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Supply chain in the wake of COVID-19 – a bibliometric and content analysis

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Abstract: The COVID-19 pandemic has immensely impacted the global supply chain. Although many research articles have been published in this field since 2020, the literature is still fragmented. Recognising this gap, this study provides a comprehensive analysis of literature published on COVID-19 and global supply chain management. The two-tier bibliometric and content analysis is performed to identify the key research themes and future research directions. A set of 273 articles published in the Scopus database during 2019 and 2021 (Q3) were considered for analysis. Further content analysis of co-citation analysis emphasises three research themes namely supply chain disruption, supply chain resilience, and control and mitigation strategies of COVID-19 outbreak. The findings highlighted that COVID-19 disruption can be minimised by information sharing, use of digital technology, and reconfiguration of supply chain. The outcome of this study led to the identification and analysis of the strategies, methodologies, and emerging focus areas for discussion.

Keywords: COVID-19; supply chain; bibliometric analysis; content analysis.

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1 Introduction

The coronavirus disease (COVID-19) pandemic is one of the most severe disruptions in history that revealed the vulnerability of the supply chains. It has affected the overall working of the supply chains including an imbalance in supply and demand, delayed deliveries, backordering and dissatisfied customers (Dohale et al., 2021; Ivanov and Dolgui, 2020). According to the report published by Sherman (2020) in Fortune, in the list of Fortune 1,000 companies, 94% are facing supply chain disruption caused by the COVID-19 pandemic. For example, in pharmaceutical supply chains, demand drastically increased and supply was low (Liza et al., 2022), while in the automotive supply chain, demand and supply both were at a low level (Belhadi et al., 2021). The focus was shifted to enhancing supply chain resilience instead of optimising for increased efficiency.

The impact of COVID-19 on supply chain management (SCM) has attracted the researcher's community which leads to a large number of research papers and articles published on this topic in the past two years. Recognising this gap, this study provides a comprehensive analysis of literature published on COVID-19 and global SCM. The extant literature has examined SCM issues in pandemics (Cordeiro et al., 2021; Raj et al., 2022), the impact of epidemic outbreaks on supply chains (Ivanov, 2020a; Queiroz et al.,

2020), on logistics (Montoya-Torres et al., 2021), and supply chain sustainability and resilience (Sajjad, 2021; Sharma et al., 2022). Some review articles were also published in this field. Chowdhury et al. (2021) provided a systematic review of COVID-19 pandemic-related supply chain studies considering 74 articles published till 28 September 2020. The literature was classified based on context, methodologies, and theories used in the study. The outcome of the study emphasised the need for more research on low demand items and SMEs. Queiroz et al. (2020) conducted a systematic literature review of 32 articles published on the impact of COVID on supply chain. Gupta et al. (2021) performed a bibliometric and network analysis of research articles published on COVID and SCM. A combination of systematic literature review and interview method is applied by Kohl et al. (2022) to identify solutions to improve supply chain crisis management. Rahman et al. (2022) examined the trend of the humanitarian supply chain in the pre, during and post-COVID periods. The articles were collected from 2006 to 2022 and analysed using bibliometric analysis.

The extant literature on the topic suggests that a comprehensive bibliometric and content analysis-based review on COVID-19 in the context of SCM is missing in the literature. To fill the gap, this study presents a comprehensive overview of COVID-19 research from the supply chain perspective. The findings provide a way for supply chain managers in deciding policies and strategies. For researchers, it will help identify research trends and future research directions. The following research questions are designed to address the research contribution:

RQ1 What is the current state of research in the domain of COVID-19 and SCM?

RQ2 What are the key research themes and how it affects the SCM outcomes?

RQ3 What are the future research directions in the domain and how it can be beneficial for academicians and practitioners?

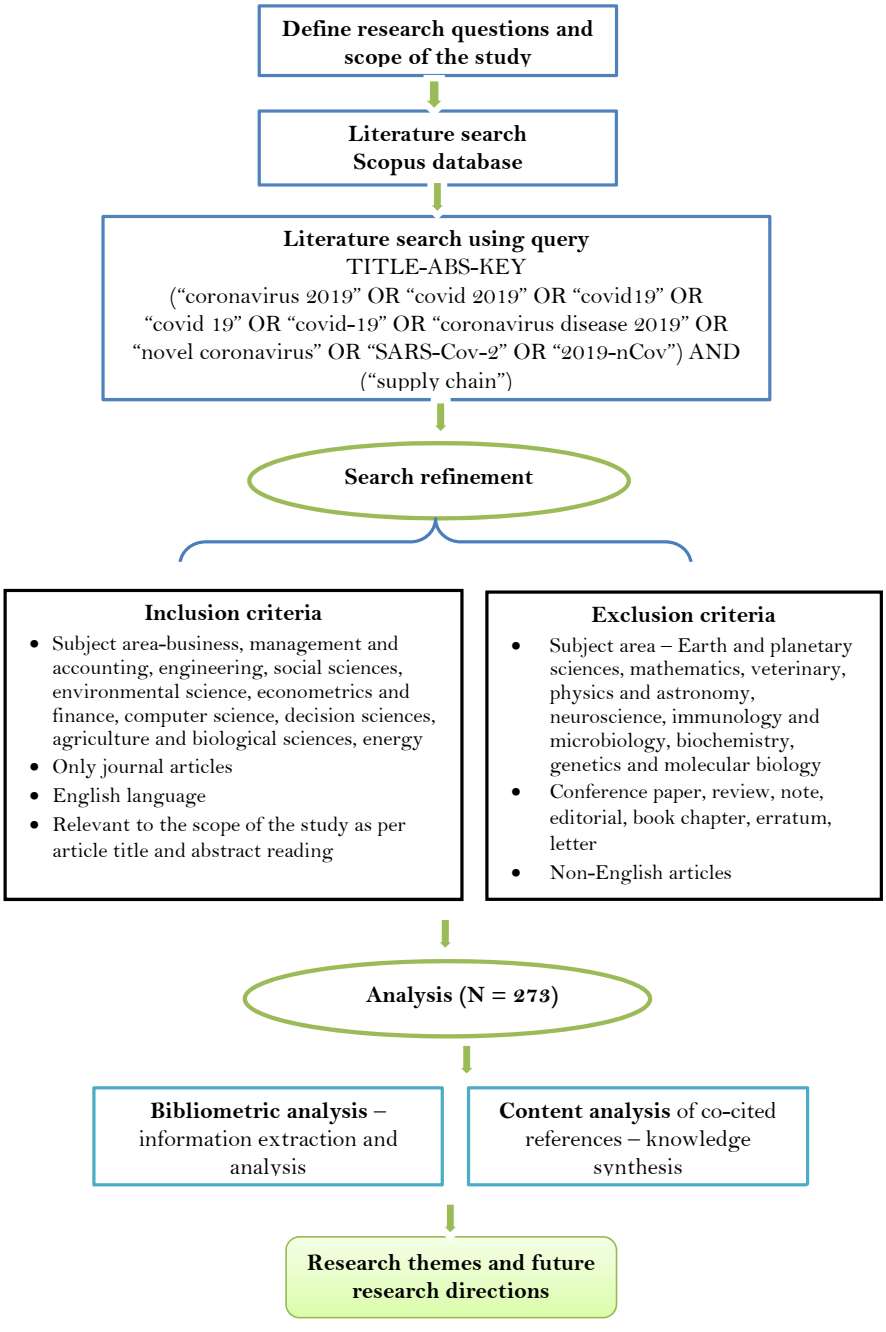
The structure of this study is as follows. Section 2 explains the research methodology. Section 3 presents the results and analysis. Section 4 presents the discussion and implications of the study. Section 5 highlights the limitations and future research directions. Finally, Section 6 concludes the study with limitations.

2 Research methodology

A literature review is an instrument that helps to map and evaluate the existing boundaries of knowledge, research gaps and identification of potential research directions (Badhotiya et al., 2016; Tranfield et al., 2003). It is a systemic and objective technique that covers a wide range of literature and provides a detailed and in-depth analysis (Sachdeva et al., 2021). In line with the research questions, this study is divided into three phases: data collection, analysis and synthesis (Figure 1). In the data collection phase, a keywords search query was designed to identify the relevant literature published on COVID-19 and supply chain. This keywords search query within the Scopus database was used to identify the relevant literature. Inclusion and exclusion criteria were applied to set the boundaries and further improve the quality of the articles considered for the study. In the analysis phase, the VOSviewer was used to extract the bibliometric information of the published articles. Additionally, content analysis of the co-cited

references was also performed to identify the research themes. In the synthesis phase, the relevant information and key insights that address the research questions are presented. A step-by-step description of subsequent steps adopted in the research methodology (Figure 1) is mentioned in the next section.

Figure 1 Research methodology of the study (see online version for colours)



2.1 Keywords search query and data collection

Following the methodology of Mallett et al. (2012), relevant keywords on the topic were identified from published literature. For ensuring wide coverage of research articles, four academicians and industry experts were consulted to confirm the keywords search query. The keywords search query consisted of two parts using both 'AND' and 'OR' operators; Part A deals with keywords related to 'COVID-19' whereas Part B captures the 'SCM' perspective. The final keywords search was as follows: ('coronavirus 2019' OR 'COVID 2019' OR 'COVID19' OR 'COVID 19' OR 'COVID-19' OR 'coronavirus disease 2019' OR 'novel coronavirus' OR 'SARS-Cov-2' OR '2019-nCov') AND ('supply chain'). Scopus database was used to extract the articles as it provides extensive coverage of articles from the social science domain (Fahimnia et al., 2015). The initial search consists of 1,383 documents.

2.2 Screening and refinement of articles

The article screening and refinement were conducted in two phases: Phase 1 consists of articles published in peer-reviewed journals, as it reflects the certified knowledge. To get more relevant articles, the database was further refined based on subject areas such as business and management, engineering, social sciences, environmental science, computer science, engineering science, agricultural and biological sciences and energy. This refinement drastically reduced the number of articles to 767. Furthermore, the articles were refined based on sources and the English language. It provides a list of 580 articles. Phase 2 deals with manual screening and refinement of the literature. In line with the need for the study and research questions, these articles were manually scanned to check the relevance of the papers. The final set consists of 273 articles for analysis.

2.3 Bibliometric analysis

The bibliometric analysis introduced by Pritchard (1969) is a quantitative tool to analyse a set of large databases (Zupic and Čater, 2014). It is an effective method to provide comprehensive information about the research field and helps in understanding the relationship among articles, keywords co-occurrence, co-citations and country's co-authorship. Here, it is important to note that literature review and bibliometric analysis are complementary to each other therefore to provide a comprehensive understanding of the articles published on COVID-19 and SCM; content analysis is used with bibliometric analysis. The content analysis of network clusters may help identify the research trends and future research directions (Krippendorff, 2018).

3 Results and analysis

The results are presented based on descriptive, bibliometric and content analysis of the articles.

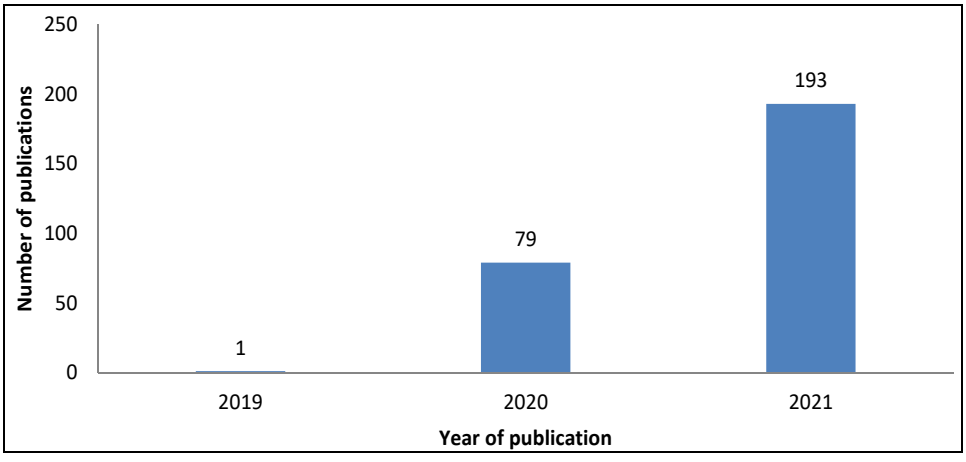
3.1 Descriptive analysis

A descriptive analysis aids in capturing the gist of published literature. A preliminary overview of 273 articles published on COVID-19 and SCM is presented in Table 1. The first article was published in 2019. Since then, there is an exponential increase in the number of publications (Figure 2). A large number of papers are published focusing on the impact of COVID-19 on the global supply chain and strategies used by management to overcome the situation. Findings reveal that the research on this topic is at the evolving phase as more work is required to adopt and effectively implement the strategies in the post-pandemic world.

Table 1 General results

Criteria	*Quantity*
Articles	273
Journals	129
Authors	943
Institutions	786
Countries	89
All keywords	1,622
Cited references	16,252

Figure 2 Publication trend (see online version for colours)



3.2 Most cited articles

Table 2 presents the list of most cited articles published on COVID-19 and SCM. Ivanov (2020a) proposed a simulation-based analysis for the impact prediction of the COVID-19 outbreak on global supply chain. Furthermore, Ivanov and Dolgui (2020) discussed intertwined supply chain networks for enhancing the resilience of supply chains. The third most cited article is published by Hobbs (2020) wherein the author discussed the impact of COVID-19 on the food supply chain. Interestingly, the majority of these

articles have used conceptual and quantitative approaches and were published in high *h* index journals. The findings of the most cited articles revolve around the impact of the pandemic on global supply chains, intertwined supply chain networks, agility, resilience, sustainability issues in supply chains, challenges, opportunities, innovations in waste management, and demand and supply gaps in healthcare and food industry.

3.3 Most influential journals

The *International Journal of Production Research* is the most influential journal published on COVID-19 and SCM followed by *Annals of Operations Research* and *International Journal of Operations and Production Management*. According to the Scopus database, the *International Journal of Production Research* ranks 5th place among 166 in the *Management Science and Operations Research* category. The journal has a CiteScore of 10.8, and possesses a SCImago journal ranking (SJR) of 1.909, indicating a high number of citations received by the articles. Interestingly, all of these top 10 journals possess a high *h* index value which reflects the quality of the journal. These journals are published by reputed publishers such as Elsevier, Emerald Insight, MDPI, Oxford University Press, Springer, and Taylor and Francis.

3.4 Most influential authors

The findings reveal that Dolgui, A. (*h* index 49) from IMT Atlantique, France followed by Ivanov, D. (*h* index 45) and Hobbs, J. (*h* index 24) are the most influential authors who have published the highest number of articles on COVID-19 and supply chain (Table 4). Dolgui, A. has published extensively on production planning, supply chain optimisation, and manufacturing line design. Similarly, Ivanov, D. published mainly on digital supply chain twins, ripple effect, structural dynamics control methods, scheduling problems, and Industry 4.0. Whereas, Hobbs, J. has focused his research work on food supply chain, food technology, supply chain resilience and risk perception. Majorly, the authors are from developed nations, particularly from the North American and European continents. However, authors from India and Bangladesh also managed to achieve ranks in the list of the top 10 most influential authors.

3.5 Most influential institutions

Table 5 provides a list of the most influential institutions. Berlin School of Economics and Law based in Germany top the list followed by the University of Tehran, Iran and Worcester Polytechnic Institute, USA. Some of the institutions are listed in QS-Ranking 2021. However, there is only one institution from the developing country, i.e., Bangladesh which managed to attain a rank among the most influential institutions. The finding shows that the research on COVID-19 in the supply chain context is conducted around the world.

Table 2 Most cited articles

#	*Article, author(s) and year of publication*	*Journal*	*H-index*	*Ranking*	*Citations*	*Type of research*
1	Predicting the impacts of epidemic outbreaks on global supply chains: a simulation-based analysis on the coronavirus outbreak (COVID-19/SARS-CoV-2) case (Ivanov, 2020a)	*Transportation Research Part E: Logistics and Transportation Review*	110	A*	348	Quantitative
2	Viability of intertwined supply networks: extending the supply chain resilience angles towards survivability. A position paper motivated by COVID-19 outbreak (Ivanov and Dolgui, 2020)	*International Journal of Production Research*	142	A	211	Quantitative
3	Food supply chains during the COVID-19 pandemic (Hobbs, 2020)	*Canadian Journal of Agricultural Economics*	37	A	194	Conceptual
4	Viable supply chain model: integrating agility, resilience and sustainability perspectives – lessons from and thinking beyond the COVID-19 pandemic (Ivanov, 2020b)	*Annals of Operations Research*	105	A	128	Quantitative
5	Challenges and solutions for addressing critical shortage of supply chain for personal and protective equipment (PPE) arising from coronavirus disease (COVID19) pandemic – case study from the Republic of Ireland (Rowan and Laffey, 2020)	*Science of the Total Environment*	244	Unspecified	123	Mixed
6	A decision support system for demand management in healthcare supply chains considering the epidemic outbreaks: a case study of coronavirus disease 2019 (COVID-19) (Govindan et al., 2020)	*Transportation Research Part E: Logistics and Transportation Review*	110	A*	95	Quantitative
7	Challenges, opportunities, and innovations for effective solid waste management during and post COVID-19 pandemic (Sharma et al., 2020a)	*Resources, Conservation and Recycling*	130	Unspecified	82	Conceptual
8	A digital supply chain twin for managing the disruption risks and resilience in the era of Industry 4.0 (Ivanov and Dolgui, 2021)	*Production Planning and Control*	76	A	72	Conceptual
9	Research opportunities for a more resilient post-COVID-19 supply chain – closing the gap between research findings and industry practice (van Remko, 2020)	*International Journal of Operations & Production Management*	138	A	65	Qualitative
10	Impact of COVID-19 on logistics systems and disruptions in food supply chain (Singh et al., 2021)	*International Journal of Production Research*	142	A	55	Quantitative

Table 3 Most influential journals

Rank	*Journal*	*Publisher*	*H-index*	*Ranking*	*Total documents*	*Total citations*	*Average citations*
1	*International Journal of Production Research*	Taylor and Francis	142	A	7	286	40.85
2	*Annals of Operations Research*	Springer	105	A	7	160	22.85
3	*International Journal of Operations and Production Management*	Emerald	138	NA	6	114	19
4	*International Journal of Production Economics*	Elsevier	185	A	6	78	13
5	*International Journal of Physical Distribution and Logistics Management*	Emerald	111	NA	4	50	12.5
6	*Sustainable Production and Consumption*	Elsevier	26	NA	7	65	9.28
7	*International Journal of Logistics Research and Applications*	Taylor and Francis	33	NA	4	27	6.75
8	*Applied Economic Perspectives and Policy*	Oxford University Press	49	B	4	26	6.5
9	*Sustainability (Switzerland)*	Multidisciplinary Digital Publishing Institute (MDPI)	85	NA	29	132	4.55
10	*International Journal of Logistics Management*	Emerald	77	A	8	21	2.62

Table 4 Most cited authors

Rank	*Authors*	*Institution*	*Country*	*Total documents*	*Total citations*	*Average citations*
1	Dolgui, A.	IMT Atlantique	France	3	320	106.66
2	Ivanov, D.	Berlin School of Economics and Law	Germany	13	909	69.92
3	Hobbs, J.	University of Saskatchewan	Canada	3	201	67
4	Govindan, K.	University of Southern Denmark	Denmark	3	95	31.66
5	Das, A.	City University of New York	USA	3	58	19.33
6	Paul, S.	University of Technology Sydney	Australia	4	59	14.75
7	Kabir, G.	University of Regina	Canada	3	42	14
8	Ali, S.	Bangladesh University of Engineering and Technology	Bangladesh	5	49	9.8
9	Luthra, S.	Ch. Ranbir Singh State Institute of Engineering & Technology	India	5	33	6.6
10	Kumar, A.	London Metropolitan University	UK	5	24	4.8

Table 5 Most cited institutions

Rank	*Institution*	*Country*	*QS ranking*	*Total documents*	*Total citations*	*Average citations*
1	Berlin School of Economics and Law	Germany	Unspecified	5	355	71
2	University of Tehran	Iran	591–600	2	102	51
3	Worcester Polytechnic Institute	USA	701–750	2	38	19
4	Hanken School of Economics	Finland	Unspecified	2	38	19
5	University of Technology Sydney	Australia	133	4	59	14.75
6	Babol Noshirvani University of Technology	Iran	Unspecified	2	23	11.5
7	Bangladesh University of Engineering and Technology	Bangladesh	801–1,000	4	38	9.5
8	London Metropolitan University	UK	801–1,000	3	24	8
9	University of Kassel	Germany	Unspecified	2	11	5.5
10	Dalian University of Technology	China	591–600	2	11	5.5

3.6 Most influential countries

The most influential countries are shown in Figure 3. Germany with 44.71 average citations followed by France, Canada and Iran are the most significant countries published on COVID-19 and supply chain with an average citation count of 19.42, 18.07 and 13.4, respectively (Figure 4). However, in terms of the number of publications, the USA ranks at the top with 59 publications). COVID-19 impacted the world of work all across the globe and significantly changed the business dynamics of organisations. Developing and emerging nations are also struggling to cope with this change. Consequently, researchers' contribution from India and China also provides multiple avenues to explore the SCM issues during and post-COVID-19.

Figure 3 Most cited countries (see online version for colours)

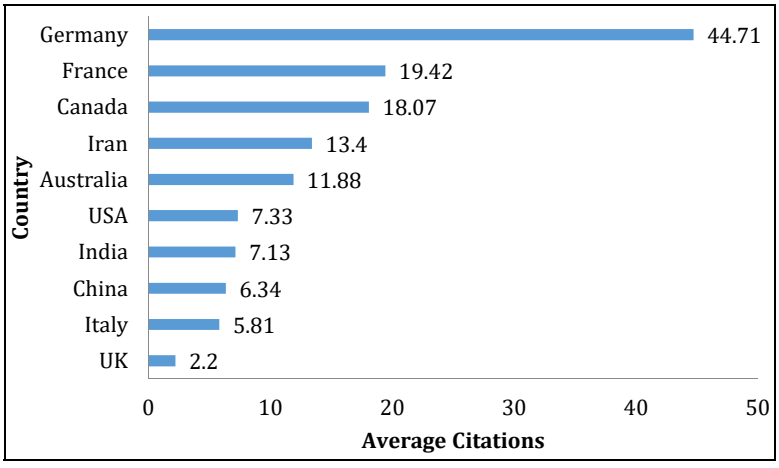
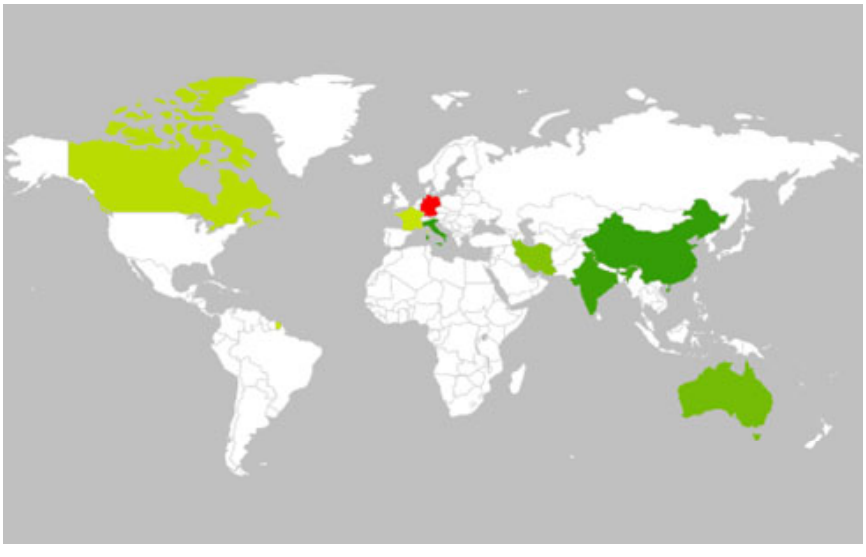


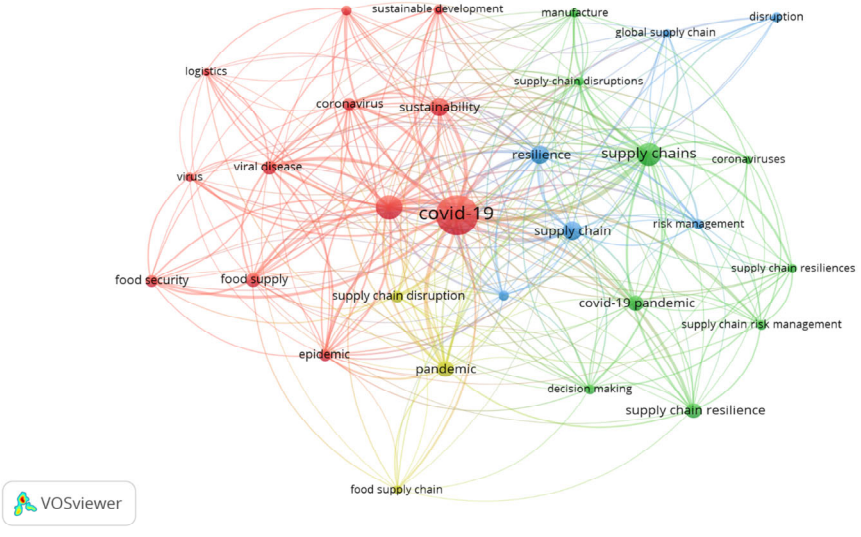
Figure 4 Most influential countries (see online version for colours)



3.7 Keywords co-occurrence

The co-occurrence analysis provides the density and centrality of the keywords that can be used to classify themes and identify major research trends (Donthu et al., 2021). The findings highlight keywords such as SCM, resilience, sustainability, pandemic, disruption, and risk management in the context of COVID-19 (Figure 5).

Figure 5 Network map of keywords co-occurrence (see online version for colours)



3.8 Content analysis of co-cited references

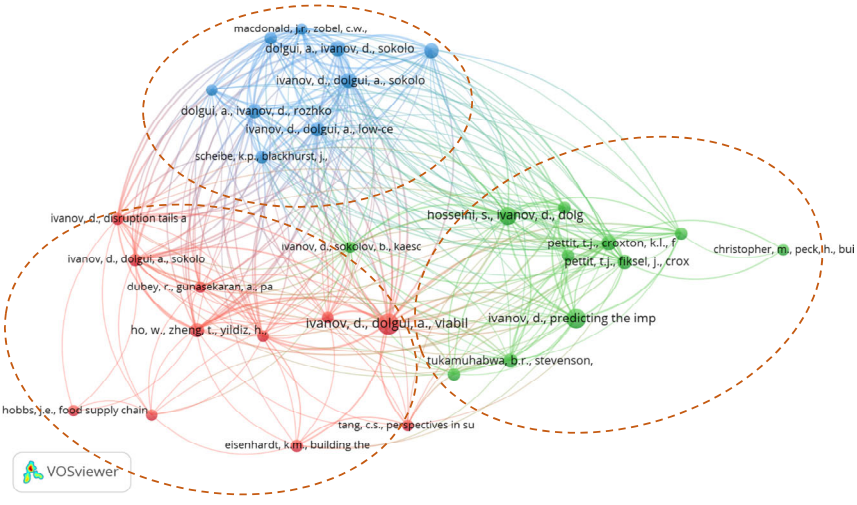
The content analysis of co-cited references is based on the degree of semantic similarities which allows for the identification of specific models in a literature network (Khanra et al., 2020; Tandon et al., 2021). Based on the content analysis of co-cited references, three thematic areas are delineated. The most cited articles in each cluster can be considered as an indicator of the thematic focus. The content analysis method is used to derive key contributions and outcomes of each article in the clusters that will be helpful to understand the thematic evolution of the research.

3.8.1 Cluster 1: supply chain disruption

The articles published in this cluster focused on supply chain disruption and risk management. The keywords used in these articles revolve around supply chain disruption, supply chain risk management, agility, adaptability, survivability, and disruption recovery and revival policies. Supply chain disruptions can have an adverse impact on the short-term performance of the firm (Tang, 2006). Whereas, supply chain agility and adaptability can improve the cost and operational performance of the supply chain and help firms in their endeavour for sustained competitive advantage (Eckstein et al., 2015). The effect of supply chain disruption on production and distribution network design using discrete-event simulation was studied by Ivanov (2019). Whereas, Hobbs (2020) highlighted the implication of the COVID-19 pandemic on the food supply chain.

Ivanov and Dolgui (2020) used dynamic game-theoretic modelling of a biological system to explore the viability of intertwined supply chain networks.

Figure 6 Network map of co-citation analysis (see online version for colours)



The content analysis of published literature in this area highlighted the contributions in this field and proposes future research directions. Tang (2006) research work highlights mitigation strategies and motivates aspiring researchers to develop new models to deal with supply chain disruption. Ho et al. (2015) provided a comprehensive understanding of risk identification, classification and factor analysis. Ivanov et al. (2017) focused on articles covering supply chain with disruption and recovery considerations. Baryannis et al. (2019) highlight supply chain risk management issues using artificial intelligence approaches. However, very few articles in this cluster are linked with COVID-19 disruption rather it focuses on disruption or epidemic situation in a generic way.

3.8.2 Cluster 2: supply chain resilience

The articles in this cluster are oriented towards the importance of resilience in the supply chain and how to overcome disruption. Resilience is defined by Christopher and Peck (2004) as "the ability of a system to return to its original state or move to a new, more desirable state after being disturbed." Ivanov et al. (2010) proposed an adaptive supply chain planning framework with structure dynamics consideration to improve the agility, flexibility and responsiveness of supply chains. Pettit et al. (2010) reviewed the literature on supply chain vulnerabilities and proposed a conceptual framework for supply chain resilience. Further, Tukamuhabwa et al. (2015) emphasised the enhancement of flexibility, redundancy, collaboration and agility for improving supply chain resilience. Hosseini et al. (2019) classified resilience drivers based on absorptive, adaptive and restorative capacity. The absorptive and adaptive capacity measure internal capability, while restorative capacity measures the exogenous capacity of the supply chain to withstand disruption. Pettit et al. (2019) presented an evolution of resilience in SCM. Based on applied grounded theory, a conceptual framework is proposed as an upgraded version of the seminal work by Pettit et al. (2010).

Table 6 Summary of articles in Cluster 1

S. no.	Author (year)	Title	Journal	Total citations	Key contribution	Type of study	Approach/technique	Outcome	Industry application
1	Ivanov and Dolgui (2020)	Viability of intertwined supply networks: extending the supply chain resilience angles towards survivability. a position paper motivated by COVID-19 outbreak	*International Journal of Production Research*	18	Conceptualisation of a decision-making environment of intertwined supply network viability. Highlighted the necessity of survivability at the level of intertwined supply network.	Conceptual	Dynamic game-theoretic modelling	Conceptual model	Supply chain
2	Ho et al. (2015)	Supply chain risk management: a literature review	*International Journal of Production Research*	8	Comprehensive review and analysis of supply chain risk management literature.	Literature review	Structured literature review	Potential gaps and future research directions	Unspecified
3	Ivanov et al. (2017)	Literature review on disruption recovery in the supply chain	*International Journal of Production Research*	7	Comprehensive review and analysis of supply chain disruption and recovery literature. The study focused on quantitative methods in the area.	Literature review	Structured literature review	Potential gaps and future research directions	Unspecified
4	Baryannis et al. (2019)	Supply chain risk management and artificial intelligence: state of the art and future research directions	*International Journal of Production Research*	6	Comprehensive review of literature on supply chain risk management and artificial intelligence.	Literature review	Structured literature review	Potential gaps and future research directions	Unspecified
5	Eckstein et al. (2015)	The performance impact of supply chain agility and supply chain adaptability: the moderating effect of product complexity	*International journal of production research*	6	Investigated the effects of supply chain agility and supply chain adaptability on cost and operational performance. On the ground of dynamic capabilities view and contingency theory, a positive relationship was found.	Empirical	Hierarchical regression analysis	Investigation and validation of the research question about supply chain agility and adaptability	Manufacturing and logistics
6	Hobbs (2020)	Food supply chains during the COVID-19 pandemic	*Canadian Journal of Agricultural Economics*	6	Assessed implications of the COVID-19 pandemic on food supply chains. Discussed the demand and supply side disruption to the supply chain.	Conceptual	Discussion	Challenges faced by food supply chain were examined	Food
7	Ivanov (2019)	Disruption tails and revival policies: a simulation analysis of supply chain design and production-ordering systems in the recovery and post-disruption periods	*Computers and Industrial Engineering*	6	Analysed influence of disruption risk and ripple effect on supply chain production ordering and network design by simulation approach. Two novel findings disruption tails and revival policy are presented.	Quantitative	Simulation	Findings of the study indicated necessity of considering revival policies in supply chain	Non-perishable
8	Tang (2006)	Perspectives in supply chain risk management	*International Journal of Production Economics*	6	Quantitative models and strategies for supply chain risk management were reviewed.	Literature review	Structured literature review	A unified framework was developed; potential gaps were discussed	Unspecified

Table 7 Summary of articles in Cluster 2

S. no.	*Author (year)*	*Title*	*Journal*	*Citations*	*Key contribution*	*Type of study*	*Approach/technique*	*Outcome*	*Industry application*
1	Ivanov (2020a)	Predicting the impacts of epidemic outbreaks on global supply chains: a simulation-based analysis on the coronavirus outbreak (COVID-19/SARS-CoV-2) case	*Transportation Research Part E: Logistics and Transportation Review*	16	Analysed the impact of COVID-19 on performance of global supply chain	Quantitative	Simulation	Important factors identified that determine impact of outbreak.	Lightning equipment
2	Hosseini et al. (2019)	Review of quantitative methods for supply chain resilience analysis	*Transportation Research Part E: Logistics and Transportation Review*	13	Reviewed quantitative models for supply chain resilience analysis	Literature review	Structured literature review	Potential gaps and future research directions.	Unspecified
3	Pettit et al. (2019)	The evolution of resilience in supply chain management: a retrospective on ensuring supply chain resilience	*Journal of Business Logistics*	10	Literature analysis and framework presentation to help managers analyse vulnerabilities and identify capabilities for supply chain resilience	Conceptual	Discussion	Conceptual framework was proposed and future opportunities are envisioned.	Unspecified
4	Pettit et al. (2010)	Ensuring supply chain resilience: development of a conceptual framework	*Journal of Business Logistics*	8	The concept of supply chain resilience is developed to overcome disruptions	Empirical	Literature review and focus group methodology	Conceptual framework was proposed and future opportunities are envisioned.	Apparel and beauty care products retailer
5	Tukamuhabwa et al. (2015)	Supply chain resilience: definition, review and theoretical foundations for further study	*International Journal of Production Research*	8	The literature was critiqued based on research method and use of theory	Literature review	Structured literature review	Strategies for improving supply chain resilience, complex adaptive systems (CAS) theory, and future research directions proposed.	Unspecified

Table 7 Summary of articles in Cluster 2 (continued)

S. no.	*Author (year)*	*Title*	*Journal*	*Citations*	*Key contribution*	*Type of study*	*Approach/technique*	*Outcome*	*Industry application*
6	Christopher and Peck (2004)	Building the resilient supply chain	*The International Journal of Logistics Management*	7	Study focused on identification and management of supply chain risk , and improve supply chain resilience	Empirical	Qualitative	Conceptual framework for risk identification and resilience improvement was proposed and future research directions were suggested.	Multiple private and public sector industries
7	Govindan et al. (2020)	A decision support system for demand management in healthcare supply chains considering the epidemic outbreaks: a case study of coronavirus disease 2019 (COVID-19)	*Transportation Research Part E: Logistics and Transportation Review*	7	A decision support system is proposed to mitigate the disruption in healthcare supply chain	Empirical	Fuzzy inference system	The performance of the proposed decision support system is validated using data which will be helpful to manage and control epidemic outbreaks.	Healthcare
8	Ivanov and Das (2020)	Coronavirus (COVID-19/SARS-CoV-2) and supply chain resilience: a research note	*International Journal of Integrated Supply Management*	7	Supply chain risk mitigation measures were analysed and potential recovery paths were proposed	Quantitative	Simulation	Potential remedies to deal with the epidemic outbreak were suggested and future research agenda's discussed.	Manufacturing
9	Saberi et al. (2019)	Blockchain technology and its relationships to sustainable supply chain management	*International Journal of Production Research*	7	The article investigates application of blockchain technology in supply chain management	Literature review	Discussion and overview	The barriers to application are classified into four categories viz. inter-organisational, intra-organisational, technical, and external. Post-adoption research agenda and proposition was presented.	Unspecified
10	Ivanov et al. (2010)	A multi-structural framework for adaptive supply chain planning and operations control with structure dynamics considerations	*European Journal of Operational Research*	6	Multi-structural planning and operations of adaptive supply chain with structure dynamics is considered	Conceptual	Control theory and agent based modelling	Conceptual framework is proposed and constructive ways to implement multi-structural supply chain were presented.	Unspecified

Table 8 Summary of articles in Cluster 3

S. no.	*Author (year)*	*Title*	*Journal*	*Citations*	*Key contribution*	*Type of study*	*Approach/technique*	*Outcome*	*Industry application*
1	Dolgui et al. (2018)	Ripple effect in the supply chain: an analysis and recent literature	*International Journal of Production Research*	10	Ripple effect in supply chain was analysed through literature review considering quantitative literature only	Literature review	Literature analysis and framework	Reason and mitigation strategies for ripple effect were discussed and a framework for ripple effect control was proposed.	Unspecified
2	Ivanov et al. (2019)	The impact of digital technology and industry 4.0 on the ripple effect and supply chain risk analytics	*International Journal of Production Research*	10	Role of digitalisation on supply chain disruption and ripple effect control was analysed	Literature review	Literature analysis and framework	Proposed a digital supply chain risk analytic framework along with future research avenues.	Unspecified
3	Dolgui et al. (2020a)	Does the ripple effect influence the bullwhip effect? an integrated analysis of structural and operational dynamics in the supply chain	*International Journal of Production Research*	9	Influence of ripple effect on bullwhip effect was analysed	Quantitative	Mathematical modelling and simulation	Ripple effect does drive bullwhip effect through backlog accumulation which can be prevented by information coordination.	FMCG beverage sector
4	Dolgui et al. (2020b)	Reconfigurable supply chain: the X-network	*International Journal of Production Research*	8	An integral framework for supply chain adaptation named as reconfigurable supply chain is introduced	Conceptual	Literature analysis and framework	Two novel concepts dynamic SC meta-structures and dynamic autonomous services were introduced and future research avenues are discussed.	Unspecified
5	Ivanov and Dolgui (2019)	Low-certainty-need (LCN) supply chains: a new perspective in managing disruption risks and resilience	*International Journal of Production Research*	8	A conceptual framework for low certainty need supply chain was proposed to handle supply chain disruptions.	Conceptual	Literature analysis and framework	Key characteristics of low certainty need supply chain are identified along with framework.	Unspecified

Table 8 Summary of articles in Cluster 3 (continued)

S. no.	*Author (year)*	*Title*	*Journal*	*Citations*	*Key contribution*	*Type of study*	*Approach/technique*	*Outcome*	*Industry application*
7	Scheibe and Blackhurst (2018)	Supply chain disruption propagation: a systemic risk and normal accident theory perspective	*International Journal of Production Research*	7	The article seeks to find what drives supply chain disruption propagation	Qualitative	Case study	Identified three aggregate dimensions and six themes that explains disruption propagation.	Unspecified
8	Macdonald et al. (2018)	Supply chain risk and resilience: theory building through structured experiments and simulation	*International Journal of Production Research*	6	The article summarize earlier contributions in the area and propose framework that helps to build theories	Empirical	Simulation	Analysis of supply chain shock on the performance of the system.	Unspecified
6	Ivanov (2018)	Revealing interfaces of supply chain resilience and sustainability: a simulation study	*International Journal of Production Research*	7	The interaction between resilience and Supply chain sustainability was analysed for mitigation of ripple effect and enhancing sustainability.	Empirical	Simulation	The findings indicate sustainable single sourcing enhances the ripple effect; facility protection mitigates the ripple effect and enhances sustainability and storage facilities reduction in downstream supply chain increases sustainability but causes the ripple effect.	Unspecified
9	Schmitt et al. (2017)	Mitigating disruptions in a multi-echelon supply chain using adaptive ordering	*Omega*	6	The impact of disruption on supply chain performance was simulated for a multi-echelon structure	Empirical	Simulation	Provides insight on post-disruption mitigation strategies using adaptive learning policies.	Manufacturing

According to Ivanov and Das (2020), the COVID-19 outbreak is considered a specific type of supply chain risk and its impact and propagation analysis is important for managers. Govindan et al. (2020) proposed a decision support system to mitigate the COVID-19 epidemic outbreak and demand management in the healthcare supply chain. Whereas, Ivanov (2020a) simulated the impact of the epidemic outbreak on the global supply chain. However, the articles in this cluster help suggest strategies and improve resilience, still more research is required on the implementation and assessment of supply chain resilience to overcome disruption caused by epidemic outbreaks.

3.8.3 Cluster 3: control and mitigation strategies of COVID-19 outbreak

The articles in this cluster focused on mitigating supply chain disruption and enhancing supply chain resilience. Schmitt et al. (2017) proposed an adaptive ordering approach to mitigate disruption in the multi-echelon supply chain. The effect of the approach on exacerbating the bullwhip effect was also discussed and simulated. The impact of disruption propagation on supply chain performance, design and planning parameters is described as a ripple effect (Dolgui et al., 2018). The ripple effect is an inverse of the bullwhip effect, the influence of which is analysed by Dolgui et al. (2020a).

Ivanov and Dolgui (2019) proposed a new perspective named as low-certainty-need supply chain to manage disruption risk and resilience. The concept suggests the management of stable production system behaviour as per the changes in the environment. A framework was proposed to gain insights on robust and resilient supply chain design and planning that work efficiently regardless of environmental changes. Ivanov et al. (2019) studied the impact of digital technology and Industry 4.0 on the ripple effect and disruption control analytics in the supply chain. The literature and case studies were analysed to demonstrate a relation between digitalisation and supply chain risk through a conceptual framework.

4 Discussion and implications

The bibliometric analysis of the research focused on the impact of COVID-19 on supply chain led to the identification and analyses of the strategies, methodologies, and emerging focus areas for discussion. In response to RQ1, bibliometric analysis and network mapping of articles, authors, institutions, journals and countries were employed to examine the impact and research trend of COVID-19 research in supply chain. To answer RQ2, co-citation analysis was performed to identify the thematic classification of the literature. In response to RQ3, the insight gained from the bibliometric analysis, network mapping and research clusters identified from co-citation analysis, future research avenues are suggested.

Significant growth has been observed in the number of articles published on COVID-19 and SCM; 79 in 2020 and 193 till August 2021. The findings of the study show that supply chains have received much attention during the COVID-19 pandemic. The USA played a significant role with the highest number of publications. Additionally, the co-citation analysis of the literature revealed three clusters namely supply chain disruption (Cluster 1), supply chain resilience (Cluster 2), and control and mitigation strategies of COVID-19 outbreak (Cluster 3).

The content analysis of the clusters shows that the disruption caused by the COVID-19 outbreak can be minimised with the help of information sharing, use of digital technology, and reconfiguration of supply chain (Chowdhury et al., 2021; Cordeiro et al., 2021; Demiroz and Haase, 2019). The analysis of extant literature suggests that efforts should be directed towards the development and implementation of resilient policies. The study provides a significant contribution to the field and has several theoretical as well as practical implications.

The identification of prominent authors and institutions from this study could be helpful for scholars and aspiring researchers to work in collaboration and advancement of research in this field. The content analysis leads to three clusters highlighting the most influential articles considered the foundation of the field. Since the topic is in the evolving phase, therefore the majority of articles are conceptual which provides a base for understanding the field. The themes presented in the cluster provide direction to promote more nuanced research in this domain. The findings of this study would be useful for practitioners and academicians to understand the disruption phenomenon and adopt resilience strategies in the field of COVID-19 and SCM. It can also be utilised for strategy and policy formulation and implementation during the COVID-19 outbreak.

5 Future research directions

The research opportunities in dealing with the pandemic such as COVID-19 in supply chain are abundant. To stop the spread of the COVID-19 pandemic, several restrictions have been imposed by the government which led to new challenges for supply chains. Based on the insights from bibliometric and content analysis, following future research directions are recommended:

1 *Understanding type of risk and cause of disruption:* There exist several types of risk that give rise to supply chain disruption. The concept of ripple effect that gives rise to supply chain disruption was given attention in recent studies (Dolgui et al., 2018, 2020a). However, in the network map of keyword co-occurrence (Figure 5), the ripple effect does not emerge which shows that there is ample scope for researchers to work in this area. The interdependency and measurement of correlation among risk factors are needed to be analysed in future (Ho et al., 2015). Also, short, as well as long-term evidence-based analysis of recovery planning, can be considered an important research area by future researchers.

2 *Adoption of resilient strategies:* The analysis shows that the extent literature has made a significant contribution to understand the disruption and suggest resilient strategies. While the research in this context can be considered to be maturing, future research can be targeted towards the adoption of resilience strategies. The effect of strategy adoption such as inventory management plans and flexible procurement strategies (Hobbs, 2020; Ivanov, 2020a) on productivity and supply chain performance may be analysed in future studies.

3 *Supply chain resilience measurement:* The measurement of supply chain resilience is important to assess the impact of COVID-19 on supply chain performance (Badhotiya et al., 2022). The interplay of key indicators to enhance supply chain resilience within the COVID-19 disruptive scenario is highly required.

4 *Technology for handling disruption:* Uncertainty and lack of information sharing is affecting the firm's performance, emphasising data sharing and knowledge creation. Fostering digital technologies in the supply chain (Ivanov and Dolgui, 2021) such as the industrial internet of things, cyber-physical system, artificial intelligence and blockchain technologies (Koh et al., 2020) can help in responding to disruption and supply chain recovery and resilience. Detailed analysis of the role of digital technologies and their integration should be focused on in future studies.

5 *Understanding the post-COVID-19 scenario:* After the crisis, attention must be paid to balancing the effects and recovery planning to prepare for such future events. Post-pandemic there would be a rise in demand and there should be a study on strategies to deal with the post-pandemic situation. Supply chain recovery is a major stage in resilience management and has not been studied so far. Along with this, strategies for the enhancement of supply chain robustness should be studied for effective handling of future disruptions.

6 *Application on developing nations:* Most of the studies are performed in the context of developed nations such as the USA and the UK. There is a need to make decision-support models and strategies for developing as well as less developed countries. A comparative study can be done to identify the impact of the COVID-19 pandemic on supply chain disruption in developed and developing countries.

7 *Industry application:* It can be seen from the content analysis of cluster articles that a lot of research is done in manufacturing (Ivanov and Das, 2020), food supply chain (Hobbs, 2020; Mahajan and Tomar, 2021; Mollenkopf et al., 2021), agriculture (Sharma et al., 2020b) and healthcare sector (Govindan et al., 2020), whereas supply chain of small and medium enterprise is not given much attention. Although the article by Sharma et al. (2020b) discussed the agricultural supply chain risk in Indian small, medium and multinational enterprises, a dedicated study on SMEs is still lacking in the literature.

8 *Environmental consideration:* A large number of medical safety instruments such as gloves, and PPE kits are wasted during the pandemic (Kumar et al., 2021). The focus of future studies should be directed towards recycling or waste management through a reverse supply chain. Response measures and policy planning's should be created for effective waste management during a pandemic to make a supply chain sustainable. The circular economy-based models will also help in reducing waste generation (Sharma et al., 2020a).

9 *Quantitative analysis:* A large number of studies on COVID-19 and supply chain are conceptual and quantitative. The validation using empirical research and analysis using a quantitative approach is lacking (van Remko, 2020). Although few articles in the literature have employed simulation-based approach to highlight the impact (Dolgui et al., 2020a; Ivanov, 2018, 2020a), the consequences over a long period should be investigated using simulation models.

6 Conclusions and limitations

In this interconnected world, supply chains grow and also become complex. Diversified supply chain networks are prone to uncertain risks and disruptions. The recent propagation of the novel COVID-19 virus caused major disruption and affected the functioning of the global supply chain. The pandemic control policies have created an imbalance in supply and demand and interrupted the flow of raw materials from China to other countries. In this paper, a bibliometric and content analysis-based comprehensive literature review is presented to highlight the work published on the outbreak of the COVID-19 pandemic on supply chain. This review has identified trends and research gaps in the literature so that post-pandemic, the supply chains could continue to offer efficiency and effectiveness.

A set of 273 articles from the Scopus database were considered for analysis. These articles were selected based on language, subject area and relevancy to the topic. The bibliographic analysis leads to top journals, most influential authors, countries and institutions and keyword co-occurrence. The *International Journal of Production Research* was ranked first according to the number of citations received. The editor-in-chief of the journal, Dolgui, A. from IMT Atlantique, France is found to be the most influential author publishing in this field of research. Germany ranks at the top as per the number of average citations. The Berlin School of Economics and Law, Germany is the most cited institution. Furthermore, the co-citation analysis helps in the identification of three clusters namely supply chain disruption, supply chain resilience, and control and mitigation strategies of the COVID-19 outbreak. The content analysis of the clusters helps in suggesting future research directions.

This study has a few limitations that can be addressed in future. First, the analysis performed in this study is based on a single database, i.e., Scopus. Further studies may consider multiple search databases for a comprehensive list of articles. This study considered articles published in peer-reviewed journals only and those related to certain subject areas; further studies may apply a more comprehensive approach towards document type and subject area consideration. This study included publications on COVID-19 and supply chain. The findings of this study may be considered with caution as the pandemic is still spreading and impacting the global supply chain. Therefore, the outcome of this study may change in future with the advancement and growing numbers of research publications. Despite these limitations, it is believed that this study offers valuable insights and paves the way for practitioners and researchers working in this field.

References

Badhotiya, G.K., Soni, G., Chauhan, A.S. and Prakash, S. (2016) 'Green supply chain management: review and framework development', *International Journal of Advanced Operations Management*, Vol. 8, No. 3, pp.200–224.

Badhotiya, G.K., Soni, G., Jain, V., Joshi, R. and Mittal, S. (2022) 'Assessing supply chain resilience to the outbreak of COVID-19 in Indian manufacturing firms', *Operations Management Research*, Vol. 15, Nos. 3–4, pp.1161–1180.

Baryannis, G., Validi, S., Dani, S. and Antoniou, G. (2019) 'Supply chain risk management and artificial intelligence: state of the art and future research directions', *International Journal of Production Research*, Vol. 57, No. 7, pp.2179–2202.

Belhadi, A., Kamble, S., Jabbour, C.J.C., Gunasekaran, A., Ndubisi, N.O. and Venkatesh, M. (2021) 'Manufacturing and service supply chain resilience to the COVID-19 outbreak: lessons learned from the automobile and airline industries', *Technological Forecasting and Social Change*, February, Vol. 163, p.120447.

Chowdhury, P., Paul, S.K., Kaisar, S. and Moktadir, M.A. (2021) 'COVID-19 pandemic related supply chain studies: a systematic review', *Transportation Research Part E: Logistics and Transportation Review*, April, Vol. 148, p.102271.

Christopher, M. and Peck, H. (2004) 'Building the resilient supply chain', *The International Journal of Logistics Management*, Vol. 15, No. 2, pp.1–14.

Cordeiro, M.C., Santos, L., Angelo, A.C.M. and Marujo, L.G. (2021) 'Research directions for supply chain management in facing pandemics: an assessment based on bibliometric analysis and systematic literature review', *International Journal of Logistics Research and Applications*, Vol. 25, No. 10, pp.1313–1333.

Demiroz, F. and Haase, T.W. (2019) 'The concept of resilience: a bibliometric analysis of the emergency and disaster management literature', *Local Government Studies*, Vol. 45, No. 3, pp.308–327.

Dohale, V., Verma, P., Gunasekaran, A. and Ambilkar, P. (2021) 'COVID-19 and supply chain risk mitigation: a case study from India', *The International Journal of Logistics Management*, ahead-of-print.

Dolgui, A., Ivanov, D. and Rozhkov, M. (2020a) 'Does the ripple effect influence the bullwhip effect? An integrated analysis of structural and operational dynamics in the supply chain', *International Journal of Production Research*, Vol. 58, No. 5, pp.1285–1301.

Dolgui, A., Ivanov, D. and Sokolov, B. (2020b) 'Reconfigurable supply chain: the X-network', *International Journal of Production Research*, Vol. 58, No. 13, pp.4138–4163.

Dolgui, A., Ivanov, D. and Sokolov, B. (2018) 'Ripple effect in the supply chain: an analysis and recent literature', *International Journal of Production Research*, Vol. 56, Nos. 1–2, pp.414–430.

Donthu, N., Kumar, S., Pandey, N. and Soni, G. (2021) 'A retrospective overview of *Asia Pacific Journal of Marketing and Logistics* using a bibliometric analysis', *Asia Pacific Journal of Marketing and Logistics*, Vol. 33, No. 3, pp.783–806.

Eckstein, D., Goellner, M., Blome, C. and Henke, M. (2015) 'The performance impact of supply chain agility and supply chain adaptability: the moderating effect of product complexity', *International Journal of Production Research*, Vol. 53, No. 10, pp.3028–3046.

Fahimnia, B., Sarkis, J. and Davarzani, H. (2015) 'Green supply chain management: a review and bibliometric analysis', *International Journal of Production Economics*, April, Vol. 162, pp.101–114.

Govindan, K., Mina, H. and Alavi, B. (2020) 'A decision support system for demand management in healthcare supply chains considering the epidemic outbreaks: a case study of coronavirus disease 2019 (COVID-19)', *Transportation Research Part E: Logistics and Transportation Review*, June, Vol. 138, p.101967.

Gupta, R., Rathore, B. and Biswas, B. (2021) 'Impact of COVID-19 on supply chains: lessons learned and future research directions', *International Journal of Quality & Reliability Management*, Vol. 39, No. 10, pp.2400–2423.

Ho, W., Zheng, T., Yildiz, H. and Talluri, S. (2015) 'Supply chain risk management: a literature review', *International Journal of Production Research*, Vol. 53, No. 16, pp.5031–5069.

Hobbs, J.E. (2020) 'Food supply chains during the COVID-19 pandemic', *Canadian Journal of Agricultural Economics*, Vol. 68, No. 2, pp.171–176.

Hosseini, S., Ivanov, D. and Dolgui, A. (2019) 'Review of quantitative methods for supply chain resilience analysis', *Transportation Research Part E: Logistics and Transportation Review*, May, Vol. 125, pp.285–307.

Ivanov, D. (2018) 'Revealing interfaces of supply chain resilience and sustainability: a simulation study', *International Journal of Production Research*, Vol. 56, No. 10, pp.3507–3523.

Ivanov, D. (2019) 'Disruption tails and revival policies: a simulation analysis of supply chain design and production-ordering systems in the recovery and post-disruption periods', *Computers and Industrial Engineering*, January, Vol. 127, pp.558–570.

Ivanov, D. (2020a) 'Predicting the impacts of epidemic outbreaks on global supply chains: a simulation-based analysis on the coronavirus outbreak (COVID-19/SARS-CoV-2) case', *Transportation Research Part E: Logistics and Transportation Review*, April, Vol. 136, p.101922.

Ivanov, D. (2020b) 'Viable supply chain model: integrating agility, resilience and sustainability perspectives – lessons from and thinking beyond the COVID-19 pandemic', *Annals of Operations Research*, Vol. 319, No. 1, pp.1411–1431.

Ivanov, D. and Das, A. (2020) 'Coronavirus (COVID-19/SARS-CoV-2) and supply chain resilience: a research note', *International Journal of Integrated Supply Management*, Vol. 13, No. 1, pp.90–102.

Ivanov, D. and Dolgui, A. (2019) 'Low-certainty-need (LCN) supply chains: a new perspective in managing disruption risks and resilience', *International Journal of Production Research*, Vol. 57, Nos. 15–16, pp.5119–5136.

Ivanov, D. and Dolgui, A. (2020) 'Viability of intertwined supply networks: extending the supply chain resilience angles towards survivability. A position paper motivated by COVID-19 outbreak', *International Journal of Production Research*, Vol. 58, No. 10, pp.2904–2915.

Ivanov, D. and Dolgui, A. (2021) 'A digital supply chain twin for managing the disruption risks and resilience in the era of Industry 4.0', *Production Planning and Control*, Vol. 32, No. 9, pp.775–788.

Ivanov, D., Dolgui, A. and Sokolov, B. (2019) 'The impact of digital technology and Industry 4.0 on the ripple effect and supply chain risk analytics', *International Journal of Production Research*, Vol. 57, No. 3, pp.829–846.

Ivanov, D., Dolgui, A., Sokolov, B. and Ivanova, M. (2017) 'Literature review on disruption recovery in the supply chain', *International Journal of Production Research*, Vol. 55, No. 20, pp.6158–6174.

Ivanov, D., Sokolov, B. and Kaeschel, J. (2010) 'A multi-structural framework for adaptive supply chain planning and operations control with structure dynamics considerations', *European Journal of Operational Research*, Vol. 200, No. 2, pp.409–420.

Khanra, S., Dhir, A. and Mäntymäki, M. (2020) 'Big data analytics and enterprises: a bibliometric synthesis of the literature', *Enterprise Information Systems*, Vol. 14, No. 6, pp.737–768.

Koh, L., Dolgui, A. and Sarkis, J. (2020) 'Blockchain in transport and logistics – paradigms and transitions', *International Journal of Production Research*, Vol. 58, No. 7, pp.2054–2062.

Kohl, M., Habl, A., Kallali, K., Puff, J., Fottner, J., Oger, R., Lauras, M. and Li, J. (2022) 'Managing supply chains during the COVID-19 crisis: synthesis of academic and practitioner visions and recommendations for the future', *The International Journal of Logistics Management*, Vol. 33, No. 4, pp.1386–1407.

Krippendorff, K. (2018) *Content Analysis: An Introduction to its Methodology*, Sage Publications, London.

Kumar, H., Azad, A., Gupta, A., Sharma, J., Bherwani, H., Labhsetwar, N.K. and Kumar, R. (2021) 'COVID-19 Creating another problem? Sustainable solution for PPE disposal through LCA approach', *Environment, Development and Sustainability*, Vol. 23, No. 6, pp.9418–9432.

Liza, S.A., Chowdhury, N.R., Paul, S.K., Morshed, M., Morshed, S.M., Bhuiyan, M.A.T. and Rahim, M.A. (2022) 'Barriers to achieving sustainability in pharmaceutical supply chains in the post-COVID-19 era', *International Journal of Emerging Markets*, ahead-of-print.

Macdonald, J.R., Zobel, C.W., Melnyk, S.A. and Griffis, S.E. (2018) 'Supply chain risk and resilience: theory building through structured experiments and simulation', *International Journal of Production Research*, Vol. 56, No. 12, pp.4337–4355.

Mahajan, K. and Tomar, S. (2021) 'COVID-19 and supply chain disruption: evidence from food markets in India', *American Journal of Agricultural Economics*, Vol. 103, No. 1, pp.35–52.

Mallett, R., Hagen-Zanker, J., Slater, R. and Duvendack, M. (2012) 'The benefits and challenges of using systematic reviews in international development research', *Journal of Development Effectiveness*, Vol. 4, No. 3, pp.445–455.

Mollenkopf, D.A., Ozanne, L.K. and Stolze, H.J. (2021) 'A transformative supply chain response to COVID-19', *Journal of Service Management*, Vol. 32, No. 2, pp.190–202.

Montoya-Torres, J.R., Muñoz-Villamizar, A. and Mejia-Argueta, C. (2021) 'Mapping research in logistics and supply chain management during COVID-19 pandemic', *International Journal of Logistics Research and Applications*, ahead-of-print.

Pettit, T.J., Croxton, K.L. and Fiksel, J. (2019) 'The evolution of resilience in supply chain management: a retrospective on ensuring supply chain resilience', *Journal of Business Logistics*, Vol. 40, No. 1, pp.56–65.

Pettit, T.J., Fiksel, J. and Croxton, K.L. (2010) 'Ensuring supply chain resilience: development of a conceptual framework', *Journal of Business Logistics*, Vol. 31, No. 1, pp.1–21.

Pritchard, A. (1969) 'Statistical bibliography or bibliometrics', *Journal of Documentation*, Vol. 25, No. 4, pp.348–349.

Queiroz, M.M., Ivanov, D., Dolgui, A. and Fosso Wamba, S. (2020) 'Impacts of epidemic outbreaks on supply chains: mapping a research agenda amid the COVID-19 pandemic through a structured literature review', *Annals of Operations Research*, Vol. 319, No. 1, pp.1159–1196.

Rahman, N.A.A., Ahmi, A., Jraisat, L. and Upadhyay, A. (2022) 'Examining the trend of humanitarian supply chain studies: pre, during and post COVID-19 pandemic', *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 12, No. 4, pp.594–617.

Raj, A., Mukherjee, A.A., de Sousa Jabbour, A.B.L. and Srivastava, S.K. (2022) 'Supply chain management during and post-COVID-19 pandemic: mitigation strategies and practical lessons learned', *Journal of Business Research*, March, Vol. 142, pp.1125–1139.

Rowan, N.J. and Laffey, J.G. (2020) 'Challenges and solutions for addressing critical shortage of supply chain for personal and protective equipment (PPE) arising from coronavirus disease (COVID19) pandemic – case study from the Republic of Ireland', *Science of the Total Environment*, July, Vol. 725, p.138532.

Saberi, S., Kouhizadeh, M., Sarkis, J. and Shen, L. (2019) 'Blockchain technology and its relationships to sustainable supply chain management', *International Journal of Production Research*, Vol. 57, No. 7, pp.2117–2135.

Sachdeva, L., Bharti, K. and Maheshwari, M. (2021) 'A five-decade review of gender-based occupational segregation: a bibliometric study of influential authors, institutions, and research clusters', *Australian Journal of Career Development*, Vol. 30, No. 2, pp.117–128.

Sajjad, A. (2021) 'The COVID-19 pandemic, social sustainability and global supply chain resilience: a review', *Corporate Governance (Bingley)*, Vol. 21, No. 6, pp.1142–1154.

Scheibe, K.P. and Blackhurst, J. (2018) 'Supply chain disruption propagation: a systemic risk and normal accident theory perspective', *International Journal of Production Research*, Vol. 56, Nos. 1–2, pp.43–59.

Schmitt, T.G., Kumar, S., Stecke, K.E., Glover, F.W. and Ehlen, M.A. (2017) 'Mitigating disruptions in a multi-echelon supply chain using adaptive ordering', *Omega*, April, Vol. 68, pp.185–198.

Sharma, H.B., Vanapalli, K.R., Cheela, V.S., Ranjan, V.P., Jaglan, A.K., Dubey, B., Goel, S. et al. (2020a) 'Challenges, opportunities, and innovations for effective solid waste management during and post COVID-19 pandemic', *Resources, Conservation and Recycling*, November, Vol. 162, p.105052.

Sharma, R., Shishodia, A., Kamble, S., Gunasekaran, A. and Belhadi, A. (2020b) 'Agriculture supply chain risks and COVID-19: mitigation strategies and implications for the practitioners', *International Journal of Logistics Research and Applications*, ahead-of-print.

Sharma, M., Luthra, S., Joshi, S. and Kumar, A. (2022) 'Developing a framework for enhancing survivability of sustainable supply chains during and post-COVID-19 pandemic', *International Journal of Logistics Research and Applications*, Vol. 25, Nos. 4–5, pp.433–453.

Sherman, E. (2020) *94% of the Fortune 1000 Are Seeing Coronavirus Supply Chain Disruptions*, Report, Fortune, New York.

Singh, S., Kumar, R., Panchal, R. and Tiwari, M.K. (2021) 'Impact of COVID-19 on logistics systems and disruptions in food supply chain', *International Journal of Production Research*, Vol. 59, No. 7, pp.1993–2008, Taylor & Francis.

Tandon, A., Kaur, P., Mäntymäki, M. and Dhir, A. (2021) 'Blockchain applications in management: a bibliometric analysis and literature review', *Technological Forecasting and Social Change*, May, Vol. 166, p.120649.

Tang, C.S. (2006) 'Perspectives in supply chain risk management', *International Journal of Production Economics*, Vol. 103, No. 2, pp.451–488.

Tranfield, D., Denyer, D. and Smart, P. (2003) 'Towards a methodology for developing evidence-informed management knowledge by means of systematic review', *British Journal of Management*, Vol. 14, No. 3, pp.207–222.

Tukamuhabwa, B.R., Stevenson, M., Busby, J. and Zorzini, M. (2015) 'Supply chain resilience: definition, review and theoretical foundations for further study', *International Journal of Production Research*, Vol. 53, No. 18, pp.5592–5623.

van Remko, H. (2020) 'Research opportunities for a more resilient post-COVID-19 supply chain – closing the gap between research findings and industry practice', *International Journal of Operations and Production Management*, Vol. 40, No. 4, pp.341–355.

Zupic, I. and Čater, T. (2014) 'Bibliometric methods in management and organization', *Organizational Research Methods*, Vol. 18, No. 3, pp.429–472.