# A Systematic Literature Review on Flexible Strategies and Performance Indicators for Supply Chain Resilience

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**Abstract** *Supply chain resilience is a widely useful concept for managing risk and disruption. Designing strategies for preparedness, response, and recovery can help businesses to mitigate risks and disruptions. Among them, flexible strategies can effectively improve supply chain resilience. In the literature, several studies have considered different types of flexible strategies and investigated their impacts on supply chain resilience. However, a systematic literature review (SLR) paper on this topic can further help to understand the scientific progress, research gaps, and avenues for future research. Hence, this study aims to explore how the literature has contributed to the area of flexible strategies and the impact on supply chain resilience performance. To achieve our objective, we apply an SLR methodology to identify themes such as research areas and key findings, contexts and industry sectors, methodologies, and key strategies and performance indicators in the connection between flexible strategies and supply chain resilience. The findings show that many studies connect flexible strategies to supply chain resilience. However, research gaps exist in analysing relationships between flexible strategies and performance, conducting comparative studies, developing dynamic resilience plans, applying flexible strategies, conducting theoretically grounded empirical studies, and applying multiple analytical tools to develop decision-making models for supply chain resilience. Finally, this study suggests several future research opportunities to advance the research on the topic. The findings can be a benchmark for researchers who are interested in conducting research in the area of flexible strategies and supply chain resilience.*

## Introduction

Supply chain management is critical in supplying, producing, and distributing goods and services to consumers and communities. However, any risks, disruptions, and uncertainties at any supply chain stage could make the whole operation vulnerable (Paul et al., 2017). The ultimate consequences could include delivery and supply delays, demand unfulfilment, and loss of revenue and business goodwill (Rahman et al., 2022). Hence, developing a resilient supply chain to absorb disruptions and keep operations going is important.

Supply chain resilience is defined by the preparedness and ability to respond to recover from and deal with disruptions (Ponis & Koronis, 2012; Ribeiro & Barbosa-Povoa, 2018; Tukamuhabwa et al., 2015). Preparedness means taking proactive actions, such as assessing risk and disruption factors and planning for strategies and resources (Paul & Chowdhury, 2020; Rahman et al., 2022). Meanwhile, response and recovery are reactive actions. Response includes the ability to quickly and accurately sense the impacts of a disruption and respond to mitigate such impacts (Scholten et al., 2020). For example, swiftly accessing alternative suppliers and emergency sources in case of a supply disruption can help mitigate the consequences. Recovery includes the planning and replanning for a future period after the occurrence of a disruption to

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bring the plan to the normal stage (Paul et al., 2017). For example, utilising alternative suppliers and resources to revise the supply chain plan for a certain period after the occurrence of supply disruption mitigates the impacts and helps restore the original plan. Recovery requires a sophisticated plan that utilises appropriate mitigation strategies. Preparedness, response, and recovery are well connected, as response and recovery can be difficult without good preparedness.

The flexible supply chain is a popular concept for managing variability in supply chains (Dhillon et al., 2023; Varma et al., 2024; Wadhwa et al., 2008). Variability includes changes in demand, processing time, lead time, and so on. Supply chain flexible strategies include flexibility in design, supply, manufacturing, transportation, and logistics. It also connects the flexibility of supply chain partners, such as flexible suppliers, manufacturing plants, logistics, and transportation.

Supply chain variabilities are well connected to risks and uncertainties. Flexible strategies can help manage supply chain uncertainties, risks, and variabilities (Tang & Tomlin, 2008; Yi et al., 2011). For example, utilising multiple suppliers and safety inventory can be useful to mitigate supply risks and uncertainties. The literature shows that flexible strategies effectively build resilient supply chains and can help manage risk and uncertainty and improve supply chain resilience by preparing well and/or enhancing capabilities to respond and recover (Chowdhury et al., 2024; Chunsheng et al., 2020; Dwivedi et al., 2023; Kamalahmadi et al., 2022; Kazancoglu et al., 2022; Mackay et al., 2020; Piprani et al., 2022; Rajesh, 2021; Sharma et al., 2023; Tang & Tomlin, 2008).

In the literature, several studies explore the usefulness of flexible strategies to improve supply chain resilience. Moreover, a few review papers exist in the literature which analysed supply chain resilience with drivers, vulnerabilities, risks and impacts, and robustness (Shishodia et al., 2023), supply chain resilience strategies (Rahman et al., 2022), framework, barriers, and strategies for supply chain resilience (Shashi et al., 2020), and recovery ability for supply chain resilience (Mandal, 2014). However, a systematic literature review (SLR) and content analysis of previously published papers on flexible strategies and supply chain resilience are non-existent. An SLR and content analysis are very helpful for researchers to understand the progress and development and plan for future research. Accordingly, this review article develops the following research questions (RQs).

RQ1: What contributions have been made in the connection between flexible strategies and supply chain resilience?

RQ2: What are the emerging research opportunities in the area of flexible strategies and supply chain resilience?

To answer the above RQs, this paper investigates flexible strategies and performance indicators for supply chain resilience by conducting an SLR and analysing articles under different themes, such as research area and key findings, context and industry sectors, methodologies, key dimensions, strategies, and performance indicators. Finally, this study also analyses the research gaps and suggests a number of meaningful future research opportunities.

The rest of the paper is organised as follows. Section "Review Methodologies" describes the review methodologies. Section "Analysing Reviewed Articles" analyses previous articles on flexible strategies for supply chain resilience. Research gaps and future research directions are provided in Sect. "Research gaps and Future Research Opportunities". Finally, Sect. "Conclusions" provides conclusions and limitations of the study.

## Review Methodologies

In this paper, an SLR process is utilised to analyse the content of the reviewed articles (Tranfield et al., 2003). An SLR provides a more accurate literature search and in-depth content analysis than other methods, such as generic and bibliometric reviews. It also helps in the systematic and critical analysis of the content of previously published articles.

In this paper, Scopus was the primary database to identify articles on flexible strategies and performance indicators for supply chain resilience. The following search criteria were used:

Keywords: flexible strategy, supply chain, resilience, performance.

Language: English.

Source type: Journal.

Search timeline: up to 2023.

The initial search using keywords identified a total of 138 articles. After filtering for language and source type, 46 articles were removed and 92 articles remained.

Next, we read the article's title, abstract, and content and applied inclusion and exclusion criteria to finalise the articles. The inclusion criteria were: (i) articles focused on flexible strategies for different aspects of supply chain resilience, and (ii) both the keywords "flexible" or "flexibility" and "resilience" appeared in the main text. The exclusion criteria were if one or more keywords mentioned in the implications and/or in the reference list were available, but the article did not focus on the flexible strategies in supply chain resilience. After applying inclusion and exclusion criteria, 30 articles were removed and 62 articles remained.

Finally, other databases, such as Google Scholar and Web of Science, were used to search the articles. The

reference check was also conducted to ensure that all relevant articles were included in the analysis. These checks did not include any new articles. A total of 62 articles were finalised for the analysis in this review. The review methodology is presented in Fig. 1.

## Analysing Reviewed Articles

This section analyses the finalised articles in key different dimensions, including subject areas, key contributions and findings, contexts of the studies, methodologies used, key sectors (manufacturing or service), different flexible strategies for supply chain resilience, and performance indicators for supply chain resilience.

### Key Subject Areas

We analysed the subject areas for the 62 articles. As flexibility and supply chain resilience is a multidisciplinary research area, the articles were expected to contribute to several subject areas. Thus, we observed the common subject areas to be business, management and accounting, engineering, decision sciences, computer science, and social sciences. The key subject areas for the reviewed articles are presented in Fig. 2.

### Key Contributions and Findings of Previous Studies

Over the last few years, many studies have contributed in the area of flexible strategies and supply chain resilience. We observed that eight articles used a literature review approach, while the remaining 54 were technical studies.

This section delves into the details of previous contributions and findings.

### Previously Published Review Articles

From the systematic review, we identified eight review articles in the area of supply chain resilience. The main contributions and findings of those review articles are summarised in Table 1. The previous review articles analysed the literature in different supply chain resilience dimensions, including drivers, vulnerabilities, risks and impacts, and robustness (Shishodia et al., 2023), resilience strategies (Rahman et al., 2022), framework, barriers, and strategies (Shashi et al., 2020), and recovery (Mandal, 2014). Significant research gaps exist in reviewing the literature on how different flexible strategies are applied to improve supply chain resilience and the potential future research directions. This paper fills these gaps.

Table 1 shows that five articles used a systematic literature review approach, while others used bibliometric analysis and literature review along with expert opinions and conceptual modelling/framework.

### Contributions and Findings of Technical Studies

We analysed the contributions and main findings of 54 technical studies and observed the following main areas of study.

i. Analysing resilience strategies using varieties of methodologies (Kummer et al., 2022; Nagariya et al., 2023; Purvis et al., 2016; Wang et al., 2016),
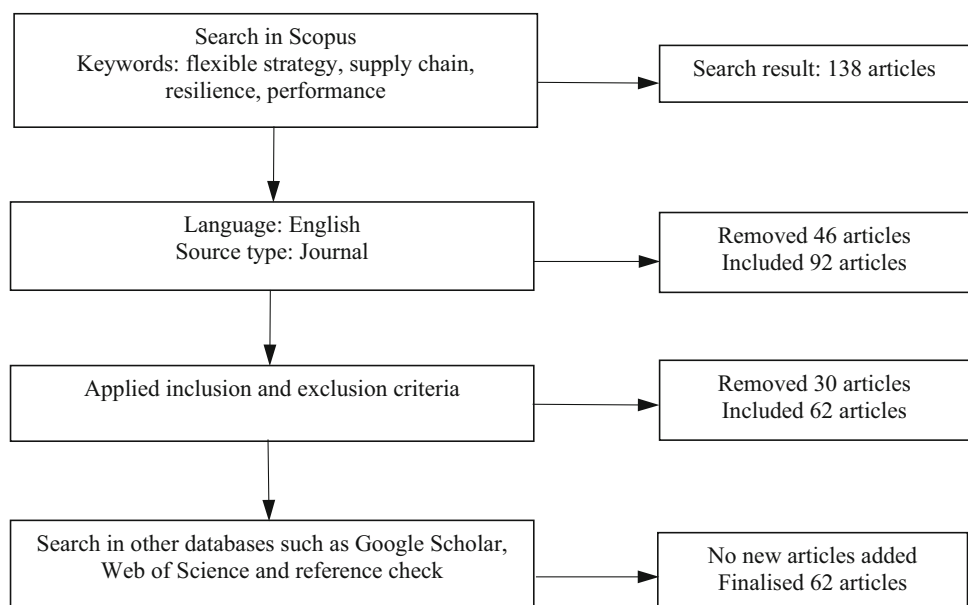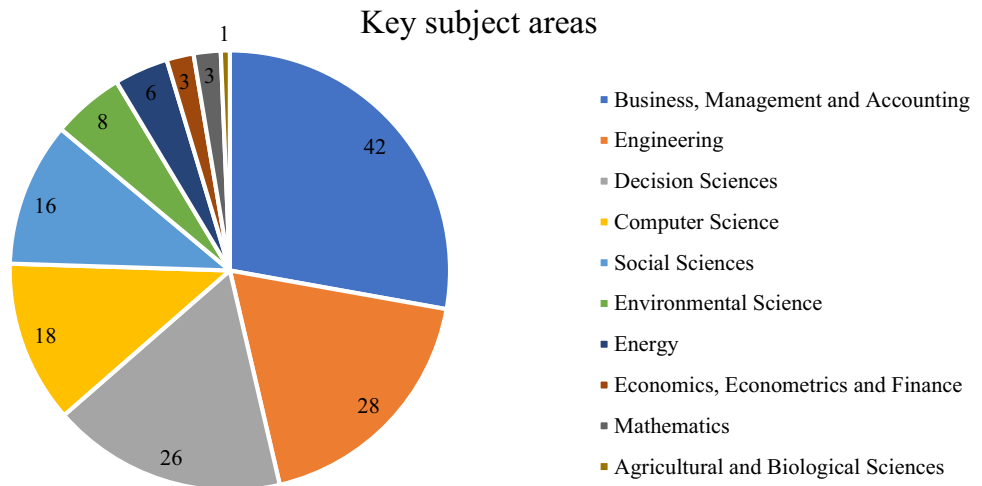
**Fig. 1** Review methodology

**Fig. 2** Key subject areas of the
reviewed articles



## Key subject areas

- Business, Management and Accounting
- Engineering
- Decision Sciences
- Computer Science
- Social Sciences
- Environmental Science
- Energy
- Economics, Econometrics and Finance
- Mathematics
- Agricultural and Biological Sciences

ii. Analysing impacts of strategies on performance (Alvarenga et al., 2023; Hamidu et al., 2024; Isti'anah et al., 2021; Lin et al., 2023; Nguyen et al., 2022; Xu et al., 2023),

iii. Exploring capabilities for supply chain resilience (Faruquee et al., 2023; Shweta et al., 2023; Um & Han, 2021; Zhou et al., 2022),

iv. Evaluating critical factors, enablers, and antecedents for supply chain resilience (Das et al., 2022; Pu et al., 2023a, 2023b; Sangari & Dashtpeyma, 2019),

v. Analysing impacts of disruption on supply chains (Ivanov, 2022),

vi. Designing/re-designing supply chain networks to improve resilience (Alikhani et al., 2021; Carvalho et al., 2012; Fattahi et al., 2020), and

vii. Selecting suppliers for supply chain resilience (Suryadi & Rau, 2023).

The main contributions and findings are summarised in Table 2.

### Contexts

This section analyses different contexts used in the literature. The contexts include both industry sectors and regions of data collection and applications. We observed that 38 studies used a specific industry context, while 41 papers used a country/regional context in their studies.

#### Industry Context

Our analysis of the articles shows that both single and multiple sectors have been considered in previous studies. Fourteen studies considered multiple industry sectors, and 24 studies considered a single industry sector. The single industry sectors include maritime (Isti'anah et al., 2021; Praharsi et al., 2021; Zavitsas et al., 2018), food (Li et al.,

2022; Purvis et al., 2016), healthcare (Vimal 2022a; Shweta et al., 2023), and textile and apparel sectors (Fahimnia et al., 2018; Nagariya et al., 2023). The other single industry sectors are container handling, delivery services, e-commerce of clothing and grocery, industrialised construction, copper industry, retail, ICT industry, automotive, sportswear, and electronic sectors.

Previous studies also considered multiple industry sectors. For example, Alvarenga et al. (2023) considered multiple sectors, including chemical and petroleum, food and beverage, and machinery sectors. Maharjan and Kato (2023) considered multiple sectors, including manufacturing, assembly, agricultural machinery parts, apparel business, and trading companies. Zhou et al. (2022) considered multiple sectors, including electronics and appliances, metals, machinery and engineering, construction materials, textiles, and clothing. Gölgeci and Kuivalainen (2020) considered multiple sectors, including chemical and pharmaceutical, food and beverage, construction equipment, retail, textile, clothing, and apparel.

#### Country/Regional Context

Forty-one studies considered a specific country/regional context. Several studies considered global or multiple regions. For example, Alvarenga et al. (2023) considered a global context, including North America, Europe, Asia, Africa, South America, and Oceania countries. Faruquee et al. (2023) collected data from the USA and the UK. Das et al. (2022) collected data from countries in Asia, Europe, and the Americas.

The majority of the studies considered a single country/regional context. Among them, seven studies considered India (Altay et al., 2018; Vimal et al., 2022a, 2022b; Nagariya et al., 2023; Rajesh, 2016; Shweta et al., 2023; Suryawanshi et al., 2021), four studies considered Iran

**Table 1** Previously published review articles

| References | Scope of the review | Main findings | Review methods |
|---|---|---|---|
| Shishodia et al., (2023) | 1. They conducted a bibliometric review in the area of supply chain resilience<br>2. They developed a conceptual framework for supply chain resilience | 1. They identified a few research areas, including scopes for developing a conceptual model for supply chain resilience, analysing drivers for vulnerabilities, analysing risks and assessing impacts, and measuring resilience and robustness of supply chain networks | Bibliometric analysis, literature review |
| Rahman et al., (2022) | 1. They identified supply chain resilience strategies for different types of supply chain disruptions<br>2. They analysed methodologies, theories, and context of different studies<br>3. They proposed future research directions for improving supply chain resilience | 1. They finalised resilience strategies for different supply chain levels, including supply, demand, manufacturing, transportation and financial levels<br>2. They found that, among quantitative methods, mathematical programming models and multi-criteria decision-making (MCDM) methods were mostly applied<br>3. Among qualitative methods, interviews and case studies were mostly applied for analysing supply chain resilience strategies | Systematic literature review |
| Grzybowska and Stachowiak (2022) | 1. They identified characteristics of disruptions to minimise disruption strategies<br>2. They focused on the duration of the disruptions to evaluate supply chain reliability | 1. They mentioned everyday supply chain disruptions as the most frequent disruptions<br>2. They found that a proactive supply chain could minimise the negative impacts of disruptions<br>3. A reactive supply chain could improve stability in supply chain by increasing capabilities<br>4. Supply chain resilience could improve supply chain efficiency and flexibility and mitigate disruption effectively | Literature review, expert opinions |
| Olivares-Aguila and Vital-Soto, (2021) | 1. They developed a roadmap for supply chain resilience<br>2. They also analysed disruptions and the strategies to cope with them | 1. They found that a strategic decision-making methodology is essential for creating roadmaps for supply chain resilience<br>2. They also found that the elimination of disruptions may not be possible | Literature review, conceptual modelling |
| Shashi et al., (2020) | 1. They conducted a literature review on supply chain resilience<br>2. They integrated different resilience variables in supply chains in different disruption scenarios<br>3. They analysed different barriers to resilience and resilience measuring tools<br>4.They also considered different supply chain resilience strategies for enhancing performance | 1. They showed different areas of supply chain resilience in business and engineering<br>2. They categorised the findings in four different areas: systematic framework, barriers, strategies and measurement of supply chain resilience | Systematic literature review |
| Zavala-Alcívar et al., (2020) | 1. They explored the relationship between sustainability and different resilient strategies<br>2. They integrated supply chain resilience and sustainability linked with disruption risk | 1. They mentioned five steps in developing supply chain resilience during disruptions: prevention, resistance, response, recovery-continuity, learning and continuous improvement<br>2. They found flexibility, redundancy, and robustness to be the key elements of supply chain resilience, which minimise disruption loss | Systematic literature review, conceptual framework |
| Hohenstein et al., (2015) | 1. They analysed supply chain resilience in-depth from the literature<br>2. They developed a framework to increase the consciousness of supply chain resilience | 1. They discussed different phases of supply chain resilience, including readiness, response, recovery and growth<br>2. They found a positive relationship between increased supply chain resilience and operating performance | Systematic literature review |
| Mandal, (2014) | 1. They investigated the importance of supply chain resilience strategies<br>2. They analysed recovery ability to develop supply chain resilience due to disruption | 1. They identified a few research areas: supply chain design, risk management, resilience, performance, etc. | Systematic literature review |

**Table 2** Contributions and findings of technical studies

| Reference | Contributions of the study | Main findings |
| --- | --- | --- |
| Alvarenga et al., (2023) | 1. They developed a conceptual model for supply chain resilience | 1. They found that both digital technologies and supply chain memory positively impact supply chain resilience |
| | 2. They investigated the impacts of supply chain memory and digital technologies on supply chain resilience and robustness | 2. They also found the impact of COVID-19 to be significant for supply chain robustness |
| | 3. They also considered COVID-19 impact as a moderating factor between supply chain memory and robustness in the adoption of supply chain resilience | |
| Maharjan and Kato, (2023) | 1. They identified the current resilient status of logistics and supply chain preferences of different companies | 1. They found positive and negative impacts of the COVID-19 pandemic on operational and financial performance |
| | 2. They determined whether the logistics and resilience would provide suggestions for mitigating COVID-19 impacts | 2. They also emphasised enhancing good business relationships with other companies in the future |
| Shweta et al., (2023) | 1. They identified vulnerabilities and capabilities in resilience | 1. They found late deliveries to be the most important vulnerability for decision-makers |
| | 2. They designed a hybrid framework to build resilience for mitigating the risk | 2. They showed that flexibility, agility, and sustainability were three important aspects to mitigate risk and improve performance |
| | 3. They analysed mitigating risks focusing on micro, small and medium enterprises | |
| Suryadi and Rau, (2023) | 1. They focused on supplier selection to mitigate strategies | 1. They found that the multi-sourcing and multi-region supplier strategies could effectively mitigate the disruption |
| | 2. They proposed a hybrid MCDM and optimisation approach to developing supply chain resilience in supplier selection | 2. They also showed the importance of alternative shipments for communicating with main suppliers |
| | | 3. Companies could improve their supply chain resilience by using backup suppliers and maintaining collaboration with suppliers |
| Xu et al., (2023) | 1. They designed a supply chain model of two-stage container logistics, including container pre-treatment and handling systems | 1. They proved the integral of time with multi-error as an efficient index to measure resilience |
| | 2. They proposed a two-dimensional measurement method to improve resilience performance | 2. They revealed the relationships among resilience, recovery ability and affordability, |
| | 3. They designed an adaptive fuzzy double-feedback adjustment control structure to optimise the container logistics supply chain system | |
| Hamidu et al., (2023a, 2023b) | 1. They analysed the role of supply chain disruptions connected with supply chain resilience and performance | 1. They found that supply chain performance could be increased by improving resilience |
| | 2. They integrated different resilience strategies in adopting the experience from the COVID-19 pandemic | 2. They found that supply chain disruption significantly impacted supply chain resilience and performance |
| Hamidu et al. (2023a) | 1. They examined the effect of supply chain resilience on performance | 1. They found that improving supply chain resilience is crucial to increase performance |
| | 2. They considered the relationship among supply chain network complexity, supply chain resilience and performance of manufacturing firms | 2. They found that supply chain network complexity negatively impacts supply chain resilience and performance |
| Juan and Li (2023) | 1. They analysed the relationships between dynamic capability and resilience in supply chain | 1. They found that supply chain resilience mediates the relationship between knowledge-based dynamic capability and financial performance with supply chains |
| | 2. They also analysed the relationships between firms' financial performance and supply chain resilience | |
| Lin et al., (2023) | 1. They investigated how to develop supply chain resilience in responding to disruptions | 1. Stabilisation, adaptation, and transformation were identified as three distinct pathways to develop supply chain resilience |
| | 2. They integrated a social-ecological perspective to develop the model in the context of last-mile delivery | 2. People orientation, digital orientation, and learning orientation were identified as operating across these pathways |

**Table 2** continued

| Reference | Contributions of the study | Main findings |
| --- | --- | --- |
| Silva et al., (2023) | 1. They explored the relationship between sustainability and supply chain resilience<br><br>2. They investigated the building of micro-foundations of sustainability in supply chain resilience<br><br>3. They identified sustainable capabilities in micro-foundations for resilience in supply chain | 1. They explored nine micro-foundations of sustainability, including the preparing, responding and transforming steps of supply chain resilience<br><br>2. They also found ten supplier cases adopting a social-ecological perspective<br><br>3. They mentioned rehearsing, acting and transforming as three dance performances in supply chain resilience with sustainability |
| Pu et al., (2023a, 2023b) | 1. They analysed multi-period consumer transaction data<br><br>They prioritised market segments by linking historical data-based marketplace in related regions<br><br>2. They considered consumer service level and marketing segmentation<br><br>3. They integrated proactive decisions to optimise disruption loss and reactive plans to recover performance | 1. They found that sales would decrease while profit would decrease for low backup facilities<br><br>2. They also found that profit increases when the facility fortification rate increases |
| Pu et al., (2023a, 2023b) | 1. They investigated the antecedents of supply chain resilience<br><br>2. The analysed their internal relationships<br><br>3. They also analysed the relationship between supply chain resilience and sustainable performance | 1. They found that capabilities positively impact supply chain resilience<br><br>2. Supply chain resilience has impacted sustainable operational performance positively |
| Faruquee et al., (2023) | 1. They discussed building resilience through multi-capabilities<br><br>2. They also explored different performance indicators<br><br>3. They categorised capabilities as proactive and reactive resilience capabilities to utilise supply chain resilience<br><br>4. They proposed a resilience capabilities framework for managers to develop supply chain resilience | 1. They found that resilience capabilities could improve relational performance<br><br>2. They discussed how a limited understanding of resilience could harm the business environment<br><br>3. They also analysed the fact that the required resilience capabilities might not be the same for every supply chain |
| Hamidu et al., (2023a, 2023b) | 1. They explored the connection between supply chain resilience and performance<br><br>2. They mentioned the role of supply chain technological innovation<br><br>They provided insights to overcome supply chain challenges and improve their performance | 1. They found that technological innovation in the supply chain positively mediates the relationship between supply chain resilience and performance |
| Nagariya et al., (2023) | 1. They identified different resilience strategies based on blockchain technology<br><br>2. They prioritised those strategies in the context of MSMEs<br><br>3. They provided mitigation strategies | 1. They found that supply chain collaboration/connectivity is the best sub-strategy<br><br>2. They also discussed collaboration capability as the second-best blockchain-based supply chain resilience strategy for MSMEs |
| Vimal et al. (2022a) | 1. They identified bottlenecks in the medical oxygen supply chain context<br><br>2. They recognised decision criteria by classifying bottlenecks<br><br>3. They also identified relevant technological solutions to improve supply chain performance | 1. They found the Internet of Things-based tagging system to be the most significant solution during a possible third wave of the COVID-19 pandemic<br><br>2. Using MCDM methods, they ranked and improved the efficiency of the medical oxygen supply chain |
| Li et al., (2022) | 1. They proposed both centralised and decentralised decision models in the context of quality preference and loss<br><br>2. They analysed optimal price, quality, and quantity decisions for resilience in supply chains related to quality preference<br><br>3. They developed production decisions for maintaining the quality of fresh food under supply chain disruption | 1. They found that supply chain profit under disruption could be increased by considering the quality of products<br><br>2. They explained that disruption costs could be resilience range in decisions<br><br>3. They investigated the theory that offline channel retailers are impacted most by disruptions |
| Zhu and Wu, (2022) | 1. They analysed the relationship among SC resilience, SC sustainability and SC performance<br><br>2. They also mentioned the mechanism of SC elasticity on SC performance | 1. They found a positive effect of SC sustainability on supply chain performance, whereas SCR had an indirect positive effect on supply chain performance |

**Table 2** continued

| Reference | Contributions of the study | Main findings |
|---|---|---|
| Kummer et al., (2022) | 1. They developed control strategies in the supply chain by integrating a standard strategy and a preventive culling strategy<br>2. They integrated various influencing factors and control strategies | 1. They found that increasing overutilised days depends on increasing infection rates |
| Das et al., (2022) | 1. They analysed critical factors for the global supply chain<br>2. They also analysed the strategies for risk reduction<br>3. They categorised those factors and analysed their inter-relationships | 1. They found that the most influential factor is cost optimisation, and reducing vulnerabilities is the least important factor<br>2. They also found that government support is the most effective factor in the casual group |
| Ivanov, (2022) | 1. They analysed blackout in supply chain risks<br>2. They examined the impacts of blackouts<br>3. They also analysed mitigation and recovery strategies | 1. They found that sequential blackouts were more impactful for supply chain performance<br>2. They also found that increased blackout duration impacts product availability<br>3. Panic buying also hurts product availability and increases delivery time |
| Vimal et al. (2022b) | 1. They analysed the resilience strategies for recovering the ripple effect in supply chain<br>2. They identified important key performance indexes and project management tools in supply chain | 1. They found that safety stocks and multi-sourcing are useful for supply chain recovery<br>2. Increasing the minimum inventory level could mitigate the ripple effect of disruptions |
| Nguyen et al., (2022) | 1. They analysed the impacts of supply chain finance on managing risk, resilience and performance<br>2. They investigated the findings in the context of small and medium enterprises | 1. They found that supply chain finance negatively impacted the risk but significantly positively impacted performance and resilience<br>2. Global competitiveness is needed to increase global and domestic market opportunities |
| Zhou et al., (2022) | 1. They analysed the relationship between IT capability and supply chain resilience<br>2. They also considered supply chain collaboration to analyse the relationship | 1. They categorised supply chain resilience as internal and external resilience<br>2. They found that IT capability positively impacts external resilience, but not internal resilience<br>3. They also found that supply chain collaboration positively impacts internal resilience, but is not related to external resilience |
| Trabucco and De Giovanni, (2021) | 1. The considered sustainable business perspective in supply chain<br>2. They analysed the supply chain performance of firms<br>3. They focused on lean strategies and digital technologies to analyse supply chain performance | 1. They found that low-cost production could be maintained by developing a lean omnichannel strategy<br>2. They found that delivery time and customer service are not dependent on lean omnichannel strategies<br>3. Environment and social sustainability have less effect on lean omnichannel strategies<br>4. Lean omnichannel positively affects production costs, supply chain visibility, inventory, and sales |
| Ekanayake et al., (2021) | 1. They formulated dynamic impacts in supply chain resilience<br>2. They generalised impacts of vulnerability and capability indicators in industrialised construction supply chain<br>3. They analysed elimination strategies of negative impacts in industrialised construction supply chain | 1. They found that vulnerabilities impact supply chain operations<br>2. Dynamics of capabilities could increase supply chain resilience<br>3. A resilient supply chain could improve business performance<br>4. Adopting appropriate and innovative technology would achieve better performance |
| Isti'anah et al., (2021) | 1. They analysed suitable resilience in supply chain to improve performance<br>2. They suggested collaboration with the company's stakeholders for better performance | 1. Human resource skill fulfilment was found to mitigate supply chain risks<br>2. Developing a backup plan could help build a resilient supply chain<br>3. An appropriate tracking system could improve serviceability |

**Table 2** continued

| Reference | Contributions of the study | Main findings |
|---|---|---|
| Alikhani et al., (2021) | 1. They integrated designing and re-designing for supply chain resilience in a retail network<br>2. They considered a multi-resilient strategies framework<br>3. They analysed the inventory sharing strategy between two retail networks to develop supply chain resilience | 1. They found that<br>safety stock can improve supply chain resilience during disruptions<br>2. Fortification of facility is related to the severity of disruption<br>3. Companies should keep safety stock and set multicover strategies to optimise total cost<br>4. Before disruption happens, companies should take some proactive strategies to respond reactively |
| Ladeira et al., (2021) | 1. They focused on flexibility and agility to improve organisational supply chain resilience<br>2. They analysed the value chain perspective, prioritising process and functional orientation | 1. They found that firms' supply chain agility positively influences process integration and flexibility<br>2. They also found that agility positively affects financial and operational performance |
| Massari and Giannoccaro, (2021) | 1. They explored supplier relationships to improve supply chain resilience<br>2. They considered the relationships from environmental perspectives and investigated supply chain performance | 1. They found that competition between suppliers could improve supply chain resilience<br>2. Increasing environmental complexity can negatively impact supply chain performance<br>3. Sharing information with suppliers can positively influence supply chain performance |
| Moosavi and Hosseini, (2021) | 1. They explored the disruption risks and analysed cost-efficient resilient design in supply chain<br>2. They investigated the impacts of strategies on supply chain resilience during the COVID-19 outbreak | 1. They found that a backup supplier is more effective and cost-effective than backup inventory<br>2. Backup inventory strategies could also improve resilience |
| Praharsi et al., (2021) | 1. They developed a framework for improving resilience<br>2. Their analysis was in the context of the maritime supply chain at the time of the COVID-19 outbreak | 1. They found different risk factors, including missing products, late delivery, non-delivery products, warehouse shortages and miscommunication, as impacting supply chain resilience<br>2. They suggested that delivery requirement forms, delivery schedule control, automotive information update, warehouse utilisation and internal company integration could improve supply chain performance |
| Ryan et al., (2021) | 1. They analysed last-mile data of community capacity by integrating the ability and willingness of the local community for data usage | 1. They highlighted the importance of a socio-ecological perspective for community resilience<br>2. Increased awareness and modern connection among the community could build social capacity<br>3. Community resilience could be improved by building and developing relationships |
| Um and Han, (2021) | 1. They analysed the resilience capabilities of organisations for global environmental change<br>2. They provided beneficial strategies for supply chain resilience on different risk management | 1. They found that mitigation strategies could enhance resilience in supply chain<br>2. They also found several types of mitigation strategies, such as acceptance, avoidance, postponement, speculation, hedging, control, and share and/or transfer<br>3. Mitigation strategies depend on product type, quality and quantity |
| Suryawanshi et al., (2021) | 1. They integrated supply chain resilience for hyperlocal grocery services<br>2. They developed a mathematical model to optimise operational costs | 1. They found that emergency quantities can improve supply chain resilience<br>2. They also found that waste management is effective for a resilient-sustainable supply chain |
| Tan et al., (2020) | 1. They analysed the impact of disruption on supply chain performance<br>2. They compared improvement in supply chain performance by analysing resilience strategies | 1. They found that contingency strategies are cost-effective during short-term disruption<br>2. Backup strategies, such as backup plants and suppliers, could fulfil backorders quickly to optimise recovery time |

**Table 2** continued

| Reference | Contributions of the study | Main findings |
|---|---|---|
| Fattahi et al., (2020) | 1. They formulated a model to optimise supply chain under disruptions<br>2. They considered recovery time and performance loss in supply chain resilience | 1. They found that a disruption increases supply chain costs<br>2. They also found that facilities with high capacity could help mitigate disruption |
| Gölgeci and Kuivalainen, (2020) | 1. They focused on resilience in the context of social capital<br>2. They investigated the role of absorptive capacity<br>3. They integrated supply chain management and marketing to improve resilience | 1. They found a positive influence between social capital and absorptive capacity<br>2. They also found a positive influence between social capital and supply chain resilience<br>3. They observed a positive influence between a firm's absorptive capacity and resilience and between resilience and supply chain performance |
| Mackay et al., (2020) | 1. They explored redundancy and flexibility in supply chain to mitigate disruption risk<br>2. They analysed contextual factors to develop a conceptual model | 1. They conceptualised disruption, resilience, robustness, flexibility and redundancy in supply chains<br>2. They found that strategies have both positive and negative impacts |
| Mao et al., (2020) | 1. They explored performance loss and optimisation of the restoration process to enhance resiliency<br>2. They proposed a bi-objective model with nonlinear programming to evaluate restoration results | 1. They explained the best way to utilise manpower resources by optimising the restoration process<br>2. They considered the preference of decision-makers to increase resiliency in supply chain network<br>3. More crews could improve supply chain resilience but also could increase the organisational budget |
| Chen et al., (2019) | 1. They focused on post-disruption procedures for resilience<br>2. They integrated disruption discovery, recovery, and supply chain re-design | 1. They found that companies could mitigate their losses by adapting strategies of alternative sources and collaborating with partners<br>2. Continuity planning could improve resiliency<br>3. Advanced and innovative IT systems could prevent information disruption for companies |
| Mikhail et al., (2019) | 1. They developed an architectural resilient design in supply chain network for improving performance<br>2. They considered proactive strategies, such as supplier fortification, multi-sourcing, and backup suppliers | 1. They found a relationship between supply chain density and supply chain profit. When density increases, supply chain profit also increases and shortage cost decreases |
| Singh and Singh, (2019) | 1. They explored organisational risk resilience in supply chain<br>2. In the context of big data analytics<br>3. They analysed SC disruption on the firm's ability | 1. They found that institutional response positively impacts big data analytics capabilities<br>2. They also found that IT infrastructure capability positively impacts the development of big data analytics capabilities and supply chain resilience<br>3. Big data capabilities could help improve resilience in supply chain |
| Sangari and Dashtpeyma, (2019) | 1. They identified enablers for supply chain resilience and evaluated their inter-relationships<br>2. They analysed both solvable enablers and important enablers to build supply chain resilience | 1. They found that information sharing, visibility and commitment are the most effective enablers<br>2. They also found that robustness is the least important enabler |
| Altay et al., (2018) | 1. They explored the relationship between agility and resilience in the humanitarian supply chain<br>2. They also analysed the effects of resilience on humanitarian supply chain performance<br>3. They considered different disruption phases, such as pre- and post-disaster phases | 1. They found that supply chain resilience positively impacts performance<br>2. They also found that supply chain agility and resilience could impact performance after a disruption |
| Zavitsas et al., (2018) | 1. They considered the environmental supply chain and analysed the impacts of emissions for better maritime security<br>2. They integrated supply chain network and resilience performance using cost optimisation | 1. They found that emission control areas should be increased for better resilience performance |

**Table 2** continued

| Reference | Contributions of the study | Main findings |
|---|---|---|
| Donadoni et al., (2018) | 1. They conducted an empirical study in the context of product complexity<br>2. They explored the relationship between different disruptions and product complexity related to supply chain resilience | 1. They found that disruption probability has a negative impact on plant performance<br>2. They also found that supply chain resilience capabilities have a moderating effect on performance |
| Fahimnia et al., (2018) | 1. They analysed green vs. resilience in the aspect of supply chain design<br>2. They developed a model for a green and robust supply chain | 1. They found that disruption mostly impacts green supply chains and robustness has long-term positive impacts on performance |
| Macdonald et al., (2018) | 1. They identified disruption risk factors in supply chain<br>2. They integrated supply chain risk and resilience to improve organisational, operational and financial performance | 1. They found that investment is useful for improving resilience<br>2. They also found that increasing the time between shocks increases recovery time and decreases loss |
| Rajesh, (2016) | 1. They identified resilience indicators in supply chain<br>2. They analysed performance measures in supply chain | They found that improving supply chain resilience could mitigate disruption risk<br>They also explained flexibility, responsiveness, quality, productivity and accessibility as resilience indicators |
| Wang et al., (2016) | 1. They explored resilience strategies in the supply chain<br>2. They considered multi-sourcing, contingent rerouting and product allocation perspectives | 1. They found that contingent strategies are effective for supply chain resilience and performance<br>2. They also found that multi-sourcing and reallocation strategies could increase supply chain performance |
| Purvis et al., (2016) | 1. They developed and implemented supply chain resilience strategies in the food and drink sector<br>2. A supply chain resilience framework was proposed | 1. They found resilience as a function of robustness<br>2. They also considered resilience a significant function of agility and flexibility<br>3. They concluded that supply chain should be equipped with readiness, sensing, response and recovery strategies for resilience |
| Fahimnia and Jabbarzadeh, (2016) | 1. They analysed the relationship between resilience and sustainability in supply chain<br>2. They explored sustainability performance based on suppliers' perspectives | 1. They found that environmental performance and social performance could impact economic performance |
| Carvalho et al., (2012) | 1. They analysed scenario-based supply chain design/re-design for supply chain resilience<br>2. They explored how mitigation strategies impact supply chain performance | 1. They found that alternative transport would be more costly than regular transport<br>2. They also found that mitigation strategies could improve supply chain resilience and subsequently positively impact supply chain performance |

(Alikhani et al., 2021; Fattahi et al., 2020; Moosavi & Hosseini, 2021; Suryadi & Rau, 2023), three studies considered China (Pu et al., 2023a, 2023b; Zhu & Wu, 2022) and three studies considered Ghana (Hamidu et al., 2023a, 2023b, 2024) in the country context.

The details of industry sectors and country/regional contexts are presented in Table 3.

## Methodologies Used

Both qualitative and quantitative methods have been applied to analyse strategies and performance indicators in supply chain resilience. Qualitative methods include literature reviews (see Table 1), interviews (Chen et al., 2019; Lin et al., 2023; Maharjan & Kato, 2023; Purvis et al., 2016; Silva et al., 2023), conceptual modelling (Mackay et al., 2020), DMAIC framework (Praharsi et al., 2021), and FEWSION for the community resilience process (Ryan et al., 2021).

Quantitative methods include structural equation modelling (Alvarenga et al., 2023; Gölgeci & Kuivalainen, 2020; Pu et al., 2023a, 2023b; Purvis et al., 2016; Um & Han, 2021), mathematical programming (Alikhani et al., 2021; Mao et al., 2020; Mikhail et al., 2019; Suryawanshi et al., 2021; Zavitsas et al., 2018), MCDM methods (Das et al., 2022; Shweta et al., 2023), simulation (Ivanov, 2022; Kummer et al., 2022; Moosavi & Hosseini, 2021; Tan et al., 2020), partial least squares (Altay et al., 2018), and

**Table 3** Industry sectors and regions

| Reference | Industry sector | Country/Region |
|---|---|---|
| Alvarenga et al., (2023 | Multiple sectors, including chemical and petroleum, food and beverage, and machinery sectors | Global—countries from North America, Europe, Asia, Africa, South America and Oceania |
| Maharjan and Kato, (2023) | Multiple sectors, including manufacturing, assembly, agricultural machinery parts, apparel business, and trading companies | Japan |
| Shweta et al., (2023) | Healthcare | India |
| Suryadi and Rau, (2023) | Anti-fire alloys for vehicles | Iran |
| Xu et al., (2023) | Container handling | Not specific |
| Hamidu et al., (2023a, 2023b) | Multiple sectors, including textiles, food and beverage, chemical and pharmaceutical, timber and paper manufacturing | Ghana |
| Hamidu, Issau, et al. (2023) | Not specific | Ghana |
| Juan and Li, (2023) | Not specific | Taiwan |
| Lin et al., (2023) | Delivery services | UK |
| Silva et al., (2023) | Coffee-producing firms and associated local institutions | Brazil |
| Faruquee et al., (2023) | Not specific | USA and the UK |
| Hamidu et al., (2023a, 2023b) | Not specific | Ghana |
| Vimal et al. (2022a) | Healthcare | India |
| Li et al., (2022) | Fresh food sector | Not specific |
| Nagariya et al., (2023) | Textile industry, micro-, small-, and medium-sized enterprises | India |
| Pu et al., (2023a, 2023b) | E-commerce (clothing sector) | China |
| Pu et al., (2023a, 2023b) | Multiple sectors, including automobile, pharmaceutical, furniture, textile, food, electrical and computer equipment | China |
| Zhu and Wu, (2022) | Multiple sectors, including fast-moving consumer goods, catering, and software and hardware services | China |
| Kummer et al., (2022) | Pork supply chain | Austria |
| Das et al., (2022) | Multiple sectors, including baby foods, soaps, and pharmaceutical products | Global—countries from Asia, Europe, and the Americas |
| Ekanayake et al., (2021) | Industrialised construction | Hong Kong |
| Isti'anah et al., (2021) | Freight forwarding, maritime supply | Indonesia |
| Vimal et al. (2022b) | Copper industry | India |
| Nguyen et al., (2022) | Multiple sectors of small and medium enterprises | Vietnam |
| Zhou et al., (2022) | Multiple sectors, including electronics and appliances, metals, machinery and engineering, construction materials, and textiles and clothing | China |
| Trabucco and De Giovanni, (2021) | Multiple sectors, including retailing, electronics, pharmaceuticals and agriculture | European countries, including Italy, France, the UK, Spain, Germany, Portugal, and Belgium |

**Table 3** continued

| Reference | Industry sector | Country/Region |
|---|---|---|
| Alikhani et al., (2021) | Retail | Iran |
| Fattahi et al., (2020) | Not specific | Iran |
| Ladeira et al., (2021) | Multiple sectors, including manufacturers of non-durable consumer goods and food items | Brazil |
| Moosavi and Hosseini, (2021) | LED panel light manufacturing | Iran |
| Praharsi et al., (2021) | Maritime industry | Indonesia |
| Ryan et al., (2021) | Not specific | USA |
| Suryawanshi et al., (2021) | E-commerce (grocery sector) | India |
| Um and Han, (2021) | Multiple sectors, including food, furniture, chemical materials, and non-metal mineral products | UK, South Korea |
| Chen et al., (2019) | Information and communications technology industry | Taiwan |
| Gölgeci and Kuivalainen, (2020) | Multiple sectors, including chemical and pharmaceutical, food and beverage, construction equipment, retail, textile, clothing and apparel | Turkey |
| Zavitsas et al., (2018) | Maritime industry | Not specific |
| Singh and Singh, (2019) | Multiple sectors, including healthcare, manufacturing, IT and logistics services | Not specific |
| Altay et al., (2018) | Multiple sectors, including railway logistics and materials, military, NGOs, state police, and 3PLs | India |
| Carvalho et al., (2012) | Automotive | Portugal |
| Donadoni et al., (2018) | Not specific | Multiple countries, including Belgium, Brazil, Canada, China, Denmark, Finland, Germany, Hungary, India, Italy, Japan, Malaysia, Netherlands, Norway, Portugal, Romania, Slovenia, Spain, Sweden, Switzerland, Taiwan, and the USA |
| Fahimnia and Jabbarzadeh, (2016) | Sportswear clothing | Australia, China, Vietnam, Bangladesh, Cambodia |
| Fahimnia et al., (2018) | Apparel | Australia |
| Rajesh, (2016) | Electronic | India |
| Purvis et al., (2016) | Food and drink sector | UK |

regression analysis (Donadoni et al., 2018; Trabucco & De Giovanni, 2021).

Table 4 provides a summary of the methods used.

Several studies integrated multiple methods such as PLS-SEM (Ekanayake et al., 2021; Hamidu et al., 2023a, 2023b; Nguyen et al., 2022), Fuzzy DEMATEL and best–worst method (Shweta et al., 2023), analytic hierarchy process and linear programming (Suryadi & Rau, 2023), analysis of variance and polynomial regression (Faruquee et al., 2023), best–worst method and fuzzy TOPSIS (Vima et al., 2022b), Delphi method and best–worst method (Nagariya et al., 2023), AHP and DEMATEL (Das et al., 2022), mixed-integer linear programming and Monte Carlo simulation (Suryawanshi et al., 2021), interpretive structural modelling and fuzzy analytical network process

**Table 4** Summary of methods used

| Methods | Number of articles |
| --- | --- |
| Literature review | 8 |
| Interviews | 5 |
| Structural equation modelling | 9 |
| Partial least squares | 1 |
| PLS-SEM | 5 |
| Conceptual modelling | 1 |
| MCDM methods | 7 |
| Mathematical programming | 11 |
| Simulation | 9 |
| Grey prediction approach | 1 |
| Regression analysis | 2 |
| Analysis of variance, polynomial regression | 1 |
| DMAIC framework | 1 |
| FEWSION for community resilience process | 1 |

(Sangari & Dashtpeyma, 2019), and discrete-event simulation and regression analysis (Macdonald et al., 2018).

Case studies were combined with other methods in several studies. For example, Purvis et al. (2016) conducted a case study in the UK's food and drink sector to analyse supply chain resilience strategies. Maharjan and Kato (2023) included a case study from Japan's manufacturing, agricultural, apparel, and trading companies to identify the current resilience status. Lin et al. (2023) provided a case study from delivery services in the UK to investigate supply chain resilience in responding to disruptions. Silva et al. (2023) discussed the findings from coffee-producing firms in Brazil to explore the relationship between sustainability and resilience. Carvalho et al. (2012) explained a case study from the automotive sector in Portugal to analyse the scenario-based design for supply chain resilience.
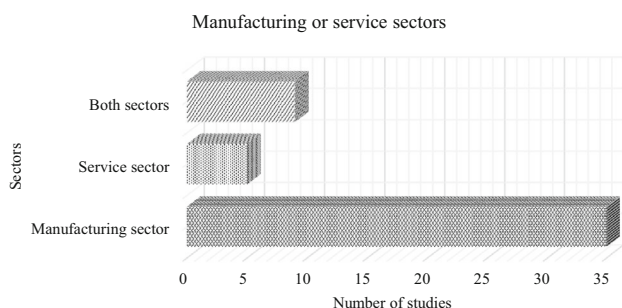


**Fig. 3** Summary of key sectors

## Key Sectors (Manufacturing or Service)

The reviewed articles show that previous studies considered both the manufacturing and service sectors as the key application areas. Figure 3 provides a summary of key sectors. Figure 3 shows that 49 out of 62 articles considered a sector, with most (35 articles) focusing on the manufacturing sector. Nine studies considered both manufacturing and service sectors, and only five considered the service sector. Sect. "Contexts" shows the specific contexts previous studies considered.

## Different Flexible Strategies for Supply Chain Resilience

We observed that numerous strategies have been used for supply chain resilience. We have categorised them as supply, manufacturing/operational strategies, transportation and distribution strategies, and supply chain levels.

The most common supply strategies were multiple suppliers/sourcing, improving collaboration with suppliers/partners, backup/alternative suppliers, supplier development, and building trust with suppliers. These strategies help to improve supply chain flexibility and supply chain resilience. For example, multiple suppliers/sourcing includes having multiple suppliers or sources of materials for mitigating risks and disruptions (Ekanayake et al., 2021; Mikhail et al., 2019; Praharsi et al., 2021; Rahman et al., 2022). It improves supply flexibility, further allowing for the diversification of the supply base. Similarly, another popular strategy in supply chain resilience is improving collaboration with suppliers/partners. It enhances communication processes, information, and resource sharing and working together to deal with risks and uncertainties in their supply chains (Chen et al., 2019; Faruquee et al., 2023; Sangari & Dashtpeyma, 2019; Silva et al., 2023).

Flexible transportation/distribution channels were the most widely applied transportation and distribution strategy. This includes flexible routes, flexible transportation capacities, and multiple distribution channels, spanning online, and physical distributions (Faruquee et al., 2023; Hohenstein et al., 2015; Massari & Giannoccaro, 2021; Suryadi & Rau, 2023). This strategy is very effective in improving resilience in transportation and distribution, particularly, and the supply chain, in general. The other flexible strategies included alternative shipment/transportation modes and backup distribution centres.

Strategies such as utilising extra capacity, resource allocation/reallocation, managing the quality of products, and using safety stock were widely applied in manufacturing/operations. Extra capacities in manufacturing plants improve production flexibilities and help mitigate supply and demand uncertainties (Altay et al., 2018; Fattahi et al.,

2020; Rahman et al., 2022). Other strategies, such as resource allocation/reallocation, managing the quality of products, and using safety stock, are also effective in dealing with risk and disruption in supply chains and improving business reputation.

In supply chain-level strategies, the common strategies were adopting digital technologies, knowledge/information sharing, business continuity/contingency planning, and multi-skilled labour. The recent studies highlighted that adopting digital technologies at the supply chain level could improve communication, tracking, data analysis, and information processing (Alvarenga et al., 2023; Nagariya et al., 2023; Nguyen et al., 2022; Trabucco & De Giovanni, 2021). All these contribute to improving supply chain performance and resilience. Similarly, the literature proved that supply chain-level strategies help improve operational, financial, and reputational performance by enhancing supply chain resilience.

The full list of flexible strategies for supply chain resilience and their categories are presented in Table 5.

### Performance Indicators for Supply Chain Resilience

Supply chain resilience studies have used several performance indicators to measure performance, including financial, operational, reputational, and supply chain performance.

In supply chain resilience, financial performance indicators include cost efficiency, return on investment, market share, sales growth, profit, and return on sales and assets. Cost efficiency is the most significant performance indicator (Alikhani et al., 2021; Donadoni et al., 2018; Fattahi et al., 2020; Nagariya et al., 2023). Organisations set their desired price while maintaining the quality of products or services and improving customer satisfaction. Another significant performance indicator is profit (Hohenstein et al., 2015; Mikhail et al., 2019; Moosavi & Hosseini, 2021; Shashi et al., 2020). Profit is a goal for organisations to enhance overall performance. Return on investment (Gölgeci & Kuivalainen, 2020; Juan & Li, 2023; Trabucco & De Giovanni, 2021) and market share (Hohenstein et al., 2015; Juan & Li, 2023; Pu et al., 2023a, 2023b; Zhou et al., 2022) are also used to evaluate organisational performance.

The most common operational performance indicators in supply chain resilience are on-time delivery, demand fulfilment, and enhanced operational efficiency and delivery time. On-time delivery (Rajesh, 2021; Shweta et al., 2023; Trabucco & De Giovanni, 2021) improves the efficiency of business processes and fulfils customer commitment. Customer order processing depends on demand fulfilment. Demand fulfilment (Moosavi & Hosseini, 2021; Rajesh, 2021; Tan et al., 2020) positively impacts the firm's performance in the competitive market. Enhanced

operational efficiency (Praharsi et al., 2021) and delivery time (Mao et al., 2020) increases customer satisfaction and improves business performance.

In supply chain resilience, reputational performance indicators include customer satisfaction, service-level improvement, customer loyalty, meeting customer satisfaction/request, quality performance, and corporate image. Service-level improvement (Hohenstein et al., 2015; Isti'anah et al., 2021; Praharsi et al., 2021) is one of the most important performance indicators. Maximising service level increases the overall performance of organisations. Customer satisfaction is the second most crucial reputational performance indicator (Gölgeci & Kuivalainen, 2020; Zhu & Wu, 2022). Customer satisfaction with a product/service enhances organisational reputation.

Resilience performance also depends on supply chain performance indicators such as restoring material flow, quickly moving to a desirable state, lead time reduction, supply chain visibility, recovery time, and response time. Among these indicators, lead time reduction (Donadoni et al., 2018; Ivanov, 2022; Nagariya et al., 2023), recovery time (Altay et al., 2018; Singh & Singh, 2019), and response time (Altay et al., 2018; Faruquee et al., 2023) are the significant performance indicators. Lead time reduction minimises the time duration of the product or service process. Reduction of recovery time and response time enhances the efficiency of organisational performance.

Table 6 summarises the list of performance indicators in supply chain resilience.

### Mapping of Strategies and Performance Indicators

The literature review shows that flexible strategies are useful in improving supply chain performance. This section explains the mapping between different flexible strategies and performance indications and discusses the strategies that effectively improve or influence performance.

From the literature analysis, we have observed that "improving collaboration with suppliers/partners" influences all major resilience performances, including cost efficiency, return on investment, market share, profit, customer satisfaction, service-level improvement, on-time delivery, demand fulfilment, lead time reduction, recovery time, and response time (Chen et al., 2019; Donadoni et al., 2018; Faruquee et al., 2023; Hohenstein et al., 2015; Juan & Li, 2023; Ladeira et al., 2021; Moosavi & Hosseini, 2021; Praharsi et al., 2021; Shashi et al., 2020; Shweta et al., 2023; Suryadi & Rau, 2023; Zhou et al., 2022; Zhu & Wu, 2022).

Similarly, multiple suppliers/sourcing, backup/alternative suppliers, flexible transportation/distribution channels, utilising extra capacity, adopting digital technologies, knowledge/information sharing, and multi-skilled labour

**Table 5** Flexible strategies for supply chain resilience

| Category | Strategies | References |
| --- | --- | --- |
| Supply strategies | Supplier development | Hamidu, (2023a), Purvis et al. (2016), Rahman et al.(2022), Shashi et al. (2020) |
| | Multiple suppliers/sourcing | Ekanayake et al. (2021), Grzybowska and Stachowiak,(2022), Hohenstein et al. (2015), Vimal et al. (2022a), Mandal, (2014), Mikhail et al. (2019), Praharsi et al. (2021), Purvis et al. (2016), Rahman et al.(2022), Shashi et al. (2020), Shishodia et al. (2023), Suryadi and Rau, (2023), Tan et al. (2020), Wang et al. (2016) |
| | Backup/alternative suppliers | Chen et al. (2019), Donadoni et al. (2018), Hohenstein et al. (2015), Vimal et al. (2022b), Mikhail et al. (2019), Moosavi and Hosseini, (2021), Praharsi et al. (2021), Pu et al. (2023a, 2023b), Shishodia et al. (2023), Suryadi and Rau, (2023), Tan et al. (2020), Wang et al. (2016) |
| | Flexible supplier selection | Shweta et al. (2023), Zavala-Alcívar et al. (2020), Zhu and Wu,(2022) |
| | Improving collaboration with suppliers/partners | Chen et al. (2019), Donadoni et al. (2018), Faruquee et al. (2023), Hamidu et al., (2023a, 2023b), Hamidu et al., (2023a, 2023b), Hohenstein et al. (2015), Juan and Li, (2023), Vimal et al. (2022a), Ladeira et al. (2021), Massari and Giannoccaro, (2021), Moosavi and Hosseini, (2021), Nguyen et al.(2022), Olivares-Aguila and Vital-Soto, (2021), Praharsi et al. (2021), Sangari and Dashtpeyma, (2019), Shashi et al. (2020), Shweta et al. (2023), Silva et al. (2023), Suryadi and Rau, (2023), Zhou et al.(2022), Zhu and Wu,(2022) |
| | Building trust with suppliers | Donadoni et al. (2018), Praharsi et al. (2021), Um and Han, (2021), Zavala-Alcívar et al. (2020) |
| | Managing good relationships with suppliers | Macdonald et al. (2018), Um and Han, (2021) |
| | Outsourcing | Um and Han, (2021) |
| | Supplier fortification | Mikhail et al. (2019) |
| | Multi-region suppliers | Fahimnia and Jabbarzadeh, (2016), Mandal, (2014) |
| Transportation and distribution strategies | Lateral transhipment between logistics centres | Maharjan and Kato, (2023) |
| | Flexible transportation/distribution channels | Hohenstein et al. (2015), Juan and Li, (2023), Nagariya et al. (2023), Sangari and Dashtpeyma, (2019), Shishodia et al. (2023), Shweta et al. (2023) |
| | Alternative shipment/transportation modes | Donadoni et al. (2018), Suryadi and Rau, (2023) |
| | Backup distribution centres | Pu et al. (2023a, 2023b) |
| | Restructuring transport | Carvalho et al. (2012) |
| | Contingent rerouting | Wang et al. (2016) |
| Manufacturing/operational strategies | Utilising extra capacity | Alikhani et al. (2021), Altay et al. (2018), Donadoni et al. (2018), Fattahi et al. (2020), Hamidu et al., (2023a, 2023b), Purvis et al. (2016), Rahman et al.(2022), Shashi et al. (2020), Tan et al. (2020) |
| | Introducing new product lines | Purvis et al. (2016) |
| | Demand monitoring | Purvis et al. (2016) |
| | Resource allocation/reallocation | Gölgeci and Kuivalainen, (2020), Maharjan & Kato, 2023, Wang et al. (2016) |
| | Demand aggregation | Shishodia et al. (2023) |
| | Managing the quality of products | Das et al.(2022), Ladeira et al. (2021), Mandal, (2014), Shishodia et al. (2023), Um and Han, (2021) |
| | Creating duplicate resources | Shweta et al. (2023) |
| | Reserved/backup inventory | Carvalho et al. (2012), Moosavi and Hosseini, (2021), Suryadi and Rau, (2023), Tan et al. (2020), Um and Han, (2021) |
| | Production capacity flexibility | Hamidu (2023b), Tan et al. (2020) |
| | Modifying product/process design | Juan and Li, (2023), Vimal et al. (2022b), Um and Han, (2021) |
| | Efficient use of resources | Nagariya et al. (2023) |
| | Flexible process/facilities | Hohenstein et al. (2015), Nagariya et al. (2023), Sangari and Dashtpeyma, (2019) |
| | Process automation | Das et al.(2022) |
| | Using safety stock | Alikhani et al. (2021), Vimal et al. (2022a), Macdonald et al. (2018), Mandal, (2014), Praharsi et al. (2021) |
| | Multiple plants | Tan et al. (2020) |

**Table 5** continued

| Category | Strategies | References |
|---|---|---|
| Supply chain-level strategies | Robustness, agility, leanness, flexibility assessment | Maharjan and Kato, (2023), Purvis et al. (2016) |
| | Supply chain memory | Alvarenga et al. (2023) |
| | Adopting digital technologies | Alvarenga et al. (2023), Hamidu et al., (2023a, 2023b), Vimal et al. (2022b), Li et al.(2022), Lin et al. (2023), Massari and Giannoccaro, (2021), Nagariya et al. (2023), Nguyen et al.(2022), Shashi et al. (2020), Trabucco and De Giovanni, (2021) |
| | Business continuity/contingency planning | Chen et al. (2019), Das et al.(2022), Maharjan and Kato, (2023), Sangari and Dashtpeyma, (2019), Shashi et al. (2020), Zavala-Alcívar et al. (2020) |
| | Risk sharing | Shishodia et al. (2023) |
| | Quick responding | Ladeira et al. (2021), Nagariya et al. (2023), Shweta et al. (2023), Xu et al. (2023), Zhou et al.(2022) |
| | Improve trackability/real-time tracking | Donadoni et al. (2018), Ekanayake et al. (2021), Hamidu et al., (2023a, 2023b), Isti'anah et al. (2021), Vimal et al. (2022a), Li et al.(2022), Shweta et al. (2023) |
| | Collaborative forecasting | Ekanayake et al. (2021), Hamidu et al. (2023b) |
| | Flexible information systems | Chen et al. (2019), Donadoni et al. (2018), Juan and Li, (2023) |
| | Managing good relationships with partners | Lin et al. (2023), Pu et al., (2023a, 2023b) |
| | Improving relationships with customers | Lin et al. (2023), Silva et al. (2023) |
| | Knowledge/information sharing | Chen et al. (2019), Donadoni et al. (2018), Faruquee et al. (2023), Gölgeci and Kuivalainen, (2020), Hohenstein et al. (2015), Isti'anah et al. (2021), Vimal et al. (2022b), Massari and Giannoccaro, (2021), Nguyen et al.(2022), Praharsi et al. (2021), Ryan et al. (2021), Sangari and Dashtpeyma, (2019), Um and Han, (2021), Zavala-Alcívar et al. (2020), Zhou et al.(2022) |
| | Resource sharing | Faruquee et al. (2023), Massari and Giannoccaro, (2021), Zhou et al.(2022) |
| | Using backup facilities | Ekanayake et al. (2021), Grzybowska and Stachowiak,(2022) |
| | Fortification of facilities | Alikhani et al. (2021), Grzybowska and Stachowiak,(2022), Pu et al., 2023a, 2023b, Tan et al. (2020) |
| | Building social capital | Nagariya et al. (2023) |
| | Reconfiguring supply chain resources | Ladeira et al. (2021), Pu et al., (2023a, 2023b), Shashi et al. (2020) |
| | Sensing customer needs | Pu et al., (2023a, 2023b) |
| | Multi-skilled labour | Hohenstein et al. (2015), Isti'anah et al. (2021), Praharsi et al. (2021), Sangari and Dashtpeyma, (2019), Shashi et al. (2020), Zavala-Alcívar et al. (2020) |
| | Developing early warning systems | Ivanov,(2022), Olivares-Aguila and Vital-Soto, (2021) |
| | Supply chain coordination | Trabucco and De Giovanni, (2021) |
| | Revenue sharing | Praharsi et al. (2021) |

are effective in improving resilience performance in supply chain management.

Table 7 provides the mapping between different strategies and their influence on resilience performance indicators.

## Research Gaps and Future Research Opportunities

We have observed the following research gaps from the literature review and have suggested future research opportunities.

## Relationship Between Strategies and Performance In Supply Chain Resilience

Very few studies analysed the relationship between strategies and performance in supply chain resilience. While a few studies did, they only considered a limited number of strategies and performance indicators (Donadoni et al., 2018; Faruquee et al., 2023; Gölgeci & Kuivalainen, 2020; Isti'anah et al., 2021; Juan & Li, 2023; Mikhail et al., 2019; Nagariya et al., 2023; Praharsi et al., 2021; Pu et al., 2023a, 2023b; Shishodia et al., 2023; Suryadi & Rau, 2023; Trabucco & De Giovanni, 2021; Wang et al., 2016; Zhou et al., 2022). For example, Shishodia et al. (2023) considered managing product quality, multiple sourcing, demand aggregation, flexible transportation systems, backup suppliers, fortification of partners, and risk sharing as

**Table 6** Performance indicators used in supply chain resilience studies

| Category | Performance indicator | References |
| --- | --- | --- |
| Financial performance | Cost efficiency | Alikhani et al. (2021), Altay et al. (2018), Carvalho et al. (2012), Donadoni et al. (2018), Fahimnia et al. (2018), Fahimnia and Jabbarzadeh, (2016), Fattahi et al. (2020), Gölgeci and Kuivalainen, (2020), Hohenstein et al. (2015), Juan and Li, (2023), Vimal et al. (2022a), Ladeira et al. (2021), Li et al. (2022), Mao et al. (2020), Moosavi and Hosseini, (2021), Nagariya et al. (2023), Praharsi et al. (2021), Shashi et al. (2020), Shishodia et al. (2023), Suryadi and Rau, (2023), Suryawanshi et al. (2021), Tan et al. (2020), Wang et al. (2016), Zavitsas et al. (2018) |
| | Return on investment | Gölgeci and Kuivalainen, (2020), Juan and Li, (2023), Trabucco and De Giovanni, (2021) |
| | Market share | Hohenstein et al. (2015), Juan and Li, (2023), Pu et al. (2023a, 2023b), Zhou et al. (2022) |
| | Sales growth | Juan and Li, (2023), Zhu and Wu, (2022) |
| | Profit | Gölgeci and Kuivalainen, (2020), Hohenstein et al. (2015), Ivanov, (2022), Vimal et al. (2022b), Ladeira et al. (2021), Li et al. (2022), Mikhail et al. (2019), Moosavi and Hosseini, (2021), Nagariya et al. (2023), W. Pu et al., 2023a, 2023b, Shashi et al. (2020), Zhou et al. (2022), Zhu and Wu, (2022) |
| | Return on sales | Gölgeci and Kuivalainen, (2020), Zhou et al. (2022) |
| | Return on assets | Gölgeci and Kuivalainen, (2020), Juan and Li, (2023) |
| Reputational performance | Customer satisfaction | Gölgeci and Kuivalainen, (2020), Hamidu et al., 2023a, 2023b, Praharsi et al. (2021), Pu et al., (2023a, 2023b), Shashi et al. (2020), Shweta et al. (2023), Zhu and Wu, (2022) |
| | Service-level improvement | Chen et al. (2019), Hohenstein et al. (2015), Isti'anah et al. (2021), Praharsi et al. (2021), Shashi et al. (2020), Suryadi and Rau, (2023), Trabucco and De Giovanni, (2021), Zhu and Wu, (2022) |
| | Customer loyalty | Hamidu et al., (2023a, 2023b), Ladeira et al. (2021), Pu et al., (2023a, 2023b) |
| | Meeting customer specifications/requests | Faruquee et al. (2023), Ladeira et al. (2021) |
| | Quality performance | Nagariya et al. (2023), Pu et al., 2023a, 2023b |
| | Corporate image | Pu et al., (2023a, 2023b) |
| Operational performance | On-time delivery | Isti'anah et al. (2021), Lin et al. (2023), Rajesh, (2016), Shweta et al. (2023), Trabucco and De Giovanni, (2021), Zhu and Wu, (2022) |
| | Demand fulfilment | Vimal et al. (2022a), Lin et al. (2023), Mikhail et al. (2019), Moosavi and Hosseini, (2021), Rajesh, (2016), Suryadi and Rau, (2023), Tan et al. (2020) |
| | Enhanced operational efficiency | Praharsi et al. (2021) |
| | Delivery time | Donadoni et al. (2018), Mao et al. (2020) |
| Supply chain performance | Restoring material flow | Alvarenga et al. (2023) |
| | Moved to desirable state quickly | Alvarenga et al. (2023) |
| | Lead time reduction | Donadoni et al. (2018), Ivanov, (2022), Nagariya et al. (2023), Shishodia et al. (2023) |
| | Supply chain visibility | Trabucco and De Giovanni, (2021) |
| | Recovery time | Altay et al. (2018), Shashi et al. (2020), Singh and Singh, (2019), Tan et al. (2020) |
| | Response time | Altay et al. (2018), Faruquee et al. (2023), Singh and Singh, (2019) |

strategies and cost efficiency and lead time reduction as performance indicators. Similar analyses were found in other studies. This makes the literature less comprehensive in analysing the thorough impacts of different strategies, individually and combined, on supply chain resilience performance.

To close this gap and improve the literature, we propose studies to consider the holistic list of strategies and performance indicators (as shown in Sects. "Different Flexible Strategies for Supply Chain Resilience" and "Performance Indicators for Supply Chain Resilience") and analyse how major strategies influence major performance indicators in supply chain resilience.

**Comparative Studies**

There is a significant research gap in the literature regarding comparative studies. Very few studies

**Table 7** Mapping between different flexible strategies and performance indicators in supply chain resilience

| Strategies | Performance indicators | | | | | | | | | | | References |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cost efficiency | Return on investment | Market share | Profit | Customer satisfaction | Service-level improvement | On-time delivery | Demand fulfilment | Lead time reduction | Recovery time | Response time | |
| Supplier development | ✓ | | | ✓ | ✓ | ✓ | | | | ✓ | | Shashi et al. (2020) |
| Multiple suppliers/sourcing | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | | Ekanayake et al. (2021), Hohenstein et al. (2015), Praharsi et al. (2021), Shishodia et al. (2023), Tan et al. (2020) |
| Backup/alternative suppliers | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | | Chen et al. (2019), Donadoni et al. (2018), Hohenstein et al. (2015), Mikhail et al. (2019), Moosavi and Hosseini, (2021), Praharsi et al. (2021), Pu et al. (2023a, 2023b), Shishodia et al. (2023), Suryadi and Rau, (2023), Tan et al. (2020), Wang et al. (2016) |
| Improving collaboration with suppliers/partners | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Chen et al. (2019), Donadoni et al. (2018), Faruqee et al. (2023), Hohenstein et al. (2015), Juan and Li, (2023), Ladeira et al. (2021), Moosavi and Hosseini, (2021), Praharsi et al. (2021), Shashi et al. (2020), Shweta et al., (2023), Suryadi and Rau, (2023), Zhou et al. (2022), Zhu and Wu, (2022) |
| Building trust with suppliers | ✓ | | | | ✓ | ✓ | | | ✓ | | | Donadoni et al. (2018), Praharsi et al. (2021) |
| Flexible transportation/distribution channels | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | | Hohenstein et al. (2015), Juan and Li, (2023), Nagariya et al., (2023), Shishodia et al., (2023), Shweta et al., (2023) |
| Utilising extra capacity | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | Alikhani et al. (2021), Altay et al. (2018), Donadoni et al. (2018), Fattahi et al. (2020), Hamidu et al. (2023a, 2023b), Shashi et al. (2020), Tan et al. (2020) |
| Resource allocation/reallocation | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | Gölgeci and Kuivalainen, (2020), Wang et al. (2016) |
| Managing the quality of products | ✓ | | | ✓ | | | | | ✓ | | | Ladeira et al. (2021), Shishodia et al., (2023) |

**Table 7** continued

| Strategies | Performance indicators | | | | | | | | | | | References |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cost efficiency | Return on investment | Market share | Profit | Customer satisfaction | Service-level improvement | On-time delivery | Demand fulfilment | Lead time reduction | Recovery time | Response time | |
| Reserved/backup inventory | ✓ | | | ✓ | | ✓ | | ✓ | ✓ | ✓ | | Carvalho et al. (2012), Moosavi and Hosseini, (2021), Suryadi and Rau, (2023), Tan et al. (2020) |
| Using safety stock | ✓ | | | ✓ | ✓ | ✓ | | ✓ | | | | Alikhani et al. (2021), Vimal et al. (2022a), Praharsi et al. (2021) |
| Adopting digital technologies | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | Hamidu et al., (2023a, 2023b), Li et al. (2022), Lin et al., (2023), Nagariya et al., (2023), Nguyen et al. (2022), Shashi et al. (2020), Trabucco and De Giovanni, (2021) |
| Business continuity/contingency planning | ✓ | | | ✓ | ✓ | ✓ | | | | ✓ | | Chen et al. (2019), Shashi et al. (2020) |
| Quick responding | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | | Ladeira et al. (2021), Nagariya et al. (2023), Shweta et al., (2023), Zhou et al. (2022) |
| Improve trackability/real-time tracking | ✓ | | | ✓ | ✓ | | ✓ | | ✓ | | | Donadoni et al. (2018), Ekanayake et al. (2021), Isti'anah et al. (2021), Li et al. (2022), Shweta et al., (2023) |
| Knowledge/information sharing | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | Chen et al. (2019), Donadoni et al. (2018), Faruquee et al. (2023), Gölgeci and Kuivalainen, (2020), Hohenstein et al. (2015), Isti'anah et al. (2021), Praharsi et al. (2021), Zhou et al. (2022) |
| Fortification of facilities | ✓ | | | ✓ | | | | ✓ | | ✓ | | Alikhani et al. (2021), Pu et al., (2023a, 2023b), Tan et al. (2020) |
| Multi-skilled labour | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | | Hohenstein et al. (2015), Isti'anah et al. (2021), Praharsi et al. (2021), Shashi et al. (2020) |

considered both the manufacturing and service sectors and multiple industry sectors (Alikhani et al., 2021; Alvarenga et al., 2023; Nguyen et al., 2022; Singh & Singh, 2019; Zhu & Wu, 2022). However, the literature has research gaps for comparative studies between developed and developing economies, large and small and medium enterprises, and their longitudinal analyses. Hence, there is a gap in generalising the findings.

To contribute to this area, we suggest conducting the following studies.

i. Comparative studies of flexible strategies and/or performance indicators for developed and developing economies.
ii. Comparative studies of flexible strategies and/or performance indicators between large, small, and medium enterprises.
iii. Analysis of findings over time for different economies and enterprises.
iv. Developing models for generalising the findings for different economies and enterprises.

### Service Sectors

Service sectors get less attention in the literature even though they are dominant in many countries. Only a few studies considered service sectors (Fattahi et al., 2020; Isti'anah et al., 2021; Lin et al., 2023; Suryawanshi et al., 2021). Hence, the literature provided few findings on supply chain resilience and their strategies and performance indicators in service sectors.

We suggest conducting more studies for service sectors, including the analysis of different flexible strategies used by different service sectors and how they influence service performance to improve supply chain resilience.

### Dynamic Plans for Supply Chain Resilience

Many studies have developed models and frameworks for analysis strategies and performance indicators in supply chain resilience (Juan & Li, 2023; Shishodia et al., 2023; Suryadi & Rau, 2023). Still, there is a gap in the literature on developing dynamic resilience plans for the changed environment. As risks and disruptions change over time, it is important to change the plan and its flexible strategies to ensure supply chains can deal with the impacts of the changing environment and improve resilience. These types of studies on flexible strategies and supply chain resilience are non-existent in the current literature.

To contribute to this area, we suggest developing the following studies.

i. Developing dynamic and flexible strategies for supply chain resilience for different disruption scenarios.
ii. Analysing the impacts of dynamic strategies on resilience performance over time.
iii. Developing dynamic supply chain resilience models for preparedness, response, and recovery considering different flexible strategies.
iv. Comparing the findings for different flexible strategies to obtain the most suitable plans for dynamic supply chain resilience plans.

### Theoretically Grounded Studies

Few studies developed theoretically grounded empirical models (Alvarenga et al., 2023; Gölgeci & Kuivalainen, 2020; Juan & Li, 2023; Ladeira et al., 2021; Pu et al., 2023a, 2023b; Singh & Singh, 2019; Um & Han, 2021; Zhou et al., 2022; Zhu & Wu, 2022). However, there is a gap in the literature in relation to applying emergent theories such as the awareness–motivation–capability framework.

In the future, we propose considering theories from multiple disciplines to develop and test models to analyse the impacts of flexible strategies on supply chain resilience, including in dynamic and changed environments.

### Analytical Studies

According to the literature review, different studies applied different analytical tools, such as mathematical programming and simulation approaches (Alikhani et al., 2021; Fattahi et al., 2020; Ivanov, 2022; Kummer et al., 2022; Mikhail et al., 2019; Pu et al., 2023a, 2023b; Zavitsas et al., 2018). Integrating multiple analytical tools improves the quality of findings and the decision-making process in supply chain management. The flexible strategies and supply chain resilience literature has a gap in relation to integrating multiple analytical tools for analysing strategies and performance indicators.

In future, we propose applying multiple analytical tools to develop decision-making models for practitioners. We also suggest dividing the studies into different sections, applying analytical tools and connecting them again to improve the quality of findings.

### Conclusions

The main objective of this study was to critically review the existing studies that considered flexible strategies for supply chain resilience. To fulfil this objective, we applied an SLR technique and analysed 62 related studies in the

domain of contributions and findings, research contexts and business sectors, methodologies, different flexible strategies and performance indicators, and relationship mapping between flexible strategies and performance indicators.

The main contributions of this study are: (i) conducting an SLR in flexible strategies for supply chain resilience, which has not yet been explored in the literature, (ii) critically analysing the existing studies and presenting the findings, and (iii) proposing future research directions based on the identified research gaps.

The main findings indicated that more research is needed to analyse holistic relationships between flexible strategies and supply chain performance. Moreover, the service sector should be studied more, as it has been widely ignored in the literature thus far. Future research should also consider developing dynamic resilience plans using flexible strategies. Finally, more theoretically grounded and analytical studies should be conducted in the area of flexible strategies and supply chain resilience.

However, this review article has some limitations. First, we consider only journal articles published until 2023 and written in English. Second, the scope of the study was limited to flexible strategies and performance indicators used in the area of supply chain resilience. In the future, the timeline of published articles and the scope of the study can be further broadened. As this SLR paper provided a critical review, a summary of existing studies, and significant future research directions, the findings of the study can be used as a benchmark for future research in flexible strategies for supply chain resilience.

**Declarations**

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## Key Questions

1. What contributions have been made in the connection between flexible strategies and supply chain resilience?
2. What are the emerging research opportunities in the area of flexible strategies and supply chain resilience?

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