

Resilience Strategies in Sustainable Supply Chain Management: Bibliometric Analysis and Future Research Directions

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ABSTRACT

The emergence of the volatile, uncertainty, complexity, and ambiguity (VUCA) has adversely affected the supply chain network's resilience. The risks and difficulties presented by the VUCA environment can harm an organisation's performance. The project stakeholders are highly encouraged to prioritise sustainability, adaptability, and resilience while considering the constantly changing, volatile, and uncertain climate. Thus, Sustainable Supply Chain Management (SSCM) is a strategic response to the challenges the VUCA environment poses. Contracting firms can expand their capacity to mitigate risks, negotiate volatility, and generate long-term value for all stakeholders by integrating sustainability concepts into supply chain operations. However, SSCM become problematic because of diverse global supply chain disruptions and sustainable demands. Understanding the trends in this topic is crucial to discovering the pattern of resilience strategies in sustainable supply chains. The current literature is reviewed in this study, focusing on studies conducted between 2006 and 2024. The Scopus database and the VOS viewer software were used to arrange a systematic literature review and provide an overview of this field. One hundred fifty-nine (159) publications on resilience, risk management and SSCM were identified and written by hundred and nine (109) authors from forty-four

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(44) countries. The top number of publications was from Iran, with thirty-eight (38), followed by the United States, with twenty-six (26). The most frequently used keywords are sustainability, supply chain management, supply chains, and sustainable development, reflecting the current significant research direction. Standard bibliometric indicators were utilised in this study, and data analysis was done using VOSviewer, Microsoft Excel, and Harzing's Publish and Perish software. The core input of this study is analysing available information to address resilience issues in mitigating risk in the sustainable supply chain. To build a more sustainable system, it offers suggestions for more research in these areas that scholars may pursue and that project stakeholders could implement in their organisations.

INTRODUCTION

The construction industry has increasingly been scrutinised due to its significant contribution to global carbon emissions. The construction industry encounters 25–40% of global carbon emissions yearly. Construction waste is considered a greater risk because of its enormous amount and varied nature, making it difficult to dispose of. According to Onat & Kucukvar (2020), this industry is projected to grow at a 4.2% annual rate in market share and become a significant contributor to the gross domestic product (GDP) between 2018 and 2023. The industry is predicted to expand at a rate of 4.2% annually from 2018 to 2023 in terms of market share and being a significant contributor to the GDP (Onat & Kucukvar, 2020). The construction industry would grow even more in terms of infrastructure, non-residential projects, and residential projects (Construction Industry Value Chain, 2020). In light of increasing concerns about environmental impact, resource depletion, and climate change, it is crucial to prioritise sustainability in all facets of construction, from materials sourcing to building design and operation. Therefore, many developed and developing countries consider sustainable development in the construction sector for rapid economic growth (Darko et al., 2019). The construction industry provides substantial employment opportunities for skilled and unskilled labour, especially daily wage labourers. Despite this, the construction sector faces several challenges, especially while confronted with the volatile, uncertain, complex and ambiguous (VUCA) challenges, such as volatile market prices, lack of coordination among project stakeholders, inadequate raw material supplies, lack of visibility, ambiguity in the procurement process wastage and quality issues create the construction industry intricate and inefficient (Gao et al., 2023). Thus, Sustainable Supply Chain Management (SSCM) were employed to minimise the environmental effect, reduce the failure hazard and enhance the competitiveness of construction companies (Wijaya & Machfudiyanto, 2023; Suhi et al., 2019).

SSCM challenges the construction industry, where multilevel networks of suppliers, contractors, and stakeholders interconnect. The challenges in the application of SSCM in the construction industry emerge because of its multifaceted, fragmented and volatile in their activities (Cataldo et al., 2022). Supply chain disruptions often occur due to the intricate and unpredictability of global supply chains (Dolgui & Ivanov, 2021; Xu et al., 2020; Parast & Shekarian, 2019). The dynamics and impacts of interrelated risks among construction organisations are often frequently overlooked in the supply chains for public projects in Malaysia, making them highly susceptible to interruptions in the supply chain (Zainal Abidin & Ingirige, 2018). However, the research related to SSCM is still in its infancy and scholars should appropriately examine and continue to discuss the findings related to this area.

Avoiding and minimising every risk is unfeasible in a VUCA environment. The resilient strategies of supply chains can speedily recover unforeseen risks in the supply chain disruption (Gao et al., 2023). It is difficult to identify, evaluate or manage, and it is often impossible to predict the sustainability risks. Even

though incidents about sustainability are rare, disruptions like natural catastrophes or strikes at suppliers' plants have a significant influence. Today's global supply chain management environment is intricate and vulnerable to unanticipated natural and man-made disasters (Chiappetta Jabbour et al., 2020), so resilience strategies become prominent. Supply chain resilience management (SCRM) plays a significant role in managing and mitigating disruption. According to (Parast & Shekarian, 2019), resilience is the aptitude of a system to bounce back from a distraction and return to its previous state or even a more ideal one. This concept facilitates organisations' ability to anticipate and react to unforeseen circumstances (Patidar et al., 2023).

Based on previous studies that have been conducted, many scholars have released bibliometric research on supply chain management (Kumar et al., 2023; Ekanayake et al., 2022). However, bibliometric research on resilience management in SSCM in the construction sector has not been published well. This statement is supported by the results of a Scopus search for the terms "resilience", "risk management", and "sustainable supply chain" that was done between 2006 and 2024. The benefit of conducting bibliometric analysis is that it can reveal bibliometric elements and research themes after completing the reviewed technique (Kumar et al., 2023; Donthu et al., 2021). The top authors, countries, institutions, publications, and themes will ideally aid academicians, practitioners, and policymakers in better comprehending a sustainable supply chain. Therefore, this investigation will consequently explore the following research questions to fulfil this goal:

RQ1. What is the annual volume of papers produced in sustainable supply chain areas?

RQ2. Which are the leading journals, publications, authors, nations, and organisations that are the main contributors to resilience research in sustainable supply chains?

RQ3. What can we learn about resilience strategies in SSCM research from the themes and subjects covered by current research?

RQ4. In which ways will supply chain resilience in sustainability develop going forward?

This research aims to use bibliometric analysis to examine and report on published data on resilience in sustainable supply chain documents gathered from the Scopus database. The article is divided into the following sections. Section 2 describes the literature review that is related to this study. In contrast, Section 3 methods applied to this paper and bibliometric analysis, while Section 4 explains the outcomes of a bibliometric analysis of resilience strategies in SSCM. Section 5 expands on the implications and future research direction, and Section 6 provides the conclusions and limitations of this study.

PREVIOUS STUDIES

The concept of "supply chain resilience" was introduced by Holling (1973), indicating that resilience is a system's ability to withstand deviations. Resilience is defined by Christopher and Peck (2004) as a supply chain system's ability to bounce back from disruptions and either revert to its initial state or transition to a new, more desirable one. Many authors have reiterated the concept of resilience as a system's capacity to recover and return to how it was (Malik et al., 2022; Patidar et al., 2022; Chowdhury & Quaddus, 2017). On the other hand, SCRM is defined by Chowdhury & Quaddus (2017) and Ponis & Koronis (2012) as a supply chain's ability to proactively plan and build its system to foresee supply chain disturbances and successfully respond to disruptions. Han and Um (2024) define resilience as an organisation's ability to recover from a significant external impact.

Furthermore, resilience in an organisational context can be described as the ability of an organisation to endure in a volatile environment (Ates & Bititci, 2011). Because of the increasing interruptions in the global supply chain, resilience has finally become highly significant in the supply chain sector. However, because research has been inconsistent in differentiating between SCRM's measurement and constructs, scholars remain divided on how the constructs and measurement of SCRM should be developed (Jüttner & Maklan, 2011).

Sustainable supply chain management is the "organisation of project resources, information, and capital flows" as well as collaboration among businesses while taking into consideration all three (3) dimensions of sustainable development, i.e. economic, environmental, and social (Mariadoss et al., 2016; Seuring & Mueller, 2008). This definition highlights three key elements: equitable consideration of all three sustainability dimensions, the Triple Bottom Line (TBL) approach, and collaboration from all supply chain participants (Gimenez and Sierra, 2013). Since the environment is constantly changing and supply chains are getting more complicated, it is getting harder to implement sustainable supply chain management (SSCM) methods (Sarkis et al., 2011). According to Cataldo et al. (2022), challenges of SSCM include environmental problems during demolition processes, inefficiencies in the logistics system, financial constraints, and lack of an integrated approach to measure sustainability because it demands time, data, and expertise. This finding was further confirmed by Singh et al. (2023) that implementing SSCM in building projects may reduce an environmental impact, minimise error and enhance the organisations' competitiveness. The attributes of a successful sustainable supply chain include sharing information and knowledge, trust issues, long-term relationships, and cooperation in supply chain management performance. However, unexpected risks still occur in sustainable supply chain activities. Sahu and Deshmukh (2023) categorise risks into market, performance, and complexity. Malik et al. (2022) have divided risks into three (3) categories: supply, demand, and supply chain organisation. Petit et al. (2019) categorise supply chain risks into seven (7) main categories: turbulence, threats, connectivity, outside pressures, resource boundaries, sensitivity and supplier or customer distractions. Overall, it can be restated that the categorisation of risks depends on each organisation's capability to react and respond quickly to the changes. Hence, it is imperative to incorporate supply chain resilience into supply chain operations to maintain competitiveness with other organisations.

METHODOLOGY

In carrying out a bibliometric analysis, the data source is crucial. Using the approach from previous bibliometric research, the author began looking for articles in January 2024 to include in the review. This search approach consists of four steps: database searching, intellectual filtering, subject filtering, and language filtering (Figure 1). Bibliometric indicators and network visualisation are used to convey the study's findings. Scopus database was chosen because it offers inclusive bibliometric data for index publications and includes articles which meet high indexing criteria.

Additionally, because of its remarkable capacity to compile huge documents for evaluation, Scopus is a scientific database often employed for bibliometric research (Paul et al., 2021). It is among the most well-known search platforms for academic publications (Donthu et al., 2021). The data limitations for 2024 are based on several factors, including data availability and data for the entire year. One hundred seventy-nine (179) articles were found based on the keywords in the database search results. Next, it was followed by the academic screening. The data were limited to the year 2006 until 2024, and data sources include journal articles, conference papers, book chapters, review papers, editorials, erratum and books. Following this academic review, the language is limited to English. Translations are unsuitable for bibliometric analysis; hence, this filtering was required.

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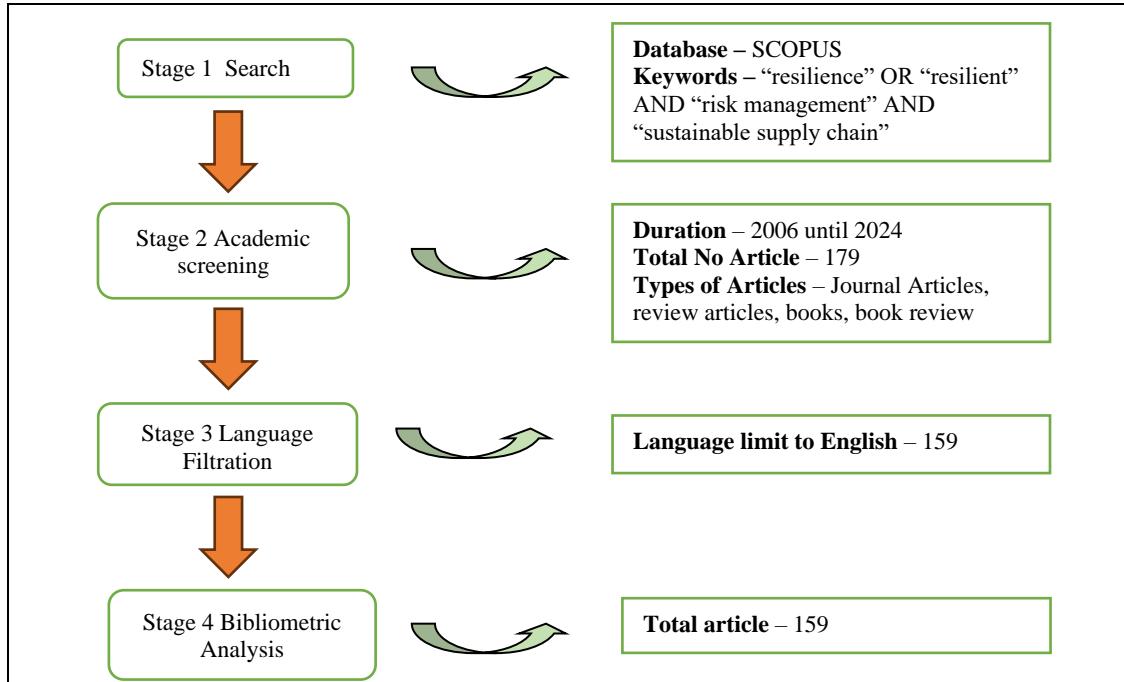


Fig. 1. Filtration strategy for bibliometric analysis

Source: Authors, 2024

Bibliometric Analysis

Numerous disciplines extensively employ bibliometric analysis to evaluate academic communication's dynamics, production, and influence. According to Pritchard (1969), bibliometric analysis is "the application of mathematical and statistical concepts to books and other kinds of communication". However, Broadus (1987) noted that a "bibliometric technique" uses quantitative methods to analyse bibliographic data. To achieve the aim of this paper, the author used bibliometric methods to comprehend the issuing patterns (RQ1), prominent contributors (authors, countries, and institutions) (RQ2), lessons learned from past research (RQ3) and recommendations for future research (RQ4). The author utilises the software package VOSviewer to analyse co-authorship and keywords and uses Harzard to discover local citations and PageRank. The keyword co-occurrence analysis analysed by VOS viewer software will assist in developing a conceptual framework and finding future studies.

RESULTS

The statistics from the data sets show the overview of resilience in the sustainable supply chain. The explanations have been organised into science mapping and performance analysis. Publication trends, topmost journals, top papers, uppermost authors, and top nations were all included in the performance

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study. The science mappings included analysis of co-authorship (authors and nations), co-occurrence of author keywords, analysis of page rank, and software (VoSviewer, Harzard, and Microsoft Excel). Based on the study's findings, evaluations of authorship, keywords, title and abstract analysis, and citation analysis were made. Data on annual increases through 2024, including frequency and cumulative percentage, were also included. Tobescu and Seuring produced the first publication on resilience in sustainable supply chains in their books in 2006. Since then, the quantity of articles has gradually increased, reaching a high in 2022 amid the epidemic.

Trend of Publication

The distribution of publications by year demonstrates that, throughout the preceding five (5) years, resilience techniques in sustainable supply chain management have received scholarly attention (Table 1). It is shown from the chart that most research papers were published in 2023 ($n = 53$), a year in which sustainable requirements are highly needed in the era of VUCA. The distribution of publication years shows a significant rise in the number of publications starting from 2021, peaking in 2023.

Table 1. Year of publications

Year	Total Publications	Percentage (%)
2006	1	0.63
2010	2	1.26
2012	1	0.63
2014	1	0.63
2015	1	0.63
2016	6	3.77
2017	4	2.52
2018	4	2.52
2019	9	5.66
2020	12	7.55
2021	23	14.47
2022	30	18.87
2023	53	33.33
2024	12	7.55
Total	159	100.00

Source: Authors, 2024

Publication Outlet and Performance

Sustainability Switzerland ($n=17$) articles are the most productive place for resilience strategies in developing nations' sustainable supply chain management research, as depicted in Table 2. It was followed by the Journal of Cleaner Production ($n=15$) articles, the Computers and Industrial Engineering "n6" articles, Annals of Operations Research, Business Strategy and The Environment and Environmental Science and Pollution Research, which are ($n = 4$) publications. Nonetheless, with two hundred seventy-one (271) citations, the Journal of Cleaner Production publications have received the most citations, followed by 209 from the International Journal of Production Research.

Table 2. Most active journals

Source Title	Total Publications	Percentage (%)
Sustainability Switzerland	17	10.67
Journal of Cleaner Production	15	9.43
Computers and Industrial Engineering	6	3.77
Annals of Operations Research	4	2.52
Business Strategy and The Environment	4	2.52

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Source: Authors, 2024

Document and Source Types

The analysis was carried out to identify types of documents and sources in the research on resilience in sustainable supply chains. Table 3 presents the summary result of document types, and it shows that 74.84 per cent of resilience in the sustainable supply chain was published as an article, 11.32 per cent as a conference paper and 5.03 per cent as a book chapter and reviewing documents. The remaining documents were editorial (1.89%), erratum (1.26%), and book (0.63%). There has been a significant rise in the number of articles written by multiple authors in the last ten (10) years, with 50% of recent publications being the result of collaborations between three or more authors.

Table 3. Type of document

Document Type	Total Publications (T.P.)	Percentage (%)
Article	119	74.84
Conference Paper	18	11.32
Book Chapter	8	5.03
Review	8	5.03
Editorial	3	1.89
Erratum	2	1.26
Book	1	0.63
Total	159	100.00

Source: Authors, 2024

Among the sources, journals were the predominant type, representing 81.76% of all documents, with conference proceedings contributing 8.81%, books (1.89%) and trade journals making up the remaining (0.63%). Elsevier and Springer, two prominent publishers, were responsible for 60% of the sources, indicating their significant influence in the distribution of research in this field. The study was published across a wide range of disciplines, with 64% of the sources categorised under sustainability issues, 20% under engineering, and 8% for business strategy and environmental science.

Table 4. Source types

Source Type	Total Publications (T.P.)	Percentage (%)
Journals	130	81.76
Conference Proceedings	14	8.81
Book Series	11	6.92
Book	3	1.89
Trade Journal	1	0.63

Source: Authors, 2024

Subject Area

The main subject areas related to resilience in sustainable supply chains are shown in Table 5. It has been identified that management, business, engineering and social sciences are all significant components of the discipline of SSCM. The majority of publications were in the fields of business, management and accounting (44.65%), followed by engineering (41.51%), environmental science (60%), Computer science, energy and social science, which had to share the same percentage which is (27.04%). Interdisciplinary

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methods are fundamental to these domains. While engineering concentrates on creating effective systems and procedures, business management deals with organisational strategies, operations, and supply chain management. Environmental impact assessment, resource management, and sustainability are all considered by environmental sciences. An extensive comprehension of the dynamics and resilience of supply chains is made possible by the interdisciplinary approach.

Table 5. Subject areas

Subject Area	Total Publications	Percentage
Business, Management and Accounting	71	44.65
Engineering	66	41.51
Environmental Science	60	37.74
Computer Science	43	27.04
Energy	43	27.04
Social Sciences	43	27.04
Decision Sciences	39	24.53
Economics, Econometrics and Finance	13	8.18
Mathematics	8	5.03
Chemical Engineering	5	3.14
Earth and Planetary Sciences	2	1.26
Psychology	2	1.26
Agricultural and Biological Sciences	1	0.63
Arts and Humanities	1	0.63
Materials Science	1	0.63
Medicine	1	0.63
Multidisciplinary	1	0.63

Source: Authors, 2024

Top Authors

The most productive authors in resilience and sustainable supply chain management are presented in Table 6. It indicates that Lotfi of Yazd University is the most prolific author, with five (5) papers. Notably, Lotfi's contributions have also helped Yatz University become the most productive institution regarding the resilience of a sustainable supply chain. Then, it was followed by Fahimnia from the University of Tehran domain, with the university's seven (7) out of twelve (12) papers (co)authored by Shen, G.Q.P. The analysis highlights that Dr. Lotfi's publications not only have a high citation count but also frequently appear in top-tier journals, underscoring his role as a key thought leader in the area of sustainable supply chain management. The bibliometric review also reveals that Dr. Lotfi's interdisciplinary methodology, which integrates perspectives from environmental science and supply chain management, has enhanced the existing body of research and provided tangible strategies for improving SSCM among SME's.

Table 6. Most productive authors

Author's Name	No. of Documents	Percentage (%)
Lotfi, R.	5	3.14
Fahimnia, B.	4	2.52

Sarkis, J.	4	2.52
Chang, A.Y.	3	1.89
Cherriaf, A.	3	1.89
Das, K.	3	1.89
Hsu, C.H.	3	1.89
Kazancoglu, Y.	3	1.89
Liu, W.L.	3	1.89
Mangla, S.K.	3	1.89
Mehrjerdi, Y.Z.	3	1.89
Nayeri, S.	3	1.89
Paydar, M.M.	3	1.89
Pishvaee, M.S.	3	1.89
Raut, R.D.	3	1.89
Sabouhi, F.	3	1.89
Sazvar, Z.	3	1.89
Talluri, S.	3	1.89
Nayeri, S.	3	1.89
Paydar, M.M.	3	1.89

Source: Authors, 2024

Top Countries

Forty-four (44) countries have contributed to and published articles on resilience in sustainable supply chain management based on the distribution of publications by region. According to data that breaks down contributions by nation, Iran is the country that contributes the most significant contribution to resilience in sustainable supply chain management ($n = 38, 23.90\%$). China ($n = 26, 16.35\%$) ranked second, and the United States ($n = 23, 14.47\%$) contributed third. The formal global structure of research collaborations is illustrated by this bibliometric, which also evaluates country co-authorship to bring light to the type and scope of international collaborations. The author identified five main collaboration networks from the analysis using the VOS viewer software to depict a network of essential countries cooperating. The first significant network, illustrated in grayscale and reflecting international connections between the United States, China, and the United Kingdom, has Iran as its primary node. It shows that SSCM is still at the infant stage and is still being debated in most developing and developed countries.

Table 7. Top countries

Countries	Number of publications	Percentage (%)
Iran	38	23.90
China	26	16.35
United States	23	14.47
India	21	12.59
United Kingdom	19	10.71
Italy	18	9.77
Australia	16	7.89
Malaysia	14	6.01
Turkey	13	5.07
Canada	12	4.19
Poland	12	4.19

Netherlands	11	3.31
Taiwan	11	3.31
France	8	2.93
Mexico	8	2.93

Source: Authors, 2024

Table 8 summarises the top fifteen (15) countries contributed to the publications. This study also assesses the quantity of publications by nation, taking into account the author's affiliated institution. The publications on resilience in SSCM involved contributors from forty-four (44) countries. Table 8 shows the top fifteen active countries that contributed at least five publications. Iran ranks first on the list with a total of thirty eight (38) publications.

Other countries that have contributed significantly to resilience in the sustainable supply chain are the United States, China, India, United Kingdom and Australia. Iran leads the research output in SSCM, with many publications originating from top-tier universities and research institutions. The focus in Iran has been on developing innovative technologies and strategies to enhance supply chain sustainability, driven by strong industry-academia collaborations. Meanwhile, China has seen a significant rise in SSCM research over the past decade, reflecting the country's increasing focus on environmental sustainability and adherence to regulations. India's contribution to SSCM research is growing, with increasing attention on sustainable practices in the textile and automotive industries and aiming to promote sustainable development in emerging markets. From these figures and tables, the top five countries in SSCM research include developed (United States, Germany, United Kingdom) and developing (China, India) economies. Developed countries such as the United States, Germany, and the United Kingdom, which are considered developed, gain advantages from having established research institutes, extensive financing, and a well-developed legislative framework that supports sustainability.

Table 8. The top 15 Countries contributed to the publications

Country	Total Publications	Percentage (%)
Iran	38	23.9
United States	26	16.35
China	23	14.47
India	17	10.69
United Kingdom	15	9.43
Australia	11	6.92
Turkey	10	6.29
Canada	8	5.03
France	7	4.4
Italy	7	4.4
Poland	7	4.4
Taiwan	7	4.4
Morocco	6	3.77
Germany	5	3.14
Malaysia	5	3.14

Source: Authors, 2024

Most Influential Institutions

The institutions with the most significant involvement in resilience in sustainable supply chain management are displayed in Table 9. Yazid University tops the list with eleven (11) total publications and fifty-four (54) referenced papers. The University of Tehran comes in second with ten (10) publications and seventy (70) cited papers. However, in terms of total citations, Daneshgahe Elm va Sanat e Iran is leading with one hundred three (103) citations. By identifying the most influential institutions, researchers in sustainable supply chain management can leverage existing networks to facilitate knowledge sharing,

collaboration on research projects, and dissemination of best practices. Researchers studying sustainable supply chain management should use current networks to promote knowledge exchange, teamwork on research initiatives, and the sharing of best practices by identifying the most powerful institutions. Influential institutions often have extensive networks and collaborations with researchers and practitioners across disciplines and geographic regions. Collaboration with essential institutions can raise the profile and influence of SSCM research, increasing the possibility of practical applications and policy impact.

Table 9. Most influential institutions based on publication

Institution	Total Publications	Percentage (%)
Yazid University	11	3.78
University of Tehran	10	3.51
Daneshgahe Elm va Sanat e Iran	9	3.51
Politechnika Poznanska	5	3.24
Islamic Azad University	5	3.24
Worcester Polytechnic Institute	4	2.16
The University of Sydney	4	1.89
Babol Noshirvani University of Technology	4	1.89
Islamic Azad University, Science and Research Branch	4	1.89
Behineh Gostar Sanaye Arman	3	1.62
Middle East Technical University METU	3	1.62
Rijksuniversiteit Groningen	3	1.62
East Carolina University	3	1.62
Texas A & M University	3	1.62

Source: Authors, 2024

Key Word Occurrences

VOS viewer was used to identify keyword co-occurrence analysis based on potential study topics related to resilience in SSCM. This analysis used the author keywords among one hundred fifty-nine (159) publications. According to Eck & Waltman (2014), the keywords can be obtained from the title and abstract of the publication or from the list that the author of that specific piece provides. Table 10 shows a network visualisation map of the co-occurrences of terms. The study's top twelve (12) keywords occur more than twice or in equal measure across two (2) studies. Figure 3 displays a visual overlay of the keyword co-occurrence networks map, where certain keywords, such as "sustainability", "supply chain management", "supply chains", "sustainable development" and "resilience" have garnered the most significant attention. The scale displays these frequently used keywords in green and yellow. The relationship between keywords is represented by connecting lines, text size, circle size, and thickness of colour (Sweileh et al., 2018). Supply chain optimisation will be the main focus in the middle of 2019 and the middle of 2020. The number of studies on COVID-19 increased slightly after the middle of 2020, with the attention shifting to pandemic COVID-19, blockchain, industry 4.0, and operations management.

Table 10. Keyword Occurrences

Keywords	Occurrences	Percentages
Sustainability	81	50.94
Supply Chain Management	62	38.99
Supply Chains	56	35.22
Sustainable Development	55	34.59
Resilience	50	31.45
Sustainable Supply Chains	27	16.98
Risk Management	21	13.21
Supply Chain	21	13.21
Decision Making	19	11.95
Resiliency	17	10.69

COVID-19	16	10.06
Sustainable Supply Chain	16	10.06

Source: Authors, 2024

Citation Analysis

This study employed the Harzing's Publish and Perish software to analyse the total number of resilience in SSCM citations using a RIS-style file obtained from the Scopus database. The primary purpose of citation analysis is to determine the association between the publication and its cited publications, presuming that the publications that reference one another are connected (McBurney & Novak, 2002). The primary goal of citation analysis is to ascertain the association between the publication and its cited publications, presuming that the publications that reference one another are connected (McBurney & Novak, 2002). The citation metrics for the obtained data set are shown in Table 9. Throughout the 18-year resilience period, three thousand one hundred thirty five (3135) citations to sustainable supply chain management articles have been documented. Researchers can measure the impact of their work with the aid of citation metrics. Researchers can assess how important their work has been within and outside their area by monitoring the number of citations their papers obtain.

Table 11 below lists the highly cited articles according to the database set that was obtained from Scopus. The articles with the most significant involvement in resilience in SSCM are displayed in Table 9. It also helps researchers evaluate potential collaborators and interdisciplinary research opportunities. By analysing citation patterns, researchers can discover individuals or institutions with whom they share common research interests or are influential within complementary fields.

Table 11. Citations Metrics

Metrics	Data
Publication years	2006-2024
Citation years	18 (2006-2024)
Papers	159
Citations	3338
Citations/year	185.44
Citations/paper	20.99
Citations/author	1067.49
Papers/author	54.37
h-index	32
g-index	55

Source: Authors, 2024

The document entitled "Evaluation of sustainable supply chain risk management using an integrated fuzzy TOPSIS- CRITIC approach" by Rostamzadeh et al. (2018) has received top citation in the area of resilience in sustainable supply chain with fifty-four (54) citations or an average of 45.17 citations per year. It was followed by the "Resilient and sustainable supply chain design: sustainability analysis under disruption risks" with seventy (70) cites per year. The latest article updated in the SCOPUS database that received the top citation is the article written by Negri et al. (2024) entitled "Building sustainable and resilient supply chains: A framework and empirical evidence on trade-offs and synergies in implementation of practices".

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Table 12. Highly cited articles

No.	Authors	Title	Year	Cites	Cites per Year
1	R. Rostamzadeh, M.K. Ghorabaei, K. Govindan, A. Esmaeli, H.B.K. Nobar	Evaluation of sustainable supply chain risk management using an integrated fuzzy TOPSIS-CRITIC approach	2018	54	45.17
2	A. Jabbarzadeh, B. Fahimnia, F. Sabouhi	Resilient and sustainable supply chain design: sustainability analysis under disruption risks	2018	34.83	70
3	M. Abdel-Basset, R. Mohamed	A novel pathogenic TOPSIS- CRITIC model for sustainable supply chain risk management	2007	112	10.18
4	B. Zahiri, J. Zhuang, M. Mohammadi	Toward an integrated sustainable-resilient supply chain: A pharmaceutical case study	2000	110	6.11
5	A. Pavlov, D. Ivanov, D. Pavlov, A. Slinko	Optimisation of network redundancy and contingency planning in sustainable and resilient supply chain resource management under conditions of structural dynamics	2005	102	7.85
6	S.I. Mari, Y.H. Lee, M.S. Memon	Sustainable and resilient supply chain network design under disruption risks	2006	93	7.75
7	R.D. Raut, S.K. Mangla, V.S. Narwane, M. Dora, M. Liu	Big Data Analytics as a mediator in Lean, Agile, Resilient, and Green (LARG) practices effects on sustainable supply chains	2004	86	6.14
8	P. Teuscher, B. Grüninger, N. Ferdinand	Risk management in Sustainable Supply Chain Management (SSCM): Lessons learnt from the case of GMO-free soybeans	2012	77	12.83
9	Y.Z. Mehrjerdi, M. Shafiee	A robust optimisation model for sustainable and resilient closed-loop supply chain network design considering conditional value at risk	2002	73	4.56
10	Z. Sazvar, K. Tafakkori, N. Oladzad, S. Nayeri	Sustainable procurement and logistics for disaster-resilient supply chain	2004	72	5.14
11	M. Negri, E. Cagno, C. Colicchia	Building sustainable and resilient supply chains: a framework and empirical evidence on trade-offs and synergies in the implementation of practices	2024	4	11

Source: Authors, 2024

IMPLICATIONS AND FUTURE RESEARCH DIRECTIONS

Implications of the study

The multifaceted nature and susceptibility of the global supply networks have increased the significance of SCRM in recent years. It can be said that SCRM is necessary for supply chain management since more scholars and project stakeholders have come to the same conclusion. This study provides numerous implications for research and practice. Figure 2 presents the previous research frameworks and techniques for SCRM in which emphasised the need for a comprehensive proactive, reactive, and supply chain design strategy to mitigate supply chain risks (Chowdhury et al., 2012; 2017). They can concentrate on several SCRM improvement strategies to raise the effectiveness of the company. Several scholars have highlighted the advantages of improving coordination and collaboration across supply chain partners (Kumar et al., 2023; Liao et al., 2023). These issues have become a significant challenge in the SSCM. Numerous researchers have suggested cutting-edge technological solutions, like blockchain, to enhance supply chain responsiveness, traceability, and visibility (Chauhan et al., 2023; Paliwal et al., 2020)

Notwithstanding the progress in the field, several other topics still require more research. Research on the impact of VUCA and sustainable demands on SCRM in different nations and industries is still insufficient. The researchers can advance the study by utilising resilience techniques, emphasising supply

chain design quality proactive and reactive capabilities. They can concentrate on different SCRM augmentation tactics to improve organisational sustainability performance.

Despite the discipline's accomplishments, more research is still required in several other areas. For example, little study has been done on how VUCA and sustainability impacted SCRM in different nations and sectors. Researchers can employ resilience tactics to further their study while concentrating on supply chain design quality, supply chain (S.C.) proactive capability, and supply chain (S.C.) reactive capability. They can focus on different SCRM augmentation methods to improve the organisational sustainability performance.

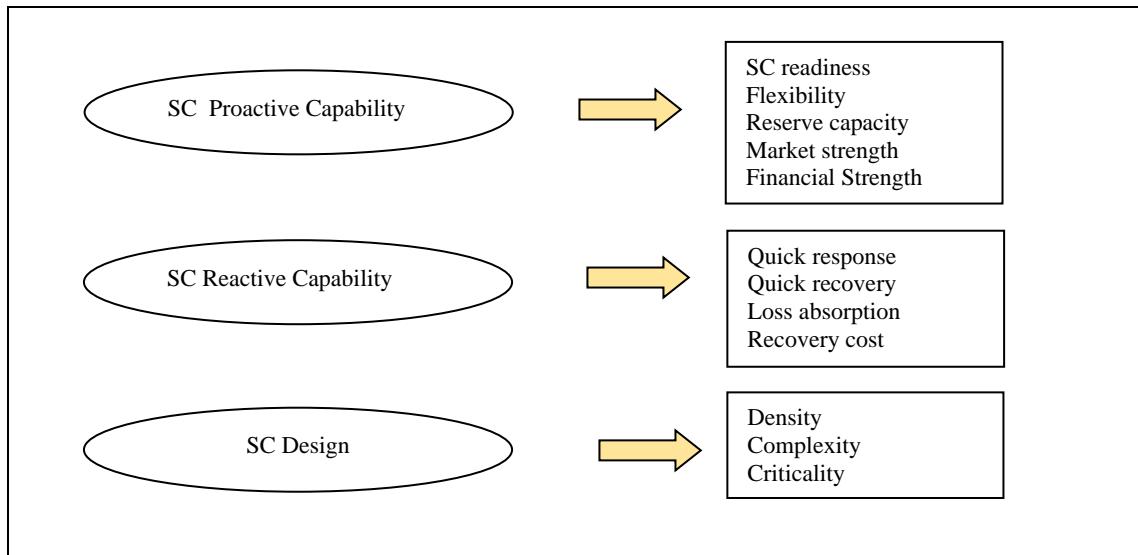


Fig. 2. Previous SC Resilience Framework

Source: Authors, 2024

The project stakeholders can use the approach presented in this study to mitigate disruptions in sustainable supply chain management. Figure 3 suggests that the researchers will likely concentrate on the S.C. resilience determinants, S.C. resilience capabilities, S.C. resilience indicators and SSCM performances. S.C. network design and planning must be done quickly due to the resilience enhancement characteristics that enable SCRM assessment.

Based on the findings on resilience assessment capabilities in S.C., the practitioners can now expand upon the three S.C. resilience strategies: proactive capabilities, adaptive capabilities, and reactive capabilities by utilising the resilience assessment capabilities in S.C. These predominantly focus on pre-disruption, during-disruption and post-disruption. The SC resilience methods will increase operational efficiency by enabling practitioners to evaluate and monitor S.C. performance. Consequently, the enhanced resilience skills might subsequently contribute to sustainable performance.

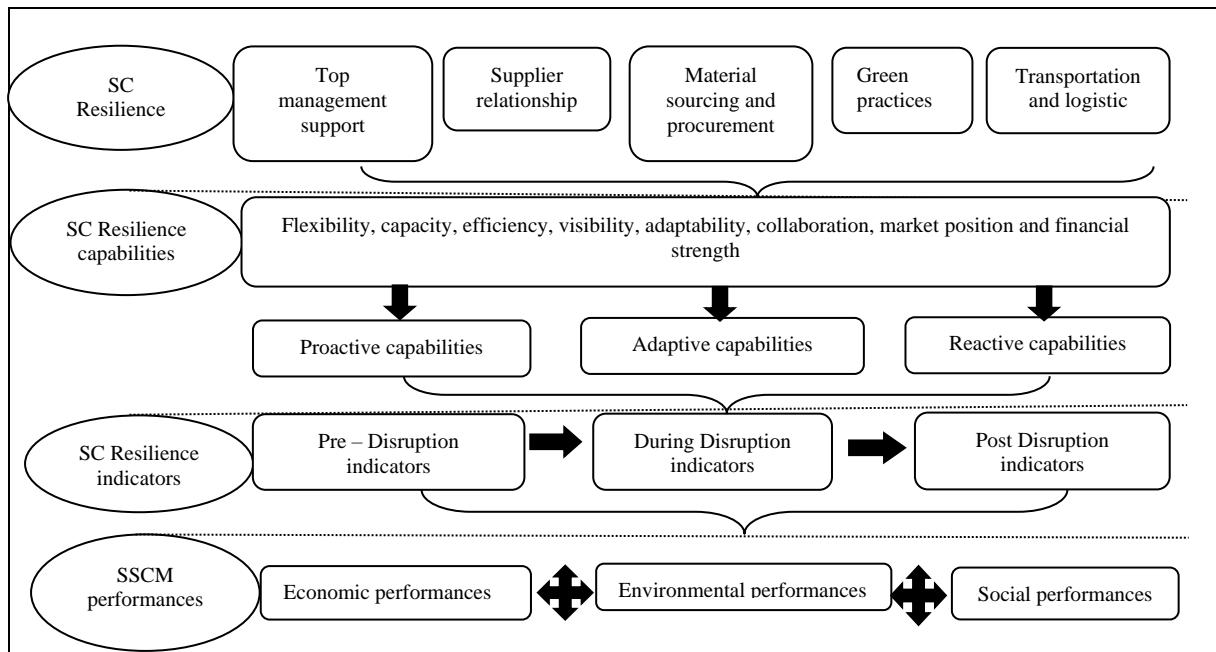


Fig. 3. S.C. Resilience Conceptual Framework

Source: Authors, 2024

Future Research Directions

Further research is needed to create resilience indicators in SSCM. The review study highlights the significance of supply chain resilience management (SCRM) in supply chain activities. The results of the studies reveal the major themes and patterns in the sector and indicate the areas that require further research to advance our understanding of SCRM. The researcher suggests categorising the issues discussed in the reviewed papers into the following categories: sustainability dimensions, supply chain stages, resilience factors, sustainable factors, stakeholder engagement, resilience metrics, technological integration, and policy regulations. These categories will facilitate the systematic organisation and analysis of the literature.

CONCLUSION AND LIMITATIONS

The study examined key areas, approaches, aims, and recent advancements in SSCM. After hundred and fifty-nine (159) studies spanning the previous twenty (20) years were reviewed, research gaps were identified, and recommendations for further research were made. The idea of SCRM in most developed and developing countries has drawn much interest recently. There was a constant increase from 2018 until 2024. Recent bibliometric analysis has yielded significant new insights into the current status of SCRM research in the construction industry. The previous authors have contributed little to mixed research, with most of their work being qualitative rather than quantitative. Evidence shows that the United States, the United Kingdom, and Iran are doing well in research in developed and emerging countries, but others are still struggling to catch up. Surprisingly, mixed-method research is not used very often. The keywords in these areas were sustainability, supply Chain Management, Supply Chains, Sustainable Development and

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Resilience. Most published articles suggest that SSCM is a new concept and is still being implemented in most developed and developing countries. It also indicates poor collaboration among authors, inefficient risk management, and lack of sustainability metrics approach in SSCM, which could deaccelerate the supply chain performance. The data used in this study were retrieved from the Scopus database, so it might not have included all accessible sources. Subsequent studies may improve this research by utilising more databases. It's possible that integrating a few datasets from several databases would result in more insightful and practical findings. This work effectively contributes to the body of knowledge by outlining the current research direction on risk management, SSCM, and resilience. This work contributes to and improves prior supply chain resilience in SSCM literature through a bibliometric technique. It also offers insightful information on previous patterns in literature.

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CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted without any self-benefits or commercial or financial conflicts and declare the absence of conflicting interests with the funders.

AUTHORS' CONTRIBUTIONS

Shariffah Zatil Hidayah Syed Jamaludin carried out the research and wrote and revised the article. Shariffah Zatil Hidayah Syed Jamaludin, Muzani Mustapa, and Zuhaili Mohamad Ramly conceptualised the central research idea and theoretical framework. The data curation, research methodology design, formal analysis, visualisation, and software were collaboratively developed by Shariffah Zatil Hidayah Syed Jamaludin, Muzani Mustapa, Zuhaili Mohamad Ramly, and Nor Juma'ah Muhammad. Shariffah Zatil Hidayah Syed Jamaludin wrote the original draft and was involved in the review, editing, and validation processes.

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