

Sustainable and Resilient Supply Chain Network Design: A Systematic and Bibliometric Review

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Abstract

The concept of resilient and sustainable supply chain network design provides a suitable solution to balance economic problems, environmental and social disturbances in the design of the supply chain network. This concept is a strategic and tactical decision in designing a supply chain network to determine the location (suppliers, manufacturers, distributors, and retailers) and the allocation of the number of raw materials or products. This paper aims to provide an extensive systematic and bibliometric overview of 'supply chain network design' as a term and concept. The Scopus database contained articles from 2010 through 2022. We analyzed 155 articles from 74 journals and 38 publishers, reviewed the compiled articles, and classified them using the VosViewer software. The analysis was conducted on productive journals, the most cited articles, keywords, research objectives, and attributes considered in each sustainability dimension. VosViewer is used to visualize bibliometric literature reviews. The indicators used in the aspects of resilience and sustainability in the supply chain network design are reviewed. This research will contribute to future academic and practitioner work on supply chain network design

Keywords

Network Design, Supply Chain, Sustainability, Resilience and Bibliometric Analysis.

1. Introduction

Supply chain network design (SCND) is a strategic supply chain planning where the process is carried out to build and model the supply chain by considering the cost and time in delivering goods or services to the market with the available resources. The supply chain network design includes all the movement and storage of raw materials, work-in-process inventory, and finished goods from the point of origin to the consumer. This includes planning, implementing, and controlling supply chain operations. The infrastructure and physical structure of the supply chain is determined in the SCND process, which is part of the planning phase in supply chain management (Govindan et al., 2017a). This topic encourages the interest and motivation of researchers to analyze it (Nagurney, 2010). The goal of an SCND mathematical model is usually to minimize costs or maximize profits. However, in recent years, attention has increased on supply chain sustainability, where the success of supply chain management is measured more broadly by considering economic, environmental, and social factors.

The impacts of climate change affect people in every region of the country, threatening lives and livelihoods and damaging infrastructure, ecosystems, and social systems. Increasing global warming and rapidly changing environmental conditions have threatened the world's sustainability to a hazardous level. So as part of overcoming the climate crisis, participation from all parties is needed to reduce greenhouse gas (GHG) emissions in the atmosphere

(Epa & of Planning, 2022). Rapid population growth and climate change have raised concerns about industrial environmental issues (Abbas et al., 2021). Industry consumes about 50% of the world's energy, so it must be responsible for the emissions produced, which is more than a third of carbon dioxide (Ramezani et al., 2019). Considering environmental issues, generalized SCND problems can affect items such as facilities, means, modes of transportation, product design, and technology selection. Social problems in the supply chain are operations related to processes and products that affect human safety, welfare, and community development. According to Jabbarzadeh et al. (2018), there are indicators on the social dimension, namely human rights, working conditions, social commitment, and business practices.

The existence of disruption and the importance of supply chain resilience in designing a robust supply chain network have been considered by researchers in the last decade. Supply chain resilience is the supply chain's ability to deal with the consequences of a risk event to return to its original state or reach a more desirable state after a disturbance occurs. Supply chain resilience is the adaptive ability of the supply chain to prepare for unexpected events, respond to disruptions, and recover them by maintaining continuity of operations at the desired level of connectedness and control over structure and function (Ponomarov & Holcomb, 2009). Aldrighetti et al. (2021) present the emergence of disturbance uncertainty from four main factors: supply, demand, control, and manufacturing processes. The supply and demand sides are each related to the specific characteristics and considerations of product and information flow from upstream to downstream in the supply chain. Without proper planning, supply chain recovery after a disruption is associated with a lot of damage and costs, which in many cases is much more than investing in a risk management strategy. One or more resilience strategies are usually used to increase resilience in the supply chain. Some essential resilience strategies are multiple sourcing, backup facilities, fortifying facilities, capacity expansion, and storage of emergency supplies (Sabouhi et al., 2018). Recently, Gholami-Zanjani et al. (2021) studied food SCND problems in the presence of demand uncertainty and epidemic disruption. They propose four resilience strategies: multiple sourcing, fortification, supply, and capacity expansion. They assume that customer requests are sensitive to lead times of delivery.

Competition is another issue considered in the robust SCND literature. Ghavamifar et al. (2018) studied the problem of tough SCND under competition. The research uses a bi-level multi-objective programming approach to formulate the problem. The design of a competitively resilient supply chain network was also studied by Rezapour et al. (2017). Based on the literature, Jabbarzadeh et al. (2018) researched the design of CLSC networks under the risk of disruption in supply, production, collection, and disposal centers. They consider uncertainty in the problem's parameters, including demand and cost. The resilience strategy used in this study is lateral transshipment. Purvis et al. (2016) demonstrate applying a qualitative supply chain resilience assessment technique in the food and beverage sector based on a traffic light system where four fundamental management paradigms create resilience (robustness, agility, leanness, and flexibility-RALF) used to evaluate companies. Research with a management paradigm combining four resilience aspects still needs to be completed. The main obstacle in developing a sustainable supply chain network is the uncertainty associated with supply chain activities. Therefore, sustainable supply chains must be resilient and flexible to cope with uncertain disruptions. Uncertainty parameters such as the number of requests and purchase costs are considered in the developed model.

Even though there have been many studies on supply chain networks and resilience, it is still difficult to find literature that addresses this issue comprehensively by considering all its aspects. This study reviews and analyzes previous research by conducting a literature study on SCND that considers several aspects: sustainability (economic, environmental and social) and disruption. This review will be critical to providing potential direction in the development of future research. This paper is structured as follows. An overview of the literature on sustainable supply chain network design (SSCND) and resilience based on previous research and research objectives and definitions of SSCND and existing resilience is presented in Section 1. Section 2 describes a literature review of sustainable supply chain network design and supply chain resilience. Section 3 explains the methodology used to perform the bibliometric analysis. Section 4 data collection, and section 5 presents the results and analysis of the findings. Recommendations, conclusions, and research limitations appear in Section 6.

1.1 Objectives

Regarding the goals of this study, they are as follows:

1. Describes the steps in conducting a bibliometric analysis on supply chain network design for sustainability and resilience.

2. Identify and review the concepts and dimensions of resilience and sustainable supply chain network design used in the past by academicians to understand the impact of incorporating resilience and sustainability in SC and how it is addressed.

2. Literature Review

2.1 Sustainable Supply Chain Network Design (SSCND)

In recent years, there has been a sharp decline in the number of natural resources and a concomitant increase in the assets of large organizations, thereby expanding sustainable supply chain management into the realm of environmental and social responsibility (Govindan et al., 2014). Adopting sustainable supply chains allows companies to reduce adverse environmental effects and increase social and economic benefits (Zailani et al., 2012), which are critical competitive advantages. Therefore, the three pillars of sustainability, namely economic, environmental and social, must be considered for the design of the supply chain network. In most studies, supply chain networks are designed based on a single objective function, namely minimizing total costs or maximizing profits, which can be a problem that needs to be elaborated on (Klibi et al., 2010). The problem becomes more complicated when other sustainability criteria (environmental and social impacts) are added. Many researchers have studied this issue in recent years. Studies published up to the end of 2014 have been reviewed by (Eskandarpour et al., 2015). Govindan, Fattahi, et al. (2017b) review green supply chain design research under uncertainty. Supply chain sustainability mainly aims to reduce environmental impacts (Fahimnia et al., 2015). According to Ivanov (2020), disturbances can harm the environment, thus encouraging companies to look for alternative solutions to preserve the environment. Greenhouse gas emissions, waste generation, energy consumption, and material recycling are commonly used as performance indicators (Mota et al., 2018). Mari et al. (2016) present a fuzzy goal programming model in which environmental impacts are estimated through carbon footprints and emissions in the transportation, production, and reverse logistics processes. Jabbarzadeh, Fahimnia, et al. (2018) identified previous studies on supply chain sustainability by measuring environmental impacts, including greenhouse emissions, energy consumption, and recovery of waste and materials produced. Compared to the environmental dimension, social responsibility is one of the pillars of sustainability and is still less explored in the literature on SCND (Seuring & Müller, 2008). Measuring social responsibility is difficult because of the broad scope and complex nature of social and environmental problems. Thus, it can be said that social responsibility is an entirely multidisciplinary and multi-stakeholder issue. Social sustainability can cover various aspects of human rights (forced labor), working conditions (exposure to hazardous materials), social commitments involving all contributing factors (improvement of population health, education and culture, equal access to health services) and business practices (fighting corruption) (Jabbarzadeh et al., 2018). In the research of Pishvaei et al. (2012), an attempt was made to select the social responsibility that is most relevant to the SCND decision by identifying the main stakeholders to determine the social impact on the observed supply chain.

2.2 Supply Chain Resilient (SCR)

The existence of disruption and the importance of supply chain resilience in designing resilient supply chain networks have been considered by researchers in the last decade. The concept of Supply Chain Resistant (SCR) is relatively new, with a broader research focus on supply chain risk management. Resilience is directly related to the structure and resources of the SCN. This can be seen as a strategic decision of the resources deployed (facilities, system capacity and inventory), suppliers and product markets as physical insurance against SC risk exposure, providing a means to avoid disruption as much as possible, as well as a means to bounce back quickly when it occurs disturbance. Christopher (2004) defines SCR as "the ability of an SC system to return to its original state or move to a new, more desirable state after being disturbed". Ivanov & Sokolov (2013) understand SCR as the ability to maintain and recover (adjust) the planned execution, as well as to achieve the planned (or adapted, but still acceptable) performance. Although there are variations in the proposed definitions of SCR, some similarities can be observed, such as anticipating unexpected disruptive events, withstanding disturbances, responding quickly to disturbances, recovering from disturbances, and returning to a steady state. Although the definition of the SCR does not highlight the cost of a resilience strategy, some researchers recognize the cost-effectiveness impact of resilience practices, where resilience aims not only to restore the desired state of a system within a reasonable time but also at an acceptable cost. Ivanov et al. (2017) discuss that disruption should be reduced through cost-effective recovery policies. The critical challenge is to outline a resilience strategy that provides adequate protection from intrusion without compromising the effectiveness of SCNs in business-as-usual situations. Modelling in the two areas of supply chain design, namely resilient and sustainable supply chain design, has been widely carried out. However, joint consideration of sustainability and resilience is still rare in the supply chain design literature.

3. Methods

This paper uses a systematic literature review (SLR) approach to answer research questions. SLR is a fundamental approach to identifying, reviewing, and interpreting all relevant literature on a research topic to be studied (Kitchenham, 2004). A systematic literature review was conducted based on research (Ahi & Searcy, 2015) that explores the indicators used in peer-reviewed articles relevant to measuring the sustainability performance of the manufacturing industry. This paper begins a four-stage systematic literature stage, from determining the search stage to the analysis stage to reviewing previous research publications. In this study, a review of literature studies and an analysis of articles according to the topic are performed. The source articles used come from the Scopus database (www.scopus.com). Scopus was chosen because it is the largest indexer of papers, and more than 20,000 abstracts are indexed on Scopus (Fahimnia et al., 2015). The Scopus database provides article metadata, including research title, researcher name, abstract, and keywords. Bibliometric analysis was carried out in March 2022 on the Scopus database through several search stages, namely keyword filtering, document type filtering (source type filtering, language filtering) and subject area filtering, as shown in Figure 1.

In this bibliometric review, stage 1 for keyword screening, determined six article keywords, namely: "supply chain", "network design", "sustainability", "resilient", "disruption", and "uncertainty". Furthermore, the words that match the query are determined from each keyword, as shown in Table 1.

Table 1. Research Keywords and Terms Used

No	Research Keyword	Terms
1	<i>Supply Chain</i>	"supply chain*" OR "supply-chain"
2	<i>Network design</i>	"network design" OR "configuration"
3	<i>Sustainability</i>	"green" OR "sustain*" OR "environment*" OR "CO2" OR "emission*" OR "energy" OR "eco" OR "life cycle" OR "waste" OR "bio" OR "econom*" OR "social"
4	<i>Resilient</i>	"resilien*" OR "robust"
5	<i>Disruption</i>	"disrupt*" OR "vulnerability" OR "hazard" OR "catastrophe"
6	<i>Uncertainty</i>	"uncertain*" OR "stochastic"

Of the six keywords and terms used, they are then combined with the "AND" and "OR" queries so that the keywords written in the Scopus database are as follows: (TITLE-ABS-KEY ("supply chain*" OR "supply-chain") AND TITLE-ABS-KEY ("network design" OR "configuration") AND TITLE-ABS-KEY ("green" OR "sustain*" OR "environment*" OR "CO2" OR "emission*" OR "energy" OR "eco" OR "life cycle" OR "waste" OR "bio" OR "econom*" OR "social") AND TITLE-ABS-KEY ("resilien*" OR "robust") AND TITLE-ABS-KEY ("disrupt*" OR "vulnerability" OR "hazard" OR "catastrophe" OR "uncertain*" OR "stochastic"))

In the first search, no sorting was done for the document type or "All" (including articles, conference articles, books, book chapters, reviews, letters, and others). In addition, from the year of publication, there is still no sorting or years of publication "All years" and the access type or access type "All", which means that open and closed access articles can be published. From the first search results, 218 articles were obtained, and the articles were published from 2004 to 2022. Then from the results of 218 articles from the first search, a second screening would be conducted. The second screening was carried out by limiting the type of document, which only focused on "Articles" and did not include conference articles, books, chapters from books, reviews, or letters. For the year of publication from "2004 - 2022", the source category is "journal", and the language used in the article is "English". The search results obtained a total of 159 articles.

Furthermore, the third screening is carried out with restrictions on the subject area. The subject areas of the 159 articles are focused on the Industrial Engineering scientific family according to the research topics on Scopus, namely: "Engineering", "Energy", "Business, Management and Accounting". "Computer Science", "Decision Science", "Economics, Econometrics and Finance", and "Mathematics". From this third search, 155 articles were found. From the results of this third search, no re-screening was carried out to obtain further screening results. A detailed explanation of each search step is presented in Figure 1.

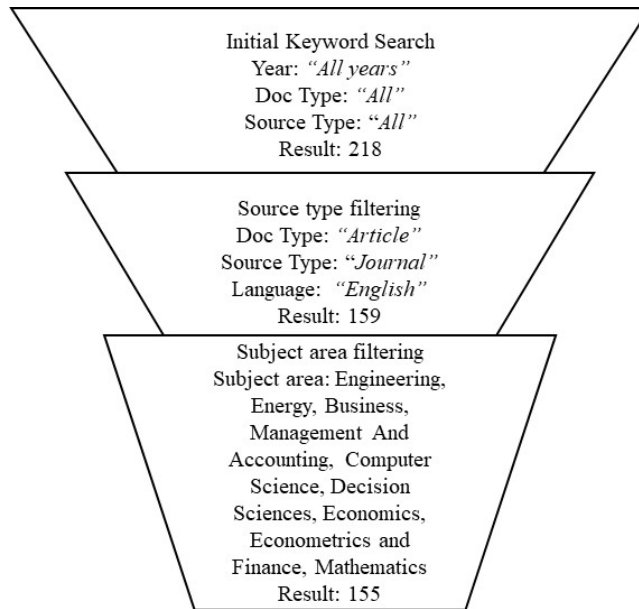


Figure 1 Article Screening Process

4. Data Collection

Bibliometric analysis was carried out from the results of 155 articles, namely the analysis of article growth rates, number of citations, and keyword analysis generated from articles. Figure 2 illustrates a graph of the growth rate related to the research on supply chain sustainability and network design, which considers uncertainty and disruption from 2010 to 2022. The graph pattern shows an increase from 2010 to 2021, reaching the highest number in 2021 with article 34. By adding the trendline in Excel to the existing data, the equation $y = 1.1466e^{0.2936x}$ is obtained to predict the number of articles; by the end of 2022, there will be 52 articles, and in 2023 there will be 70 articles.

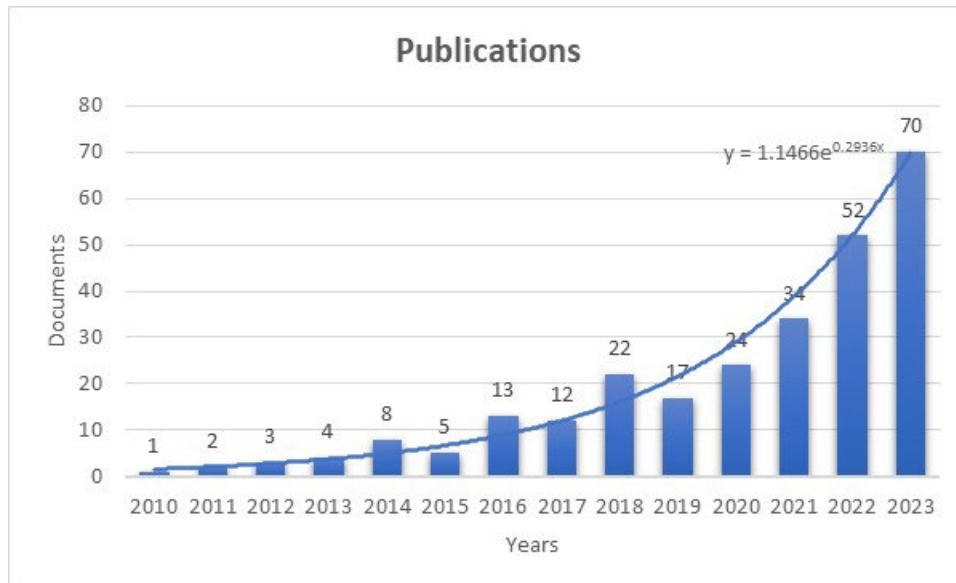


Figure 2. Patterns of Increasing Research Topic Areas with Combinations of Keywords and Terms

5. Results and Discussion

A bibliometric literature review analysis was conducted on 155 articles obtained from the search and filtering results of the Scopus database. The analysis was carried out on productive journals, the highest article citations, keywords, research objectives and attributes considered in each sustainability dimension. VosViewer is used to visualize bibliometric literature reviews. VosViewer was chosen because it is easy to use and can be run with various data source formats. Regarding the group of 38 publishers, Elsevier appeared most frequently, followed by Taylor and Francis, Inderscience Publishers and MDPI (Figure 3). Elsevier has published and continues to publish many leading journals, including 'Computers and Industrial Engineering', 'Journal of Cleaner Production', 'Transportation Research' and 'Computers and Chemical Engineering'.

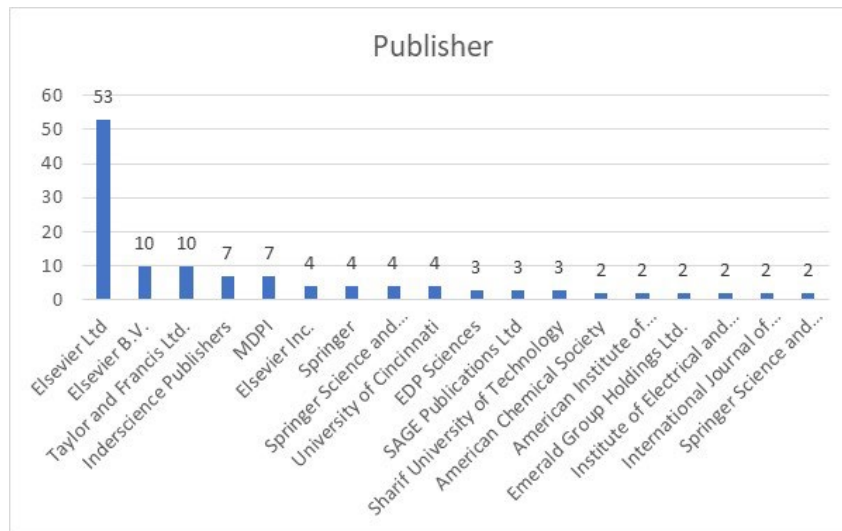


Figure 3. Publishers of cited articles

The following analysis is an analysis of productive journals published from 155 articles in which there are 74 journal names. Figure 4 shows the ten leading earning journals. The top 5 productive journals are "Computers and Industrial Engineering" with 15 articles, "Journal of Cleaner Production" with 12 articles, "Sustainability (Switzerland)" with 7 articles, "Transportation Research Part E: Logistics and Transportation Review" with 6 articles, and the "European Journal of Operational Research" with 6 articles. Of the five journals produced 30% of the total published articles.

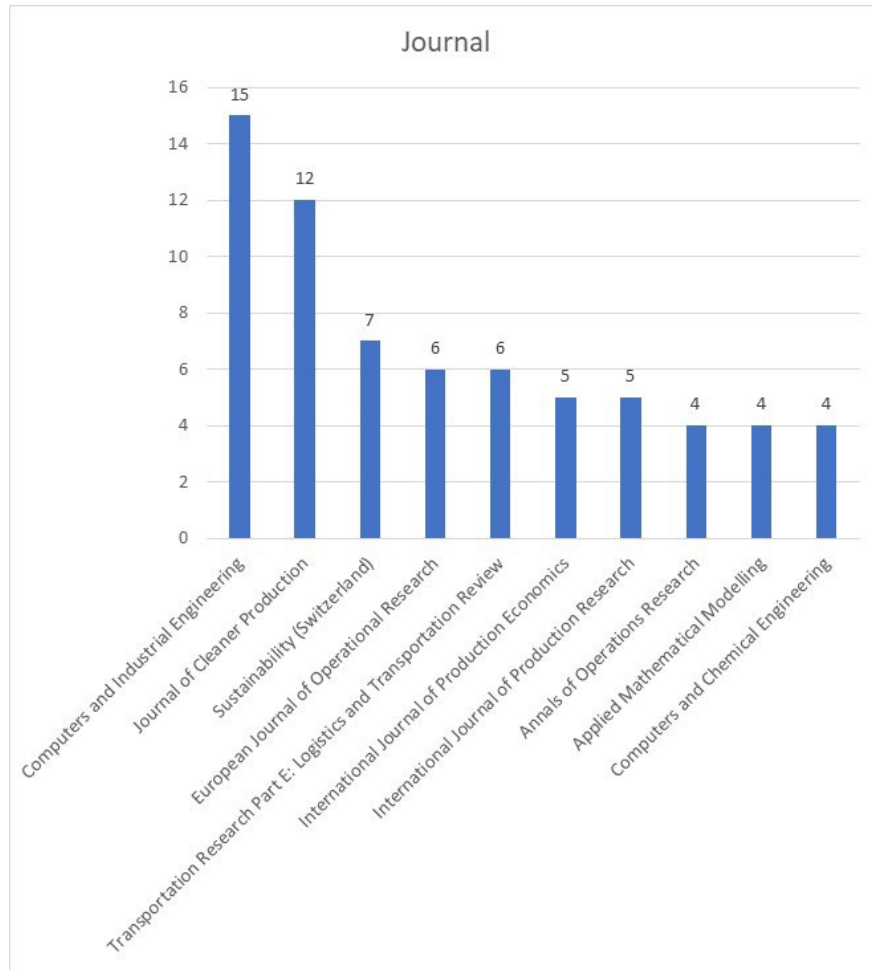


Figure 4. Top 10 Most Productive Journals from 2010 to 2022

The article citation analysis was taken from the highest number of citations in the metadata obtained from 2010 to 2022, shown in Table 2. The most citations carried out by researchers were in the article by Klibi et al. (2010), with a total of 547 citations and a score per year was 45. The score was calculated by dividing the number of citations 547 by 13 years (years published from 2010 to 2022). The second most popular citation is the research conducted by Pishvae et al. (2011), with a total of 456 citations with an annual score of 41.36 (456 citations/12 years). The sorting in Table 2 is based on the highest total number of citations. Table 2 also presented the author's name, year, title, source of publication, and the number of citations.

Table 2. Ten Most Cited Articles in 2010 – 2022

No	Author (Year)	Article Title	Journal Name	Cited	C/Y
1	Klibi et al. (2010)	<i>The design of robust value-creating supply chain networks: A critical review</i>	European Journal of Operational Research	547	45
2	Pishvae et al. (2011)	<i>A robust optimization approach to closed-loop supply chain network design under uncertainty</i>	Applied Mathematical Modelling	456	41,36

No	Author (Year)	Article Title	Journal Name	Cited	C/Y
3	Govindan et al. (2017)	<i>Supply chain network design under uncertainty: A comprehensive review and future research directions</i>	Fuzzy Sets and Systems	319	63,6
4	Pishvaei et al. (2012)	<i>Robust possibilistic programming for socially responsible supply chain network design: A new approach</i>	European Journal of Operational Research	318	31,6
5	Talaei et al. (2016)	<i>A robust fuzzy optimization model for carbon-efficient closed-loop supply chain network design problem: A numerical illustration in electronics industry</i>	Journal of Cleaner Production	190	31,67
6	Keyvanshokoh et al. (2016)	<i>Hybrid robust and stochastic optimization for closed-loop supply chain network design using accelerated Benders decomposition</i>	European Journal of Operational Research	165	27,33
7	Hatefi dan Jolai (2014)	<i>Robust and reliable forward-reverse logistics network design under demand uncertainty and facility disruptions</i>	Applied Mathematical Modelling	159	19,75
8	Hasani et al. (2012)	<i>Robust closed-loop supply chain network design for perishable goods in agile manufacturing under uncertainty</i>	International Journal of Production Research	155	15,5
9	Govindan et al. (2015)	<i>Bi-objective integrating sustainable order allocation and sustainable supply chain network strategic design with stochastic demand using a novel robust hybrid multi-objective metaheuristic</i>	Computers and Operations Research	135	19,14
10	Rezapour et al. (2017)	<i>Resilient supply chain network design under competition: A case study</i>	European Journal of Operational Research	115	22,80

Keywords describe a characteristic of a particular field of research or study that appears in the metadata of the downloaded Scopus document. Based on the author keywords and the most index keywords can be seen in Figure 5. The keyword network was analyzed using the VosViewer® software, which showed that the keywords that often appear would be presented in the form of a circle, where the larger the circle, the more the keywords appear in the metadata obtained. The results of keyword identification show that several keywords have the same meaning, so replacing keywords with the same meaning is carried out using the input thesaurus feature on VosViewer. The keywords are in Table 3.

Table 3. Keyword Input in VosViewer Thesaurus

Label	Replace by
supply chains	supply chain management
supply chain network	supply chain management
chains	supply chain management

uncertainty analysis	uncertainty
supply chain network design	network design
supply chain network	network design
sustainability	sustainable development
stochastic programming	stochastic systems
stochastic model	stochastic systems
closed-loop supply chain network designs	closed-loop supply chain networks
closed-loop supply chain network design	closed-loop supply chain networks
carbon	carbon emission
multi-objective optimization	multiobjective optimization
multi-objective modeling	multiobjective optimization
robustness (control systems)	robustness
risk management	risk assessment
resiliency	resilience
robust optimisation	robust optimization models
environmental issues	environmental regulations

Based on the network analysis results, 1239 keywords with a minimum of five times were mentioned. Based on the network analysis results, 6 (six) clusters, namely supply chain management, network design, stochastic systems, sustainable development, and uncertainty consisting of red, green, blue, yellow, purple and light blue, as shown in Figure 5—analysis to map the year of publication with overlay visualization on Vosviewer (in Figure 6). Keywords related to the year of research are classified in terms of the colour purple to yellow. Bright yellow indicates keywords that have been new or trending in recent years, and purple indicates research in the oldest or older years. Figure 6 shows the topics of sustainable development and resilience with yellow nodes indicating these two topics are research topics that have just been researched. The subsequent analysis is to get keywords and the occurrence rate of these keywords appearing in the article. Five keywords often appear namely "supply chain management" with 123 occurrences, "network design" with 70 occurrences, "uncertainty" with 61 occurrences, "robust optimization" with 49 occurrences, and "optimization" with 47 occurrences. The treemap for keywords and their frequency of occurrence can be seen in Figure 7.

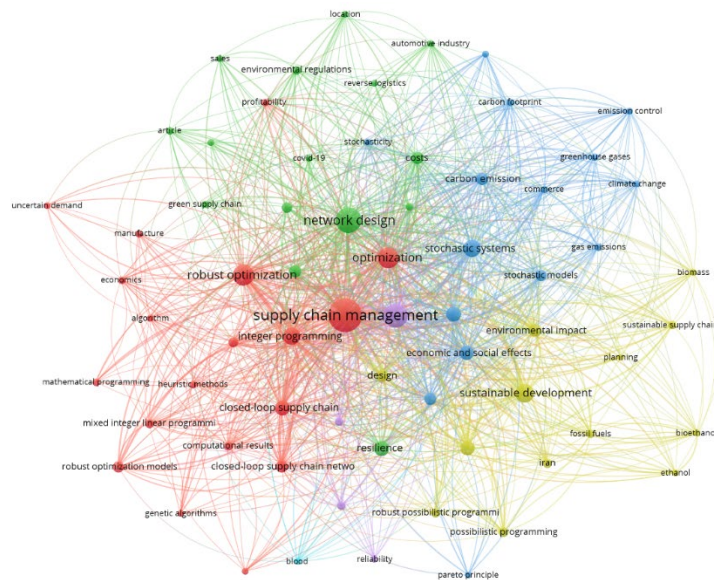


Figure 5. Keyword network visualization using Vosviewer

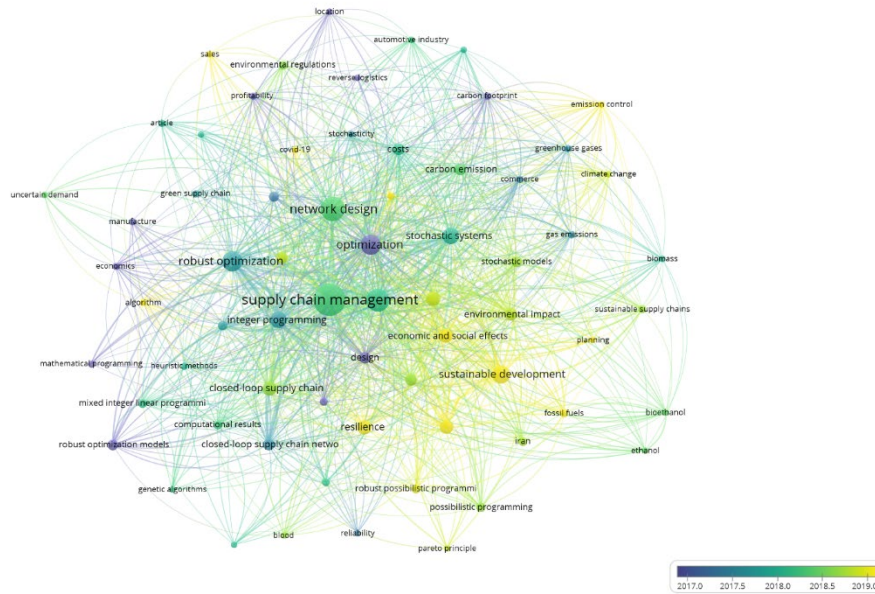


Figure 6. Overlay Visualization based on research years using Vosviewer

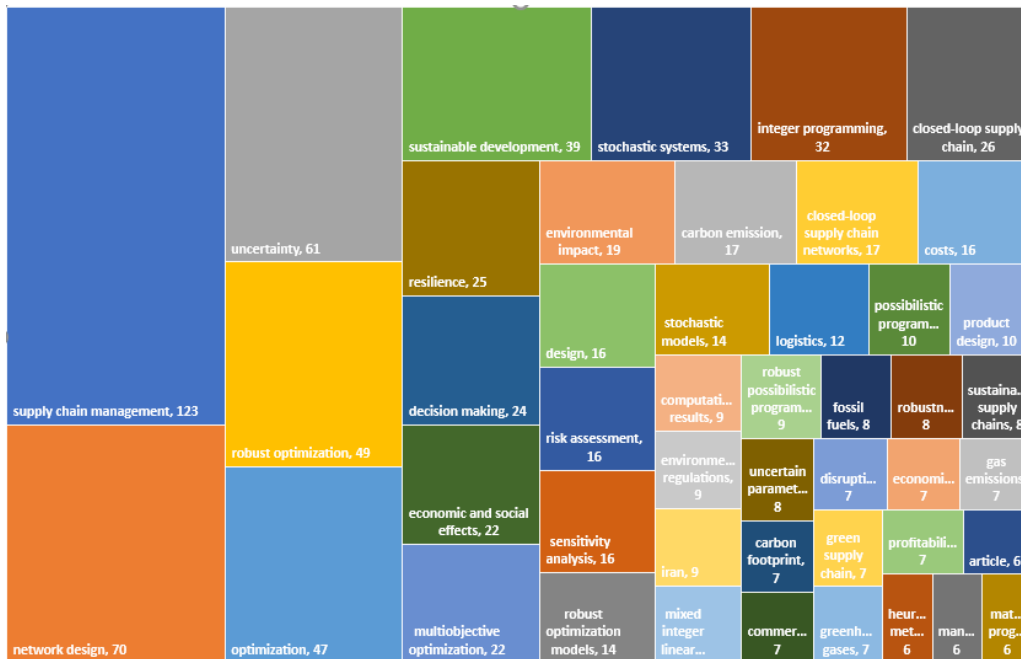


Figure 7. Tree map Number of Keywords

Based on the results of the classification of research methods, it is found that the number of modelling dominates the research conducted by researchers, namely 141 articles or 91%. Furthermore, the conceptual framework approach, with a total of 6 articles (4%), was followed by a literature study approach of 3%, namely four articles and then followed by case study research of 2% of the total or three articles and only 1% of empirical studies. The classification can be seen in Figure 8. The condition in the research was mostly deterministic for 43.3%, and the rest percentage used stochastic or uncertainty concerns (Figure 9).

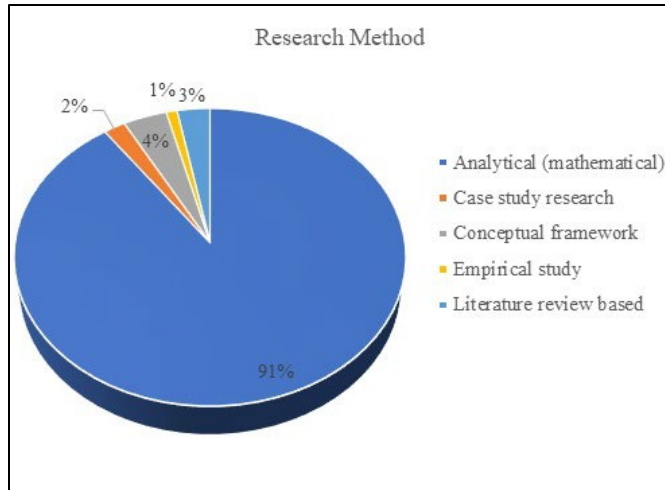


Figure 8. Research Method

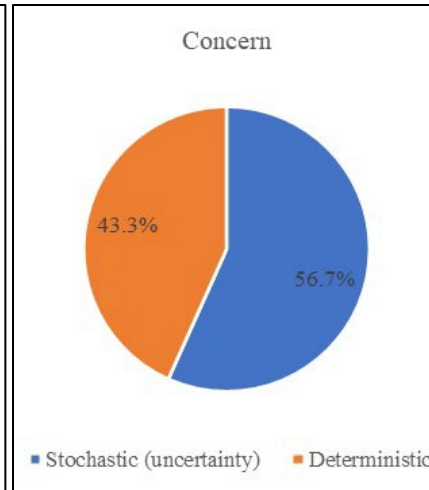


Figure 9. Concern

There are three main dimensions in the concept of a sustainable supply chain: economic, environmental and social. We compiled and mapped the indicators used in each aspect based on the articles collected on SSCND and resilience. The indicators for each aspect can be seen in Figure 10.

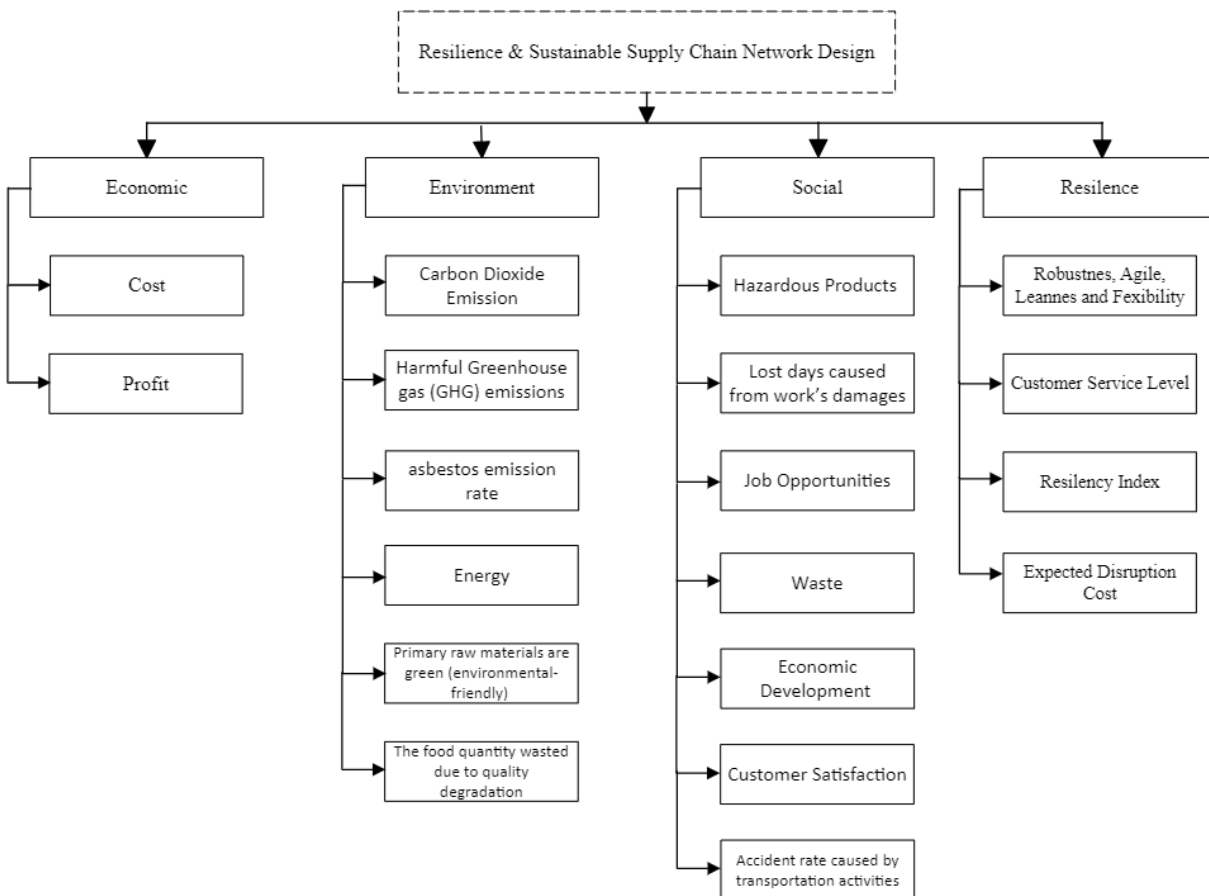


Figure 10. Research Mapping Based on Aspects of Resilience Sustainable Supply Chain Network Design

The assumption of a deterministic demand in previous research is considered irrelevant. This is because, in reality, consumer demand is constantly changing from time to time. Therefore, several researchers have developed the SCND model by considering more realistic conditions, including stochastic demand (Foroozesh et al., 2022; Ghavamifar et al., 2018b; Hatefi & Jolai, 2014). Based on the collected articles, a list of the uncertainty parameters considered in an SSCND model is made. The various uncertainties in research related to resilience and SSCND can be seen in Figure 11.

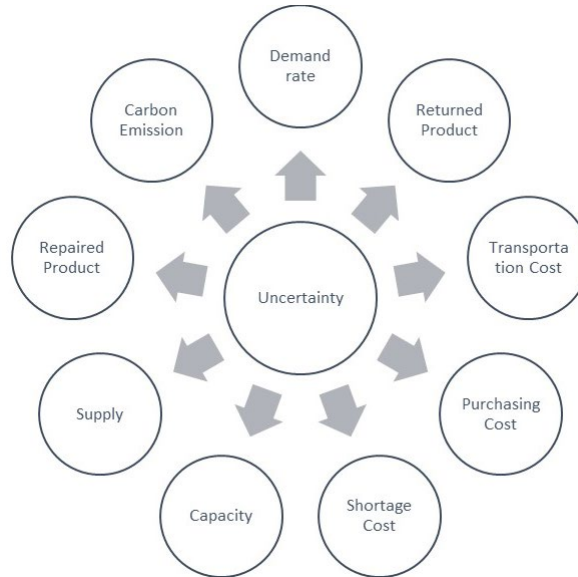


Figure 11. Types of Uncertainty

The resilience strategy aims to obtain an SCND structure that can reduce risk and efficiently implement responsive policies. This can be done by avoiding or transferring risk and/or by investing in a flexible network structure. According to Kenan-Flagler (2006), resilience strategies are divided into pre-disruption mitigation and post-disruption contingency strategies. There are several methods for pre-event mitigation strategies. When a disruption occurs, that disrupts and reduces a supplier's production capacity, safety stock can act as a buffer. Diversification of risk from different suppliers gives decision-makers greater flexibility in dealing with disruptions. Once a disturbance affects the system, several post-event mitigation plans can be implemented to reduce the effect on system efficiency. For example, Jabbarzadeh et al. (2016) studied the problem of designing a resilient supply chain network under the risk of supply/demand disruption and disruption and utilizing backup facilities and facilities as a strategy to increase resilience. Sabouhi et al. (2018) propose a hybrid approach based on data envelopment analysis and mathematical programming for robust supply chain network design problems. Ghavamifar et al. (2018a) studied the problem of tough SCND under competition. They use a bi-level multi-objective programming approach to formulate the problem. The design of a competitively resilient supply chain network was also studied by Rezapour et al. (2017). The various resilience strategies used in research related to resilience and SSCND are developed and can be seen in Table 4.

Table 4. Various of Resilience Strategies

No.	Resilience Strategy	Author
1	Multiple-Sourcing	Mari et al.(2014); Deghani et al. (2018); Hasani et al.(2021); Rezapour et al.(2017); Sadeghi et al.(2021); Vali-Siar & Roghanian (2022)
2	Facility Fortification	Deghani et al. (2018); Hasani et al.(2021); Vali-Siar & Roghanian (2022)
3	Geographical Facility Dispersion	Hasani et al.(2021)
4	Semi-Finished Goods Production	Hasani et al.(2021)
5	Capacity Expansion /Augmentation	Aloui et al. (2021); Vali-Siar & Roghanian (2022)

6	Reserving Extra Production Capacity With Suppliers	Rezapour et al.(2017); Sadeghi et al.(2021)
7	Holding Excess Inventory	Sadeghi et al.(2021)
8	Keeping "emergency stock" at retailers or DC	Rezapour et al.(2017); Sadeghi et al.(2021)
9	Financial resources	Foroozesh et al.(2022)
10	Route risk	Foroozesh et al.(2022)
11	Horizontal Collaboration	Foroozesh et al.(2022)
12	Applying an alternative bill of materials (BOM) through importing goods	Deghani et al. (2018)
13	Logistic Collaboration	Aloui et al. (2021)
14	Reusing The Returned Product	Ziari & Sajadieh (2022)
15	Fortified Suppliers	Liu et al.(2021)
16	Lateral Transshipment	Jabbarzadeh et al. (2018)
17	SC Intermediaries	Das et al. (2021)

Risk mitigation strategy techniques can mitigate the detrimental impacts of disruptions. SC resilience is improved using several resilient strategies. In addition, scenarios are planned to show the occurrence of hazard risks. To increase resilience under disturbance (i.e., incurring hazard), the following strategies are also exploited in some research models:

1) Multiple Sourcing

A required number of upstream facilities can serve facilities using multiple sourcing method. This issue is advantageous when one or more facilities shut down or experience a capacity decrease due to disturbances. The use of several suppliers, including backup suppliers and finance suppliers, results in finished and semi-finished goods that are supplied from a variety of sources. They allow multiple sourcing for raw materials to alleviate dependence on a single supply center and increase redundancy. Disasters and pandemics can interrupt the flow of goods. The entire supply chain is exposed when the supplies are interrupted. Having backup suppliers is thus one of the best ways to avoid this catastrophe (Sadeghi et al., 2021)

2) Facility Fortification

In a facility fortification plan, a number of fortification levels are established for facilities to reinforce them against interruptions, and each level has its own cost, meaning that more fortification is more expensive (Fattahi et al., 2017). It strengthened already-built infrastructure, increasing their capability resistance to risk uncertainty. The cost of fortification is assumed to depend on how much protection is provided and to continuously change as a piecewise linear function.

3) Geographical Facility Dispersion

Maximizing the geographic dispersion of SC facilities is the same as minimizing the centralization of facilities. The risk of disruption occurring in one region affects all the facilities that are present there. In other words, limiting the number of centralized SC facilities in each region and distributing them makes the chain less susceptible to disruption. However, SC's overall profit declines when costs for setting up facilities, shipping materials, and maintaining inventories rise. Additionally, spreading out the facilities might require lengthier trips between SC locations, resulting in increased CO2 emissions.

4) Semi-Finished Goods Production

The goal of this strategy's adoption is to estimate how many semi-finished products will be produced as a result of component shortages at the end of each period. Semi-manufactured items can be generated during component shortages based on the BOM of each product and the quantity of the necessary components that are available at any given time. The agile production paradigm conflicts with various disruption risk mitigation techniques, such as stock holding and manufacturing semi-finished goods. Nevertheless, this agile behavior becomes increasingly apparent when budget demand uncertainty rises.

5) Capacity Expansion /Augmentation

As the name suggests, capacity expansion involves expanding capacity for periods when the production center's capacity is reduced as a result of disturbances. The capacity expansion plan for facilities is the resiliency tactic described in the fundamental concept. Through a capacity reserve that is available, logistics facilities can momentarily raise their capacity to handle disturbances. Since capacity expansion incurs additional costs, as capacity expansion improves customer satisfaction, the expected penalty costs and total costs were lower than the disrupted model design.

6) Reserving Extra Production Capacity with Suppliers

The capacity expansion, as its name suggests, involves boosting capacity for situations in which the production center's capacity is reduced as a result of disruptions. If other suppliers are disrupted, this method compels providers to transport the additional raw material capacity at a higher cost. With the support of suppliers less impacted by the disruption, this technique helps provide raw materials (Sadeghi et al.,2021)

- 7) **Holding Excess Inventory**
This plan involves keeping a specified quantity of raw materials on hand at the factory in case of an interruption. The factory's limited capacity and a purchase price that is lower than it was during the disruption are the fundamental driving forces behind this choice. This tactic strengthens the ability of the supply chain to satisfy demand despite disruptions.
- 8) **Keeping "emergency stock" at retailers or DC**
Based on the store's capacity and storage costs, a specific quantity of the product is kept in the distribution center or retailer as a safety stock under this method. As was previously noted, some interruptions enhance consumer demand. Therefore this tactic helps the market thrive by meeting needs like panic buying. Redundancy requirements include keeping a safe and ready supply of raw materials and finished items to prevent interruptions. Two different decisions must be made to keep emergency stock in the SC network: where should this stock be located? In addition, how much product should be kept in each location?
- 9) **Financial resources**
Today, financial resources are crucial for supply chain expansion and disruption management. Companies struggle with funding and resource constraints. In the suggested model Foroozesh et al.(2022), financial resources are supplied by financial suppliers, which might be external sources like banks, savings bonds, shareholders, or income.
- 10) **Route risk**
The risk route is also essential to consider in the network. The optimal route selection in a multi-mode supply chain and its impact on CO2 emissions should be examined (Foroozesh et al.(2022)). Ziaei & Jabbarzadeh (2021) have presented a multi-objective method for locating transfer sites and routing in a multi-modal network of hazardous material, taking into account various uncertainties and reducing risk, carbon emissions, and transportation costs.
- 11) **Horizontal Collaboration**
The most important aspect of collaboration, namely horizontal collaboration among retailers, is considered by Foroozesh et al.(2022). A risk-sharing technique between the same tiers is implemented through horizontal cooperation between retailers. With fewer shipments on the network, this new resilience indicator also results in lower CO2 emissions.
- 12) **Applying an alternative bill of materials (BOM) through importing goods.** With this approach, part shortages can be effectively managed even in disturbances.
- 13) **Logistic Collaboration**
Companies looking to accomplish their economic, social, and environmental sustainability goals now face a strategic challenge: integrating the logistical collaboration strategy amongst suppliers. Sharing information about the development and spread of the current disruptions has also made this technique more promising in the context of the shared management of resources and tools. Additionally, a collaborative strategy could reduce the number of opened distribution centers, minimizing fixed facility costs. Logistics collaboration can improve resiliency and decrease costs by sharing non-disrupted facilities in the network.
- 14) **Reusing The Returned Product**
Reusing the returned goods is a resilience tactic to deal with energy waste and increase supply effectiveness. Additionally, the reconfiguration of the supply chain network is justified by the reduced costs of creating glass products resulting from returned goods.
- 15) **Fortified Suppliers**
After any disruptive occurrence, they presume that a reinforced supplier's remaining capacity is unaffected. This presumption might need to be changed, however. For instance, protecting a supplier from flood risk could not shield it from other disruptive events, like earthquakes. Extend this supposition so that a fortified provider has a remaining multi-level capacity based on the degree of security and the kind of disruption event to make it more plausible.
- 16) **Lateral Transshipment**
Lateral transshipment is a managerial practice that allows for the redistribution of products from facilities with stock on hand to centers that face shortages.
- 17) **SC intermediaries**

The research studies the options for including SC intermediaries to take the role of supply agent or supply contractors to manage the supply of items when traditional/classical supply networks known to us were almost inoperative or ineffective in fulfilling buyer requirements. SC intermediaries can help overcome supply chain sustainability and resilience failures. These middlemen are frequently a part of the world's supply chain. By SC intermediaries, unique organizational forms that play a role in global sourcing are recognized. These forms occasionally take the form of supply contractors or organizations that provide finished goods. When markets have only been operating on a small scale for online transactions and all production companies, have not been running because the necessary staff is unavailable. As a result, supply management systems are not functioning.

Each of the strategies mentioned above may have a varied impact on how well SCN performs concerning various performance assessment metrics, such as profitability under normal and disruptive conditions, environmental and social concerns.

6. Conclusion

This paper presents a systematic literature review on themes related to resilience and the design of sustainable supply chain networks. Based on the Scopus database from 2010 to 2022, 155 articles were obtained from the original, more enormous collection of 218 articles. In the context of this research, this research presents a systematic and bibliometric that focuses on the resilience and design of a sustainable supply chain network taking into account the existence of uncertainty. Bibliometric analysis was performed to find out trends each year, the name of the publisher and the name of the most productive journal, citations and network visualization. Descriptive analysis for publishers who publish the most topics raised is Elsevier Ltd, while for the most journals from Industrial and Computer Engineering. The article by Klibi et al., published in 2010, had the highest total number of citations, but Govindan et al. (2017) had the highest citation ratio per year. A literature study was conducted to determine the methods used in previous studies, consideration of parameter conditions, indicators on economic, environmental and social aspects, and indicators and types of resilience strategies. The results show that this research area continues to grow yearly. It was found that the network design policy taking into account environmental, social, and disturbance aspects began to be done a lot. The various resilience strategies that have been carried out can be developed or combined between these strategies to get the best strategy. So, we encourage future studies in this area. We will also be interested in exploring network design strategies under stochastic conditions close to actual conditions. The limitation of this study is that this study uses a single database, namely Scopus and articles collected from 2010 – March 2022, where the topics discussed can continue to develop over time. Therefore, research on this topic must be repeated in the coming years. Future studies should use a larger sample size with the keywords used. Future research is needed to use mathematical modelling for SSCND to comprehensively consider the presence of disturbances and uncertainties. In addition, there is a need for a combination of resilience strategies in designing networks to obtain optimal goals.

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