and academicians to further investigate all elements of procurements and supply chain to discover specific measures for resilience in supply chain. Based on this review, we recommend some key research areas which need to be explored:

- The case studies have proven to be valuable in determining the best direction to deliver an in-depth discussion on subjects such as procurement and supply chain resilience. To validate both the principles and the actual scenario of disruptions and the adoption of the most effective strategies, empirical research should be also conducted.
- It has been observed that COVID-19 has affected all areas of business operations, world economy and society. The study suggests that the future research may focus more on extending how the organisations are adopting the new ways of doing business and strategies to tackle the similar type of unknown systemic threats and disruptions.
- The identified strategies in this literature review have the potential to undergo additional development and improvement to produce a quicker recovery of business after the COVID-19 pandemic outbreak. Future research may be carried out to develop framework to gauge the impact of the COVID-19 pandemic outbreaks in supply chains.
- Applications of optimisation tools, theoretical frameworks, network theory, game theory, simulation-based methodology and data-driven analytics for smart procurement system should be explored as a future scope for research during uncertain business environment.
- Technological innovations may play an important role in developing smart procurement system. So future research in this direction may be also carried out.

7.1 Implications

The practitioners and academicians can benefit from the observations and findings to develop a better understanding of resilient supply chain.

7.1.1 Academic implications. Firstly, this study identified the procurement enablers taking learning from COVID-19 crisis, which provides the researchers with the new dimensions of relevant studies on supply chain resilience. Secondly, this paper tried to address the key strategies for making resilient supply chain by offering the first structured review on extant studies. This study provides researchers with the scope of future study to develop a clearer approach and structure through research in this area. This paper contributes in reviewing the strategies adopted in procurement system for resilient supply chain. It identifies procurement enablers to build the resilient supply chain. The study suggests a research direction for assessing readiness, situation awareness, visibility and redundancy for the supply chain resilience.

7.1.2 Practical implications. This review of procurement system and supply chain disruption due to COVID-19 crisis can help organisations and practitioners towards a better knowledge, understanding about procurement system and the requirements of making a resilient supply chain during uncertain business environment such as COVID-19 crisis. Major strategies for making resilience supply are identified in this study. These strategies can be used in any manufacturing organisation as a framework for business continuity and restoring operations based on real situations. Managers can have a clear understanding of the evaluation of current situation and capability for further improvement. The managers of manufacturing organisations can directly refer to identified strategies such as supplier-buyer collaboration, technologies adoptions, production diversification, agile production, reverse logistic and information flow to restore the business operations affected from COVID-19 crisis. Therefore, this literature review can be considered as a good set of strategies for understanding, evaluation and restoring the business operations during uncertain times due to pandemic or any other disaster.

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