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THE DECADES OF RESEARCH ON SCM AND ITS ADVANCEMENTS: COMPREHENSIVE FRAMEWORK
A. Hariharasudan; Sebastian Kot; J. Sangeetha

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THE DECADES OF RESEARCH ON SCM AND ITS ADVANCEMENTS: COMPREHENSIVE FRAMEWORK

A. Hariharasudan
Faculty of English, Kalasalingam Academy of Research and Education, Anand Nagar, Krishnankoil 626126, Tamil Nadu, India, dr.a.hariharasudhan@gmail.com
Sebastian Kot
The Management Faculty, Czestochowa University of Technology, Armii Krajowej 19B, 42-201 Czestochowa, Poland; Faculty of Economic and Management Sciences, North-West University, Vaal Triangle Campus, P.O. Box 1174, Vanderbijlpark 1900, South Africa, sebacat@zim.pcz.czest.pl (Corresponding Author)
J. Sangeetha
Research Scholar, Kalasalingam Academy of Research and Education, Anand Nagar, Krishnankoil 626126, Tamil Nadu, India, sangeethajsairam@gmail.com

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Abstract: Supply Chain Management (SCM), a corporate strategy approach to materials and distribution management, has been evolving over the last decades from traditional marketing and production functions. The purpose of the study is to explore the bibliometric data of Supply Chain Management and its advancements. Besides, it describes from the origins of traditional SCM to the progress of modern SCM 4.0, with reference to the benefits, function, importance and limitations of all five branches of SCM. The methodology includes a detailed and systematic review of scientific articles published in Scopus indexed journals. The data were obtained from the Scopus database between 1990 and 2021 in order to achieve the study's desired outcome. Boolean operators and filtering were applied to obtain relevant data. In addition, VOSviewer software is used to visually classify and analyse bibliometric data distribution and network using cluster maps. The study's findings were divided into three main categories: publication period, coauthorship and citations, with the results demonstrating the diverse needs of SCM in the globalised digital era. Further, the results emphasise that SCM and its advancements have unique merits around the world, but Sustainable SCM and SCM 4.0 remain the most popular as they play a vital role in changing environmental concerns. In addition, the findings reveal that the visualization networks of each category exhibit the strengths and connections of publications. These visualization networks, followed by their analysis, explain the new insight to the present research. This research also paves the way for future research into the evolving trends of SCM in today's technologically advanced world.

1 Introduction

In the global competitive market environment, creating a customer circle and adhering to their needs are the most critical tasks for the majority of the market owners. Customers ventured in search of goods and products in ancient times, but in modern times, market producers make it easier for customers to have the products of their choice delivered to their doorstep and at their available time. These days, marketing companies look for raw materials, basic components, and parts for their manufacturing processes beyond their city, state, and country's borders. The finished goods are then distributed through a network of channels to various parts of the world, depending on where the final customer is located. To put it in simpler terms, Supply Chain Management (SCM) is the synchronization of all of the above activities, which in turn manages demand and supply on a global scale. To begin with the advent of SCM, in the year 1958, Forrester predicted that "there will come general recognition of the advantage enjoyed by the pioneering management who have been the first to improve their understanding of the interrelationships between separate company functions and between the company and its markets, its industry, and the national economy" [1]. Though Forrester mentioned this several decades ago, Mentzer et al. (2001) claim that Forrester identified effective management issues and illustrated the dynamics of determinants with the concept now known as Supply Chain Management (SCM) in modern business literature [2]. Further, Oliver and Webber mentioned Supply Chain (SC) in 1982, who described it as a network of organizations [3].

The concept of SCM initially emerged and flourished in the manufacturing industry in the 1990s [4,5]. The widespread use of SCM can be understood through the words of Ross where he states, SCM has become such an important topic that it is impossible to open up a periodical on marketing or customer management without seeing an article about SCM and its related topics [6]. According to the analysis of Lalonde in 1997, the words "supply chain" appeared in 13.5% of recurrent titles at the Council of Logistics Management's Annual Conference

in 1995. Only two years later, at the 1997 conference, the term was mentioned in 22.4% of the sessions [7]. The prominence of SCM plays a vital role in marketing as it manages the entire supply chain process as a single entity, reduces total supply chain costs and time process in product development, profitability, increases customers satisfaction towards the product, loyalty and overall corporate growth [8]. Over the past decades, the term SCM has gained popularity worldwide. Accordingly, the definition of SCM has been described by many researchers at different times. SCM is the coordination of activities within and between upright connected businesses in order to profitably serve end customers [9]. After successfully implementing SCM, it has been upgrading and advancing rapidly based on the business needs, sustainable environment, and technology developments.

SCM further widens its scope globally, which paves the way for the emergence of Global Supply Chain Management (Global SCM). The immense benefit of Global SCM in the marketing environment is that it makes the product available to customers across the world. Its practical application can result in more efficient risk management and enterprise utilisation, producing lower costs and higher revenues, as Global SCM necessitates both operational and financial decisions [10,11].

Environmental Management has been pursuing the idea of environmental protection by managing human interactions and their impacts through pollution control and prevention, as well as managing ecological systems since the late 1960s [12]. Accordingly, it paves the way to Green Supply Chain Management, which is a sub-area of Sustainable SCM that combines Supply Chain Management and Environmental Management [13,14]. Green SCM measures provide cost and risk benefits to businesses, such as higher efficiency, greater property value and enhanced environmental conditions. As a result, raw material and energy costs can be reduced, low-emission manufacturing can be structured, and the company's image can be strengthened, all of which can lead to increased product sales and societal acceptance[15-18].

On the other hand, Sustainable Supply Chain Management (Sustainable SCM) has become a growing concern for businesses of all sizes and in various industries [19,20]. The significance of sustainability in a supply chain goes beyond going green because environmental responsibility is a critical focal point in today's industry. A supply chain built on a sustainable platform creates more partnership opportunities [21,22].

The recent trend in SCM is Supply Chain 4.0 (SCM 4.0), which offers significant opportunities for firms to improve productivity, profitability, quality of products and efficiency in global trade [23]. According to the World Trade Organization (2019), "Supply Chain 4.0" is the re-organization of supply chains – design and planning, production, distribution, consumption, and reverse logistics – using technologies that are known as "Industry 4.0" [20]. Supply Chain 4.0 is already having a significant impact on human well-being as it influences the size distribution of firms within industries as well as income distribution across countries. Above all, e-commerce, enabled by Supply Chain 4.0, involves a significant substitution of market labour for household shopping time [24-27].

Though there are numerous studies in SCM and its advanced areas, bibliographic studies are still scarce. In addition to that, even if the preference for bibliometric researches is increasing, the SCM and its advanced areas provide a plethora of chances for the methodology to identify future recommendations and trends. There are a few studies, which have been attempted to explore the key indicators of SCM, but according to the understanding of authors and based on the reviewed literature[28-50], there is no overall approach for SCM and its advancements, such as Global SCM, Green SCM, Sustainable SCM and SCM 4.0. Considering this, the present study will extend a full understanding of the proposed issues. Consequently, this study seeks to offer a bibliometric approach to SCM, Global SCM, Green SCM, Sustainable SCM and SCM 4.0. More precisely, explaining and identifying trends and other key issues by surveying and reviewing the published articles. The data for published articles related to proposed areas are obtained from the Scopus database, which links with millions of publications. Further, this study uses VOSviewer software for analysis. Besides explaining the trends of SCM, Global SCM, Green SCM, Sustainable SCM and SCM 4.0, the authors also identify gaps and opportunities of SCM and its advancements.

2 Detail understanding of SCM and its advancements

2.1 Supply Chain Management (SCM)

SCM is an interconnected and complex network concept that refers to the sum of all processes that begin with the acquisition of raw materials from the manufacturer/producer and end with the delivery of the finished product to the customer [51,52]. For decades, the ability to reduce costs was regarded as the pinnacle of supply chain management. Currently, this goal is linked to customer satisfaction, industrial productivity, environmental sustainability, and technological advancements. In the digital age, modern supply chains must create specific, technological, procedural, and managerial capabilities and capacities to achieve four new demands: customer focus, technology adoption, relationship management, and leadership styles [53].On the other hand, supply chain management activities are responsible for over 90% of the environmental impact on resources such as air, soil, and land, as well as over 80% of greenhouse-gas emissions for consumer goods[54].

Supply chain dynamics influence not only employment practices and working conditions but also business practices and functionality that structure decent work opportunities [55]. The significance of SCM on business needs is vital as SCM helps in supporting and improving supply chain efficiency while also creating business optimization. According to the scope of SCM, businesses should emphasise greater organisational support for SCM implementation and a greater degree of attention for manufacturing integration and information flow integration in the manufacturing process to maximise benefit and reduce expenses [56].

SCM further advances its effects on the sustainable environment. A fair trade environment should be fostered to promote and enhance seller-buyer collaboration, and supply chain collaborative effort had a positive impact on long-term supply chain performance [57]. Further, it is analyzed that successful safety management necessitates long-term SCM activities that positively impact workplace safety and environmental performance [58].

Consequently, SCM has gained popularity to assist businesses in better utilising the resources of their suppliers to gain a competitive advantage [59,60]. As a result, SCM extends its roots into various branches, which are discussed briefly in the following section.

2.2 Global Supply Chain Management (Global SCM)

Globalization has reconfigured the business world and proposed the concept of a global supply chain. It is defined as a global network of companies that network and outsource services [61,62]. Globalization also underscores the need to rethink the criteria used in selecting supply chain managers [63]. Advances in industrial technology increased globalisation of demand and supply sources, phenomenal advances in information and communication availability, abundant investment funds and creative business design drive fierce competition in today's markets. As a result of the global market's emergence, SCM must be reoriented in a global network context. Global supply chains involve cross-border, inter-organizational relationships between suppliers, governments, intermediaries, local traders, and customers. Firms compete in a global economy, so the world, rather than a country or region, serves as the unit of business analysis [64,65]. Global supply chains are becoming increasingly important in determining a company's and a country's competitiveness. Modern global supply networks span continents, host a diverse range of economic operators, and deliver goods and services in ever-increasing volumes to the global community [66]. Global collaboration frameworks that enable supply chain teams to solve intricate supply and logistics problems open up new opportunities and improve decision-making for businesses [67]. Global supply chains provide the most benefit when the right supply chain partner applies knowledge at the right time [68]. Knowledge of GSCM allows supply chains (SCs) to be distributed as a unified entity of fragmented parts that perform within their respective functions [69]. GSCM is crucial to the success of all growing enterprises wanting to enhance competitive advantage in the global market [70].

2.3 Green Supply Chain Management (Green SCM)

In recent years, environmental concerns have become a global issue. Green SCM has been identified as an important topic that has an impact on the environmental concerns for any business that engages in supply chain activities and, as a result, leads to improved environmental performance [71,72]. For manufacturers who want to maintain a competitive edge while also becoming more environmentally sustainable, integrating environmental concerns into supply chain management has become increasingly important [73]. As a result, combining a "green" component into SCM, also known as Green SCM, entails considering the impact and interrelations between SCM and the natural environment [74]. For many businesses in the twenty-first century, the green supply chain is becoming a growing concern and challenge. Green SCM covers the entire customer order cycle, including design, procurement, production, assembly, packaging, logistics, and distribution [75]. The words of Rauter et al. best illustrate the concept of Green SCM as follows: A green or sustainable business, in general, can be defined as any organization that takes environmentally sustainable initiatives to improve that each process, marketing strategy, and economic growth adequately addresses existing environmental issues while still making a profit [76]. According to the traditional supply chain viewpoint, the "quality revolution" of the 1980s and the supply chain revolution of the 1990s were the catalysts for Green SCM. Its primary goal is environmental efficiency, which seeks to limit harm to the environment while also enhancing the productivity of production and remanufacturing, which have become the essential sources for achieving industry standards [54-56,77,78]. New government policies have made it illegal to sell products that contain environmentally harmful materials or are made through polluting processes. Companies that use environmentally damaging and/or contaminating processes are prohibited from selling their products and may face financial penalties as well as prosecution [79]. As a result of these new legal regulations, the significance of Green SCM has recently increased. To conclude, many global enterprises have already implemented, and others are considering Green SCM for a variety of reasons, including compliance with various environmental laws and regulations, brand enhancement, career advancement, and cost reduction [80].

2.4 Sustainable Supply Chain Management (Sustainable SCM)

Sustainable development, it can be said, has evolved into a term that encompasses more than just economic concerns, as it also considers the environmental impact and resource use, as well as social consequences [81]. According to Metta and Badurdeen, managing Sustainable Supply Chains (SSCs) necessitates greater cooperation and integration between product and process designers and their SC counterparts [82]. Sustainable SCM is exemplified by environmental or green SCM, which aims to reduce negative environmental impacts in supply chains [83-84]. It also includes social issues in the supply chain, such as ensuring that manufacturers work in safe conditions or that goods are sourced ethically and fairly throughout the supply chain. Sustainable SCM differs from traditional SCM in that it explicitly incorporates environmental or social objectives that extend the economic dimension to the triple bottom line [85]. The primary goal of supply chain sustainability management is to create designs for supply chains that are less hazardous or even contribute to sustainable development [86]. Sustainable SCM practises are becoming a common business trend in the industry for long-term development [87-88]. The need for organisations to achieve sustainability and strengthen supply chain performance has prompted the transition to a Sustainable Supply Chain (SSC), which encompasses operations from a three-dimensional perspective, such as economic, social and environmental [62,89-91]. Purchasing from local suppliers as part of the economic aspect of sustainable SCM can help to support local economic regeneration. The focus of sustainable supply chain activities varies by organisation, emphasising environmental issues and others focusing on social issues [92,93]. The words of Zeplin et al. best describe the future trends and significance of Sustainable Supply Chain Management as follows: “If manufacturing companies are to survive and compete in the global economy, they must implement Sustainable SCM practices” [62].

2.5 Supply Chain Management 4.0 (SCM 4.0)

Digital technologies have changed the way societies exchange information and interact [63]. Technological advancements have altered how people communicate and share information, and every industry is undergoing a rapid transformation as a result of the fourth industrial revolution (Industry 4.0), which paves the way for SCM 4.0 [67,68]. Industry 4.0, which combines a variety of technologies, concepts, and methods to enable production systems’ autonomy, versatility, dynamism, and precision, has been incorporated into the Supply Chain Management 4.0 development process [74,75]. SCM 4.0 model integrates IT and future technologies, aided by IoT, AI and big data, in a holistic, cross-functional framework under the strategic leadership of the SCM [76-79]. SCM 4.0 is an advanced and powerful framework with interlinked procedures that evolve from isolated applications to a large, synchronised, and effective correlation between SC phases [71]. The new supply chain is characterised by the following characteristics: progressive digitalization, agility, net value regulation, real-time track-and-traceability, installation of control tower programme, receptive to changes in the environment, sensitivity to demand uncertainty and customer behaviour, implementation of intelligent processing through big data, and finally, connectivity not only with customers but also to their social networks and potential customers’ Internet communities [81,82]. Apart from its significance, Supply chains are threatened by the fourth industrial revolution’s digital transformation, which creates a level of complexity and uncertainty. As a result of the adoption and acceptance of multiple technologies in the SC, new risks, such as confidentiality, privacy, integrity, hacking, malware, cyber-attacks, spyware and data loss, have an impact on businesses, which can have a significant impact on various production procedures [83-85]. However, as SCM 4.0 is currently underway, with the most important benefits being increased flexibility, quality standards, efficiency and productivity, which each company must reconsider how to enforce and implement as new technology for instrumentation, interconnection, and intelligence can create the robust, secure, and sustainable SCs required by businesses [77,78].

3 Methodology

The methodology of the study is based on a bibliometric review of SCM, Global SCM, Green SCM, Sustainable SCM and SCM 4.0. The methodology based on bibliometric review is crucial as it gives a detailed examination of the studies published in each research field, and it helps to classify and analyze the objective criteria. In addition to that, the adoption of VOSviewer software shows the bibliometric data distribution and its network in a graphical way via cluster maps.

The data relating to the present study were collected in June 2021 from the Scopus database, which is the most used and reliable database. The data were collected from 1990 to 2021 because this duration is considered a crucial period for SCM and its advancements, and most of the studies were conducted during this period. The obtained dataset includes the bibliometric data related to SCM, Global SCM, Green SCM, Sustainable SCM and SCM 4.0 published in Scopus indexed journals. The collected datasets attempt to give and capture insight into a larger world around a piece of research.

The query for the terms Supply Chain Management, Global Supply Chain Management, Green Supply Chain Management, Sustainable Supply Chain Management and Supply Chain Management 4.0 received large results. Boolean operators and filtering were used to obtain the relevant results. Subsequent to the application of Boolean operators, the filtered bibliometric data were acquired.

The overall collected datasets and filtered datasets were presented in the following sections. Further, the filtered data were analyzed in the present research. Bibliometric analysis was conducted by the authors using bibliometric indicators. This analysis is considered as the mechanism employed to interpret and analyze the collected data. The datasets were then processed using VOSviewer to graphically show some of the potential findings. The synchronized occurrences of publications by year, coauthor analysis among countries and author citation network were employed in the present study. The findings of the processed dataset displayed key trends state of development SCM, Global SCM, Green SCM, Sustainable SCM and SCM 4.0 in the scientific research. Graphic representation and analysis of aforesaid occurrences are significant, as they can assist researchers to better understand what has been studied in the field of SCM and its advancements, and they map the important trends in the areas.

Figure 1 shows the complete research framework of the present research. Besides, it elaborates on the detailed methodological workflow of the study.

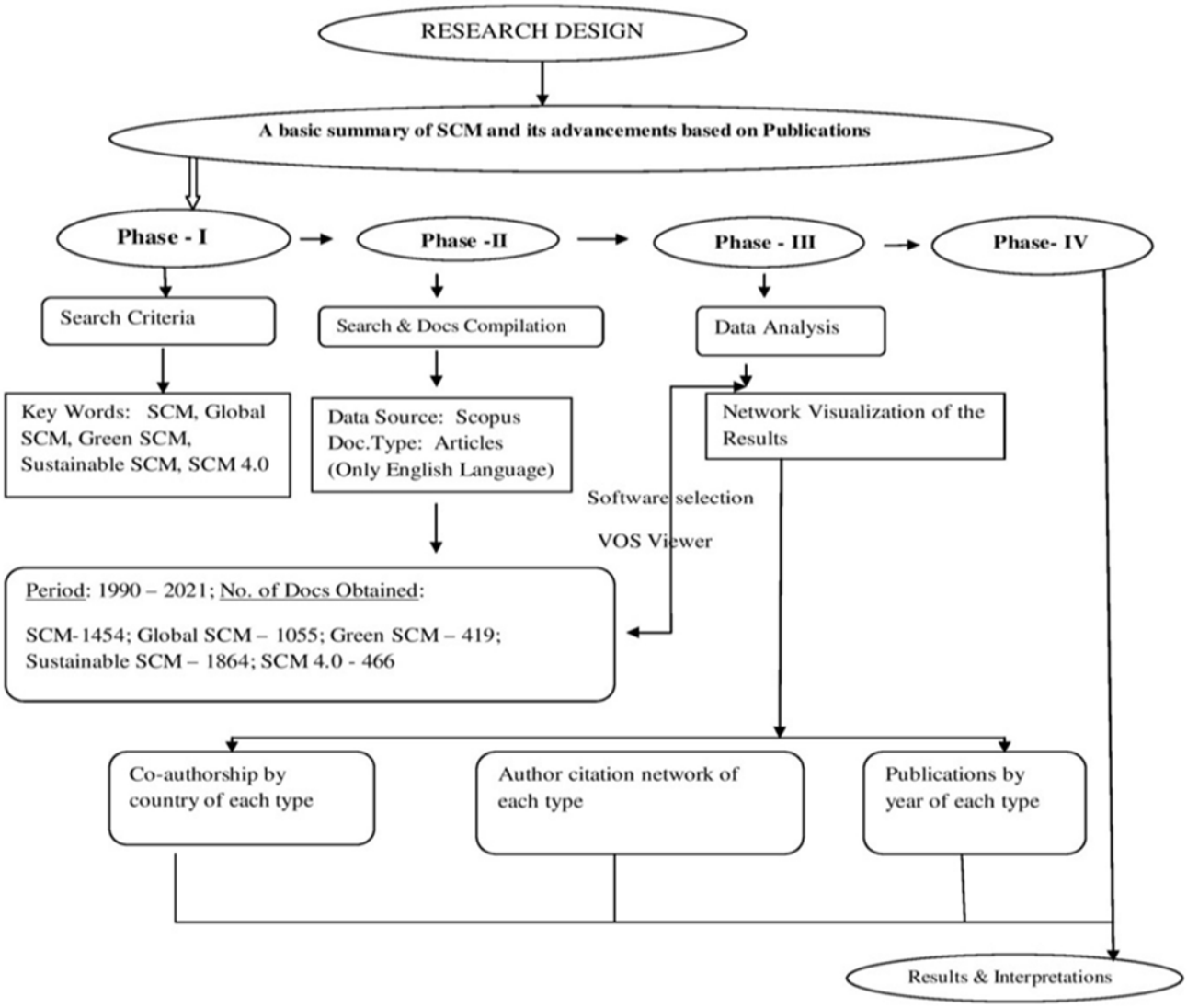

Figure 1 Research Design of the Study

3.1 Supply Chain Management

3.1.1 Publications by year

Using keyword search in Scopus data search, it comes to know that the first article related to SCM was published in 1969. It is associated to provide all necessary sterile supplies and portable equipment for patient care [79]. Though it was not completely satisfied SCM requirements, the initiatives were started this year. However, the momentum was started to SCM in the year 1993. The publications of research articles gradually increased from this period. The number of publications has grown significantly ever since (as portrayed in Figure 2). While seeing the annual productivity, the article publications were continuously in uptrend still now. A

total of 62547 research articles were published between 1990 and 2021. After using filters and Boolean operators, 1454 articles were obtained for analysis related to SCM. The annual trends of publications of articles related to this topic are shown in Figure 2, which is illustrated from the sample of 1454 articles. A total of 127 articles were published in the year 2010 that is considered as a peak in publication. Here, it is important to mention that there was a gradual decline in the publications related to SCM because there might be the reason that there were numerous advancements in the field of SCM so that the past researchers would concentrate on those specific fields. The authors of the present study have also focused on those specialized fields of SCM too. After analyzing the growth in the number of articles on SCM published over the years, the analysis will be refined to disclose information allowing for a better understanding of the relevance of past research.

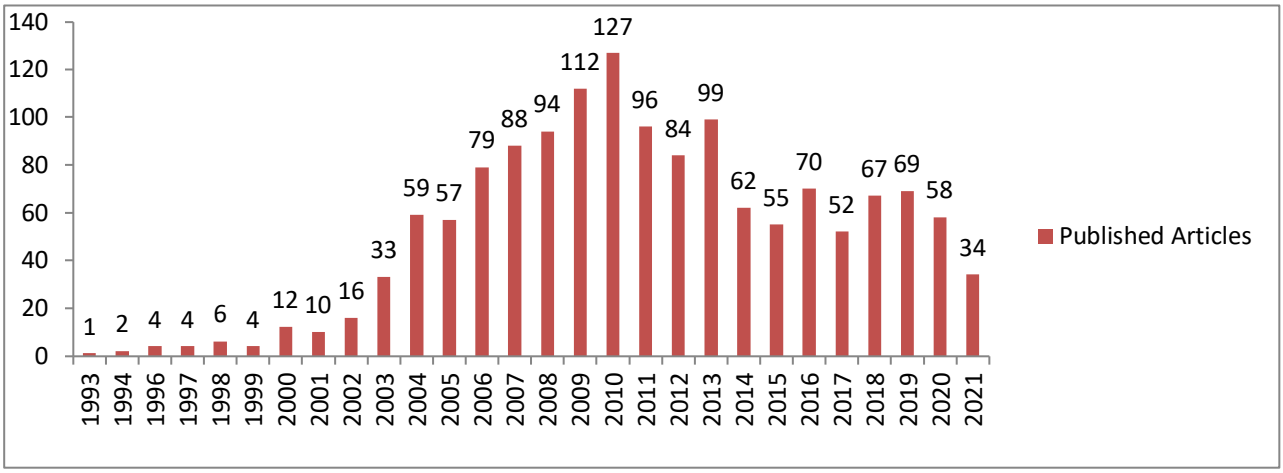

Figure 2 SCM Publications by Year

3.1.2 Geographical analysis of SCM publications

It is excited to mention here that while analyzing the authors' country of affiliation, the articles related to SCM received global attention because the published articles (1454) were distributed among 78 countries. Table 1 shows the top 10 countries where most of the academic papers were published related to SCM. In addition to that, these countries account for 82.80% of all published articles. According to the data, United States of America (USA) holds the highest number of publications, totalling 378 articles, followed by United Kingdom (UK) with 237 articles, and India with 187 articles. Sweden is in 10th place as it holds 47 publications.

Table 1 Top 10 number of SCM publications in coauthorship by country

S. No	Coauthorship By Countries	Number of Publications	Percentage Calculated from Total Number of Publications (% of 1454)
1	United States	378	26%
2	United Kingdom	237	16%
3	India	187	13%
4	Australia	74	5%
5	China	61	4%
6	Finland	59	4%
7	Germany	56	4%
8	Italy	55	4%
9	Canada	50	3%
10	Sweden	47	3%

Figure 3 is obtained from VOSviewer. It shows the country coauthorship map that was generated from the considered articles of 1454. It is clear to see that the clusters of countries USA, UK and India are in evidence. This occurs as these three countries together account for 54% of the publications. The lines connecting the points shown on the map indicate the coauthorship between countries, and the distance between the clusters indicates the strength between them and how much these countries publish in coauthorship.

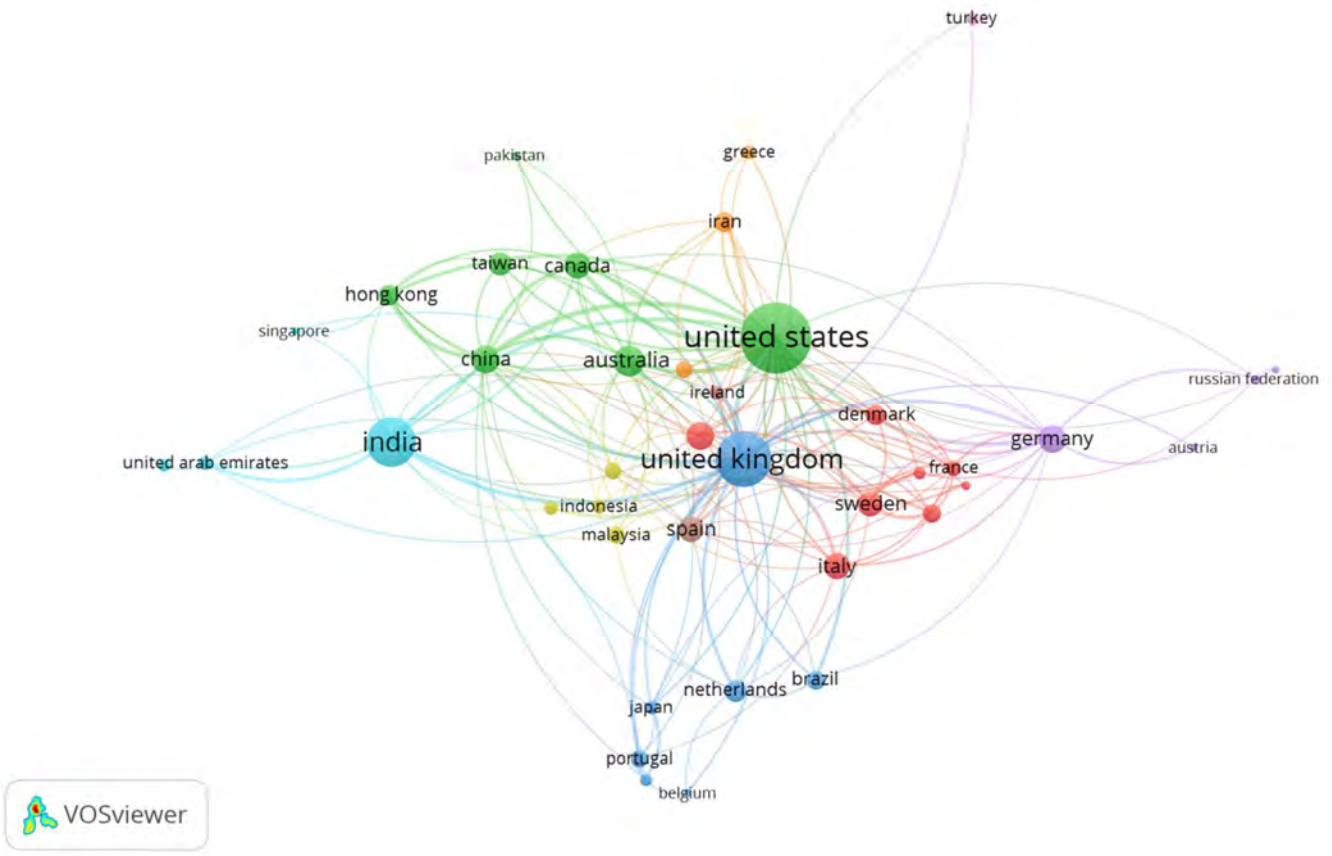

Figure 3 Coauthorship by country for SCM publications

3.1.3 Analysis of citations of SCM

Citations analysis is considered the most broadly used method of assessing the impact of the authors and articles since it discovers the key papers in the research field. Identifying the most cited articles can help researchers understand the seminal material that can be used as a reference to support their studies in terms of both historical average and annual average so that there is, in advance, a clear starting point [80].

In the present study, the author citation network is presented in Figure 4 (obtained from VOSviewer). The citation of the article can be generated when two articles refer to the same document. This method is implemented for documents, journals and authors and reveals the relevance of a document for a thematic field. The American author Gunasekaran shows in the yellow cluster as one of the authors mentioned most often with the total strength link of 5082 and citations of 103.

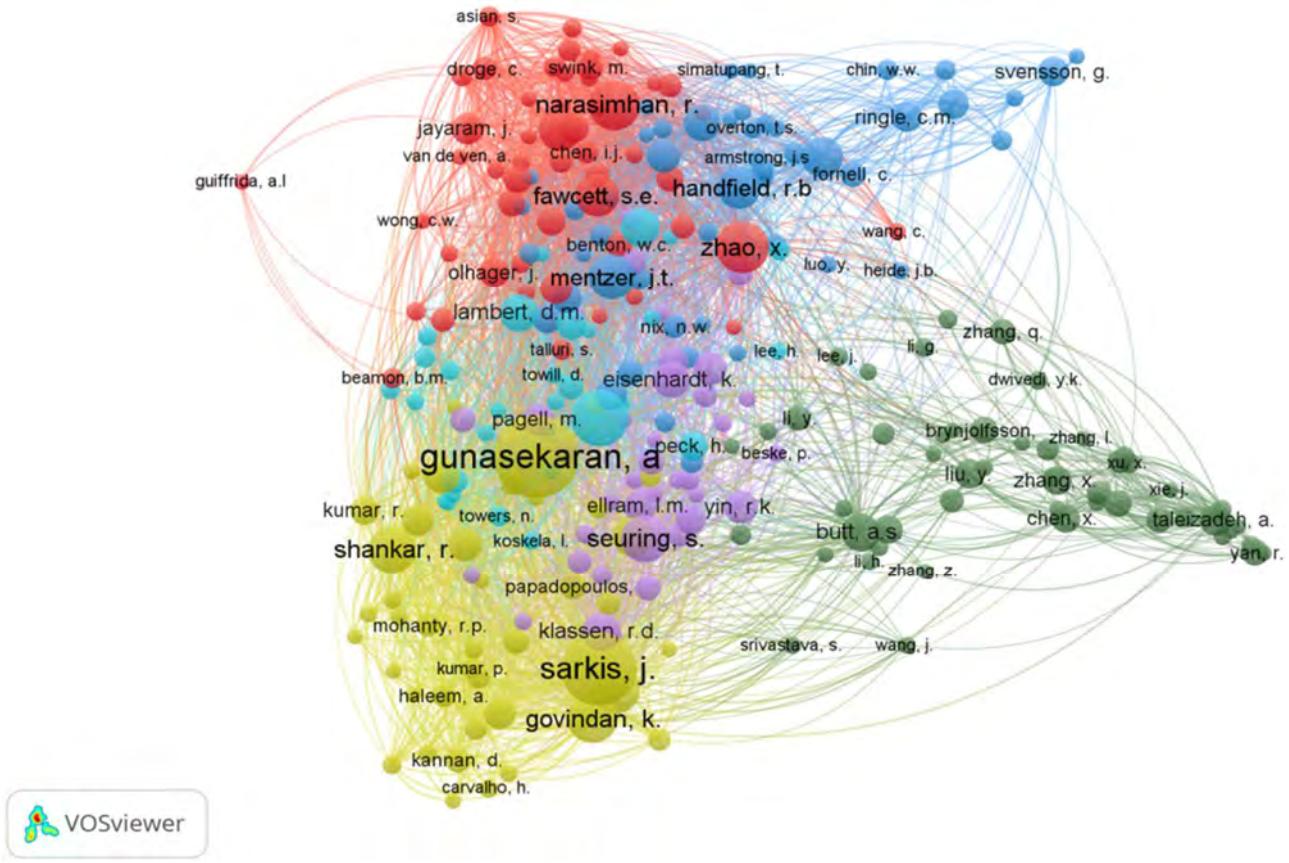

Figure 4 Author citation network of SCM

3.2 Global Supply Chain Management

3.2.1 Global SCM publications by year

The first publication related to Global SCM was published in the year 1990. It is considered the beginning of Global SCM because the term globalization received global attention during this period, and the companies around the world are interconnected using a global supply chain. There were 7891 research articles published between 1990 and 2021. Following the application of filters and Boolean operators, 1055 articles for Global SCM analysis were found. According to bibliometric analysis, it is exciting that the year 1990 is significant as the studies related to Global SCM were started this year. Consequently, there is a constant increase of studies concerning Global SCM through slight ups and downs. It can be seen from Figure 5. Though there is a high impact due to Covid 19 in business around the world, there are considerable studies related to Global SCM in 2020. It is observed that there were 115 articles published related to Global SCM this year. Further, it keeps on increasing; the researchers around the world may conduct more studies concerning Global SCM in the upcoming years also by considering positive and negative outcomes of Global SCM.

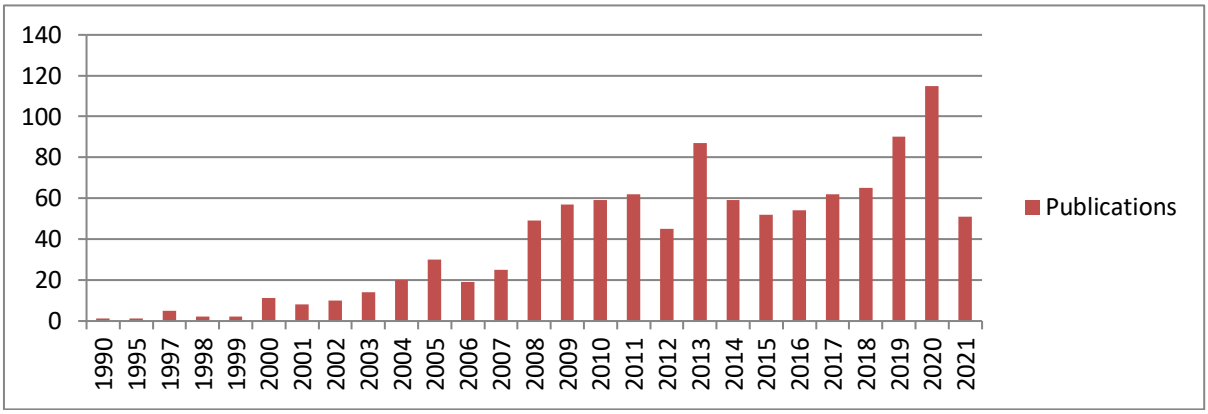

Figure 5 Global SCM Publications by Year

3.2.2 Geographical analysis of Global SCM publications

While analyzing the bibliometric data of Global SCM, it is interesting to discover that Global SCM is considered the desired subject for global researchers who conduct research on the supply chain. Though the studies are lesser than SCM, the studies conducted for Global SCM receive worldwide attraction. The authors' country of affiliation is significantly attractive because 1055 published articles were distributed among 80 countries. Table 2 shows the top 10 countries where most of the academic papers were published related to Global SCM. In addition to that, these countries account for 83.79% of all published articles. According to the data, United States of America (USA) holds the highest number of publications, totalling 333 articles, followed by United Kingdom (UK) with 121 articles, and India with 120 articles. France is in 10th place as it holds 34 publications.

Table 2 Top 10 number of Global SCM publications in coauthorship by country

S. No	Coauthorship By Countries	Number of Publications	Percentage Calculated from Total Number of Publications (% of 1055)
1	United States	333	32%
2	United Kingdom	121	11%
3	India	120	11%
4	Australia	52	5%
5	Germany	50	5%
6	Italy	50	5%
7	China	48	5%
8	Canada	40	4%
9	Taiwan	36	3%
10	France	34	3%

Figure 6 shows the map of coauthors' country of affiliation generated by VOSviewer. The network visualization cluster of Global SCM publications related to coauthorship countries reveals that the clusters of countries USA, UK and India are in evidence and link with many nations. It indicates that these three countries together account for 54% of the publications as same as SCM publications. Coauthorship between countries is represented by the lines connecting the points on the map. The distance between the clusters represents the strength of the coauthorship and how much each country publishes in coauthorship.

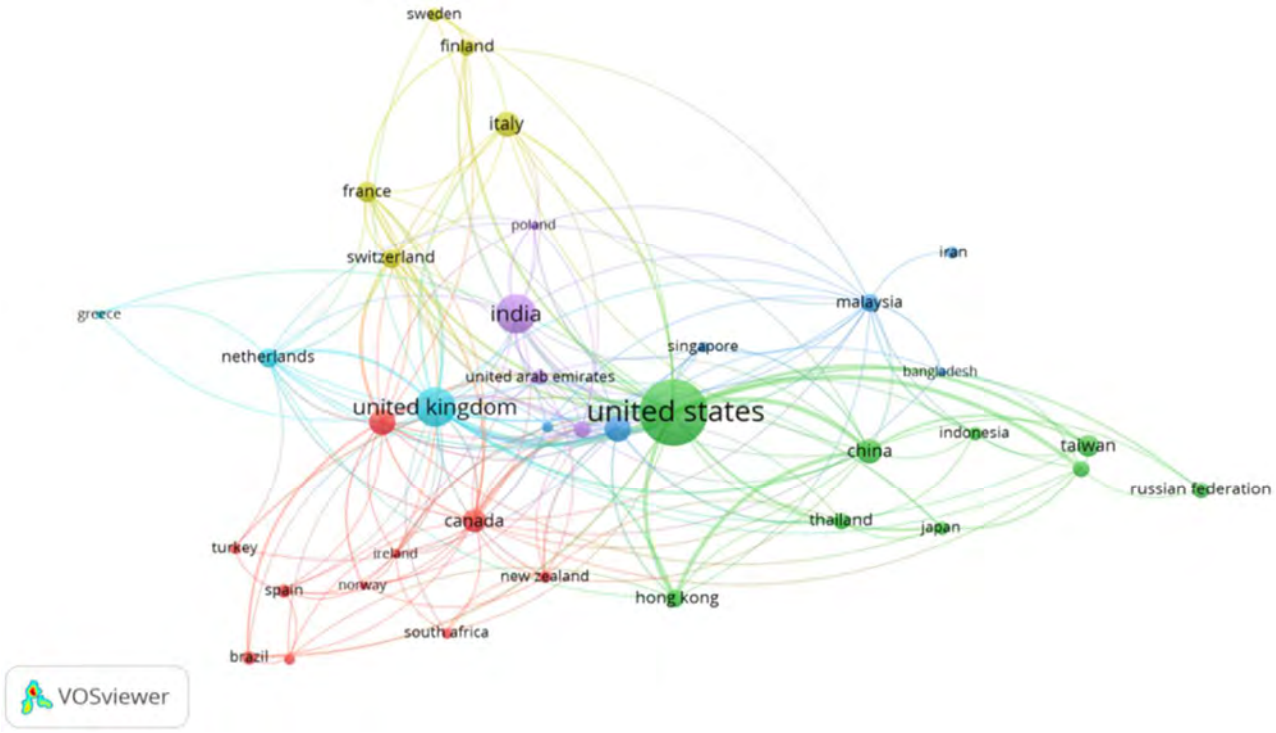

Figure 6 Coauthorship by country for Global SCM publications

3.2.3 Analysis of citations of Global SCM

The present study obtained the author citation network of Global SCM using the network visualization of VOSviewer, and pictures in Figure 7. An article citation is created when two articles refer to the same document. This method is used to evaluate the thematic relevance of documents, journals and authors. The American author Gunasekaran shows in the blue cluster as one of the authors mentioned most often with the total link strength of 2518 and citations of 100.

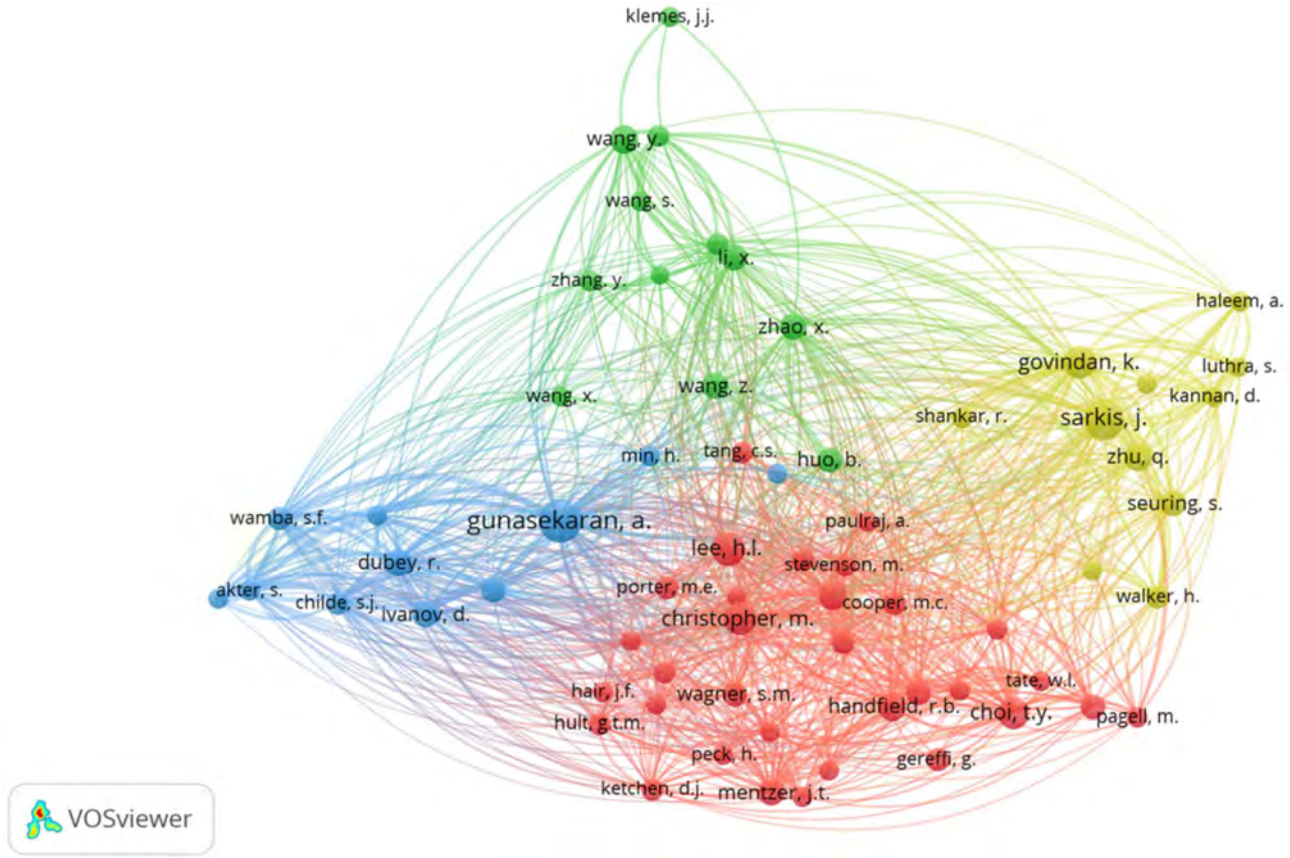

Figure 7 Author citation network of Global SCM

3.3 Green Supply Chain Management

3.3.1 Green SCM publications by year

It is observed from the bibliometric data that between 1990 and 2021, there were a total of 3767 research articles published. Using filters and Boolean operators, 419 articles for Green SCM analysis were discovered. Though the studies related to SCM emerged/published in the early 1990s, the researchers were interested in conducting research on Green SCM only after 2004; it is evidenced from the first research article related to Green SCM, which was published in the year 2004. It can be identified from Figure 8 that shows the steady increase of publications concerning Green SCM year on year. Nowadays, the industries worldwide concentrate on more environmentally-friendly surroundings for their businesses; it might be the reason for the past researchers to conduct and explore the impact of Green SCM. It is also clearly visible in the reviewed literature. In 2020, there are many studies conducted in relation to Green SCM, which marks 63 published research articles, and this count is considered high.

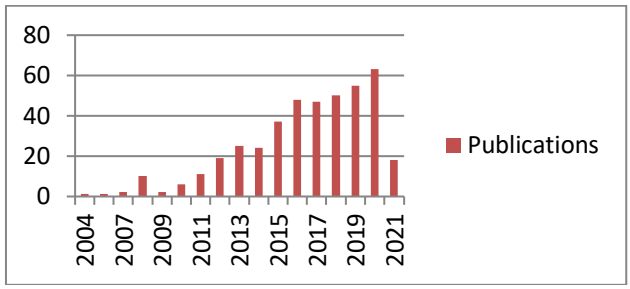

Figure 8 Green SCM Publications by Year

3.3.2 Geographical analysis of Green SCM publications

The attention on environmentally-friendly surroundings for the supply chain, especially Green SCM, receives much importance. Considering that, the researchers of different countries contribute a lot in terms of their research articles publication. After applying required filters and Boolean operators, there were 419 articles considered for geographical analysis of Green

SCM. The country-wise affiliation of authors is spread across 61 countries. This connection is more significant in recent years. It shows that most of the nations and their researchers are interested in conducting research on Green SCM. Table 3 shows the top ten number of Green SCM publications in coauthorship by country. The listed top ten countries occupy 94% of all published articles concerning Green SCM. From Table 3, it can be identified that India has the highest number of publications, totaling 86 articles, followed by China with 76 articles, and USA with 64 articles. Australia and Indonesia deserve 10th position by having 16 articles.

Table 3 Top 10 number of Green SCM publications in coauthorship by country

S. No	Coauthorship By Countries	Number of Publications	Percentage Calculated from Total Number of Publications (% of 419)
1	India	86	21%
2	China	76	18%
3	United States	64	15%
4	United Kingdom	46	11%
5	Iran	27	6%
6	Brazil	23	5%
7	Malaysia	22	5%
8	Taiwan	20	5%
9	South Korea	17	4%
10	Australia/Indonesia	16	4%

The software tool, VOSviewer, is used to map the coauthors' country of affiliation. The network visualization clusters of Green SCM publications concerning coauthorship countries are displayed in Figure 9. The clusters of India, China and USA are emphasized, and they link with many nations. From Table 3 and Figure 9, it can be determined that the top three countries, in terms of Green SCM publications, account for 54% of publications. The lines connecting the points shown on the map indicate the coauthorship between countries, and the distance between the clusters indicates the strength between them and how much these countries publish in coauthorship.

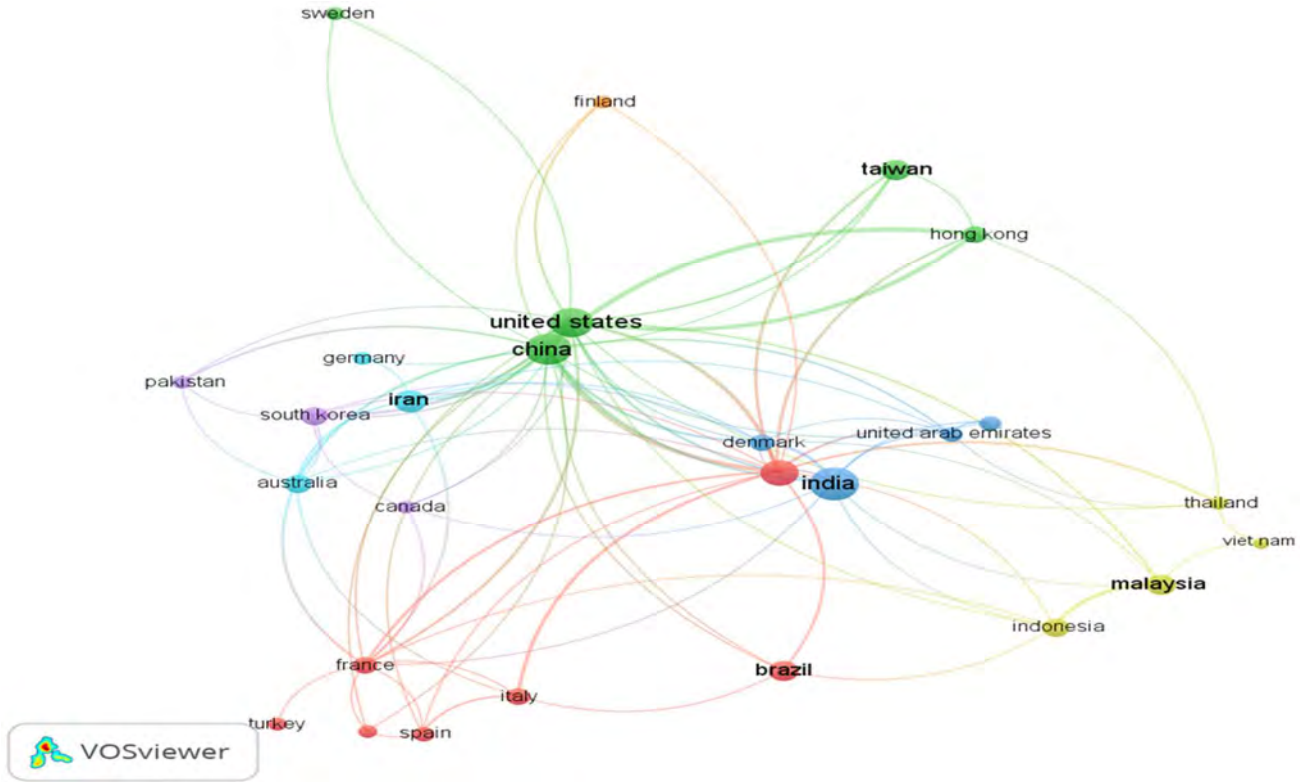

Figure 9 Coauthorship by country for Green SCM publications

3.3.3 Analysis of citations of Green SCM

The bibliometric data of Green SCM using the network visualization of VOSviewer reveals the author citation network, which is shown in Figure 10. When two articles refer to the same document, the citation of the article can be generated. This method is used for documents, journals, and authors to determine the relevance of a document to a specific thematic field. The American author Joseph Sarkis shows in the green cluster as one of the authors mentioned most often with the total strength link of 77853 and citations of 1023.

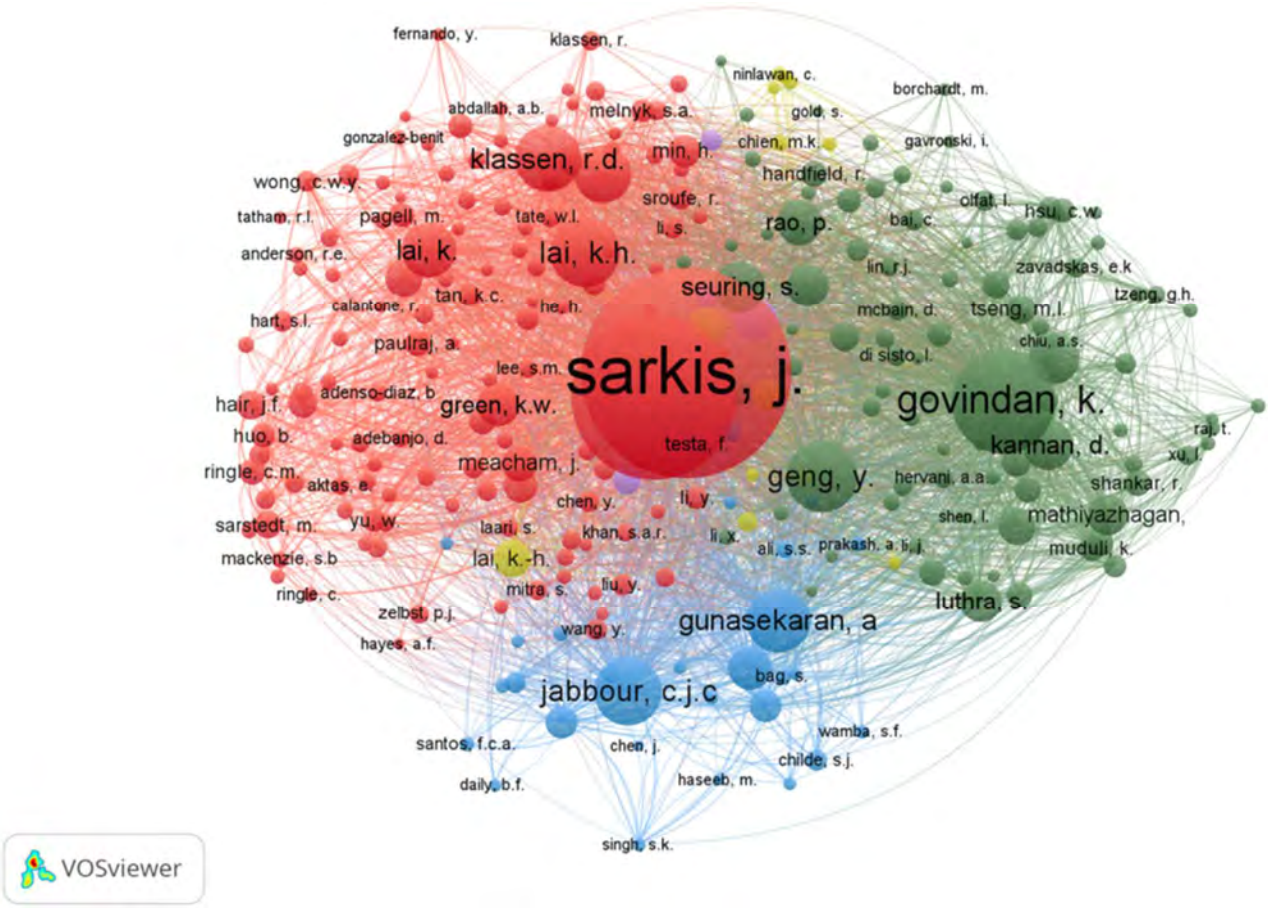

Figure 10 Author citation network of Green SCM

3.4 Sustainable Supply Chain Management

3.4.1 Sustainable SCM publications by year

The integration of environmentally-friendly and financially viable practices into the complete supply chain lifecycle is called sustainable supply chain management [52]. From 7413 published research articles, 1864 articles were considered for the present study after applying filtering and Boolean operators. Further, it is observed that the emergence of publication relation to Sustainable SCM was initially identified in the year 1996. The publications trend of Sustainable SCM is shown in Figure 11. It is easy to understand the trend of publications in Sustainable SCM from Figure 11; there is a constant growth of publications in Sustainable SCM as it shows the increasing interest of the researchers in this field. It is not only for the interest of the researchers on Sustainable SCM, but also the industries and economies have given more importance to Sustainable SCM. There are more articles published in the year 2020; this year has marked the highest count in Sustainable SCM.

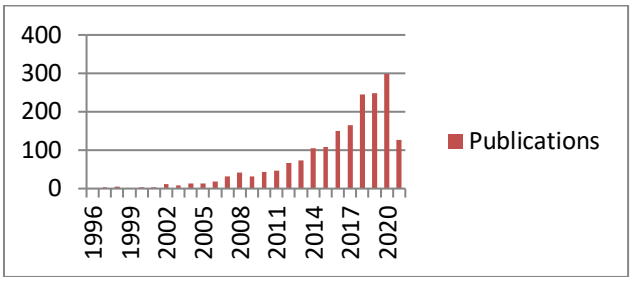

Figure 11 Sustainable SCM Publications by Year

3.4.2 Geographical analysis of sustainable SCM publications

In the current era, making a sustainable environment is an important task for any economy. Considering this concept, researchers and industries and countries have

shown much attention to Sustainable SCM. Thus, many research articles were published in collaboration with diverse nations with the help of researchers around the world. From the obtained bibliometric data, there were 1864 articles were considered for analysis. The country-wise affiliation of authors is spread across 83 countries. Table 4 shows the top ten number of Sustainable SCM publications in coauthorship by country. The listed top ten countries occupy 88% of all published articles concerning Sustainable SCM. From Table 4, it can be seen that USA has the highest number of publications, totaling 351 articles, followed by UK with 315 articles, and India with 189 articles. Iran deserves 10th position by having 81 articles.

Table 4 Top 10 number of Sustainable SCM publications in coauthorship by country

S. No	Coauthorship By Countries	Number of Publications	Percentage Calculated from Total Number of Publications (% of 1864)
1	United States of America	351	18%
2	United Kingdom	315	17%
3	India	189	10%
4	China	183	10%
5	Germany	137	7%
6	Italy	116	6%
7	Canada	101	5%
8	France	94	5%
9	Australia	91	5%
10	Iran	81	4%

The obtained bibliometric data of Sustainable SCM were processed in VOSviewer to identify the coauthors' country of affiliation. The network visualization of coauthorship countries is displayed in Figure 12, which was generated from VOSviewer. The clusters of USA, UK and India are exposed well, which means they link with many nations. From Table 4 and Figure 12, it can be determined that the top three countries of sustainable SCM publications account for 45% of publications. The coauthorship of countries is represented by the lines connecting points on the map, and the distance between clusters indicates the strength of the countries and their coauthorship publications.

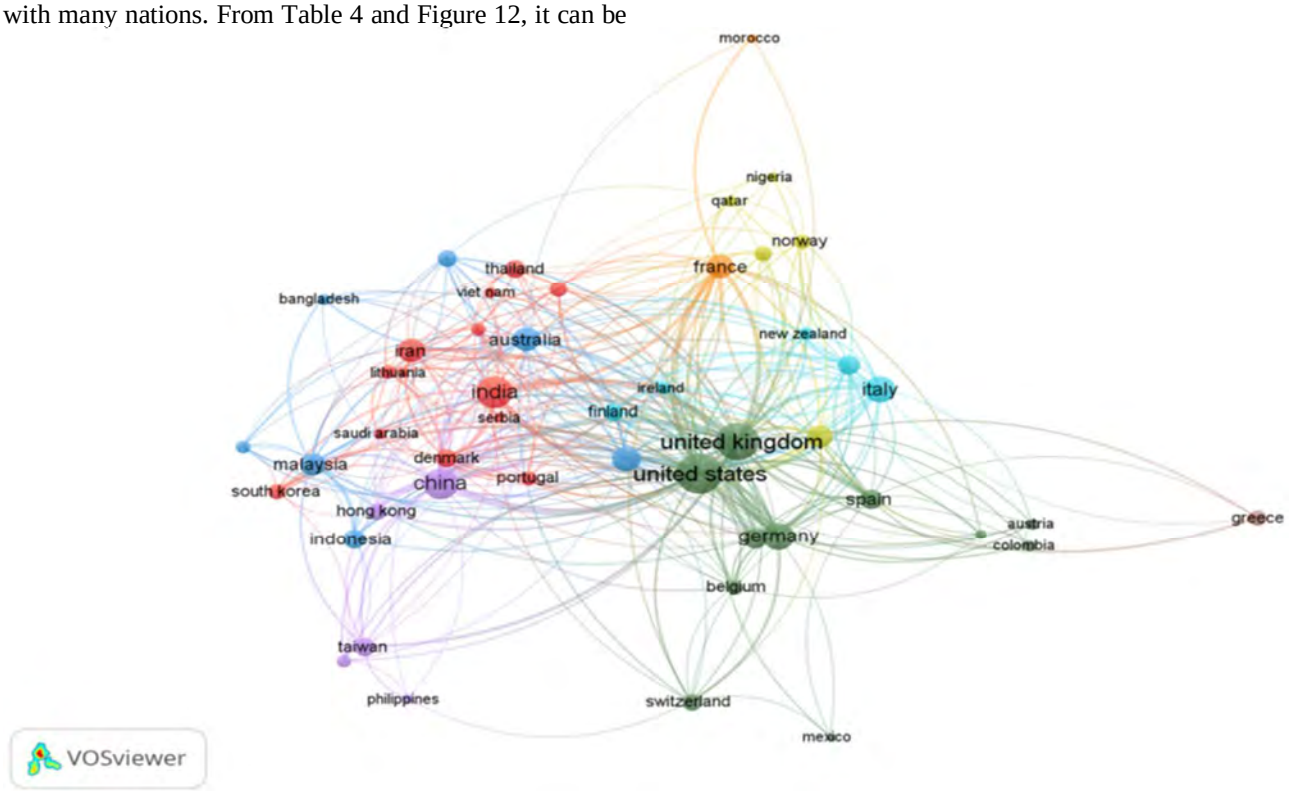

Figure 12 Coauthorship by country for Sustainable SCM publications

3.4.3 Analysis of citations of sustainable SCM

The author citation network is presented in Figure 13, which was generated by citation network visualization of VOSviewer, and the bibliometric metric data of Sustainable SCM obtained from the Scopus database were used for analysis. The citation of the article can be generated when two articles refer to the same document. This method is implemented for documents, journals and authors and reveals the relevance of a document for a thematic field. There are a few authors who are emphasized in Figure 13, which means their citation networks are highly linked with other studies. Among them, the American author, Joseph Sarkis, shows in the blue cluster as one of the authors mentioned most often with the total strength link of 137995 and citations of 1396.

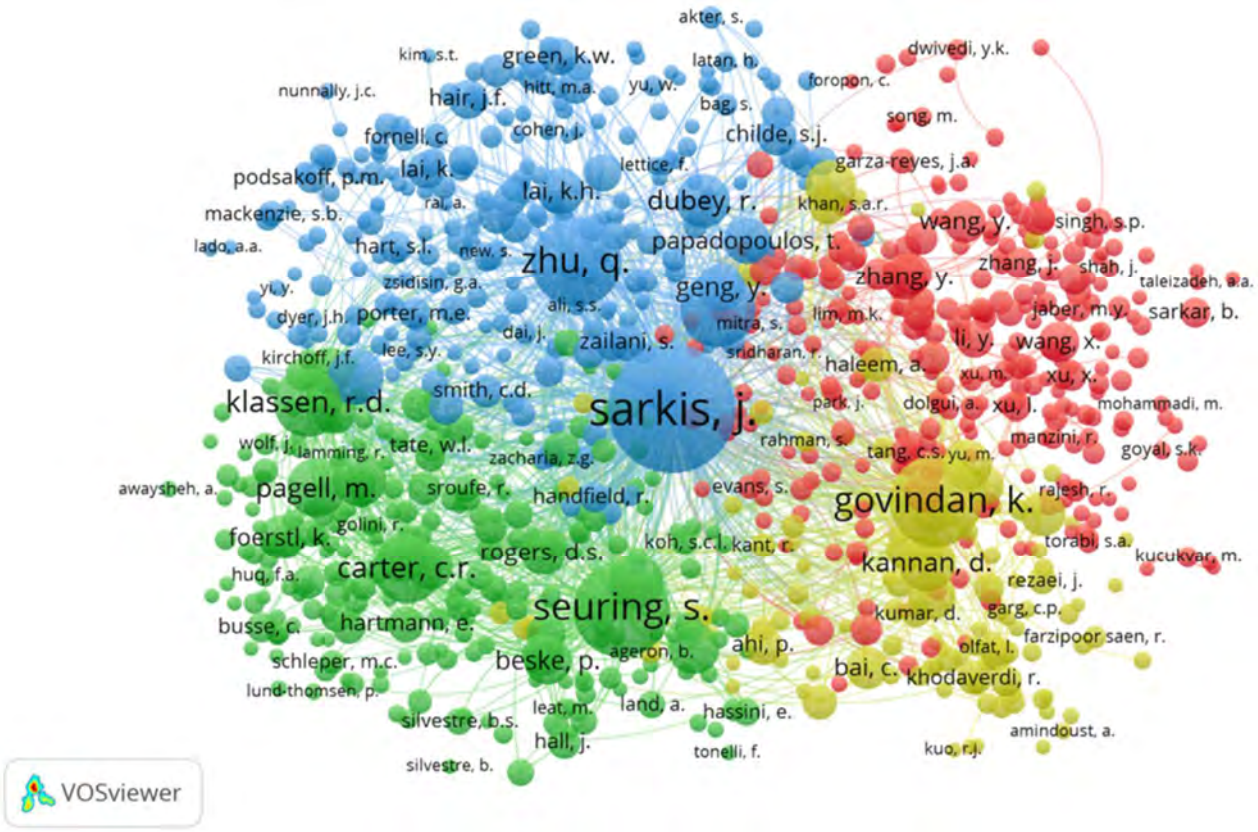

Figure 13 Author citation network of Sustainable SCM

3.5 Supply Chain Management 4.0

3.5.1 SCM 4.0 publications by year

In this digital era, all the fields have been digitalized or automated. The vision of Industry 4.0 engulfs SCM too. Considering that, many industries and countries adopt automation in SCM, which means SCM 4.0. Due to the technology adoption of industries and countries, researchers around the world also conducted research on this field vibrantly nowadays. For SCM 4.0, there were 466 articles considered for analysis after applying filtering and Boolean operators; earlier, there were 1194 articles. Figure 14 shows the trend of publications in SCM 4.0. SCM 4.0 highly emerged after 2010 because most of the industries started adopting automation in the last decade, especially after 2015. The year 2020 marked the highest number of publications, there might be a reason that Covid 19 restricted the human workforce and companies, drastically transferred to automation, and the researchers got interested in exploring the impact of this changeover, SCM 4.0. From the bibliometric analysis, it can be understood that there would be an uptrend in SCM 4.0 publications in the upcoming years as most of the businesses start implementing automation, and researchers also hunt for emerging areas to conduct their research.

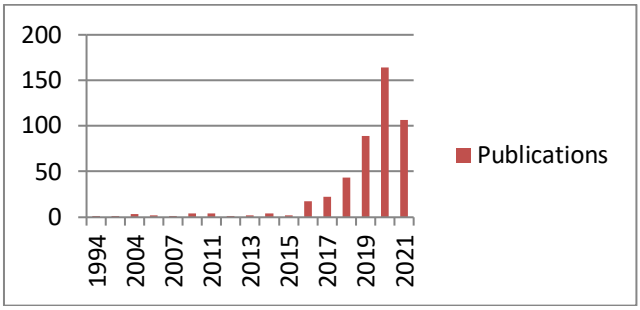

Figure 14 SCM 4.0 Publications by Year

3.5.2 Geographical analysis of SCM4.0 publications

Technology or automation adoption has been increasing all around the world in SCM, which is known as SCM 4.0. The researchers of the world show more importance to this field, and SCM 4.0 becomes a trendy word in recent days. That is the reason the research on SCM 4.0 spread across the world in collaboration with diverse nations. The present study had considered 466 articles for geographical analysis of SCM 4.0. It is exciting to know that the country-wise affiliation of authors is linked across 76 countries. Table 5 shows the top ten number of SCM 4.0 publications in coauthorship by country. The listed top ten countries cover 81% of all published articles related to SCM 4.0. Table 5 shows that India has the highest number of publications, totalling 57 articles, followed by USA with 56 articles and UK with 54 articles. Australia holds 10th position by having 20 articles.

Table 5 Top 10 number of SCM 4.0 publications in coauthorship by country

S. No	Coauthorship By Countries	Number of Publications	Percentage Calculated from Total Number of Publications (% of 466)
1	India	57	12%
2	United States of America	56	12%
3	United Kingdom	54	12%
4	Italy	40	9%
5	Germany	38	8%
6	China	36	8%
7	Brazil	29	6%
8	Spain	26	6%
9	France	24	5%
10	Australia	20	4%

The bibliometric data of SCM 4.0 were processed in VOSviewer to determine the country of affiliation of the coauthors. Figure 15 shows the network visualisation of coauthorship countries, which was generated using VOSviewer. The clusters of India, the USA, and the UK are well-exposed, implying that they are linked to many countries. Table 5 and Figure 15 show that the top three countries in terms of SCM 4.0 publications account for 36% of all publications. While comparing with other SCM advancements, the publications related to SCM 4.0 almost spread across the top 10 countries of SCM 4.0 publication equally that shows the interest of the global researchers. The coauthorship of countries is represented by lines connected to points on the map, and the distance between clusters indicates the strength among the countries and the publication in coauthorship of those countries.

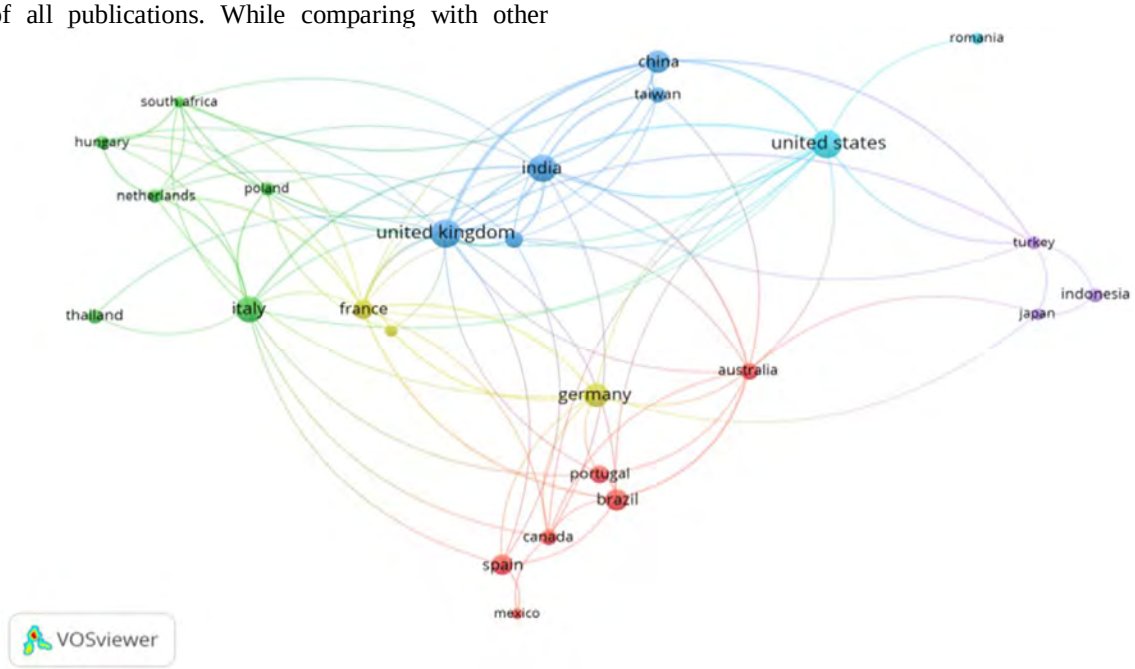

Figure 15 Coauthorship by country for SCM 4.0 publications

3.5.3 Analysis of citations of SCM 4.0

Figure 16 depicts the author's citation network and analyses it using SCM 4.0 bibliometric data obtained from the Scopus database, as generated by VOSviewer's citation network visualisation. The citation of the article can be generated when two articles refer to the same document. This method is used to determine the relevance of a document to a specific thematic field for documents, journals, and authors. Several authors are highlighted in Figure 16, indicating that their citation networks are strongly linked to other studies. The American author, Gunasekaran, appears in the yellow cluster as one of the authors mentioned most frequently, with total link strength of 6891 and 158 citations.

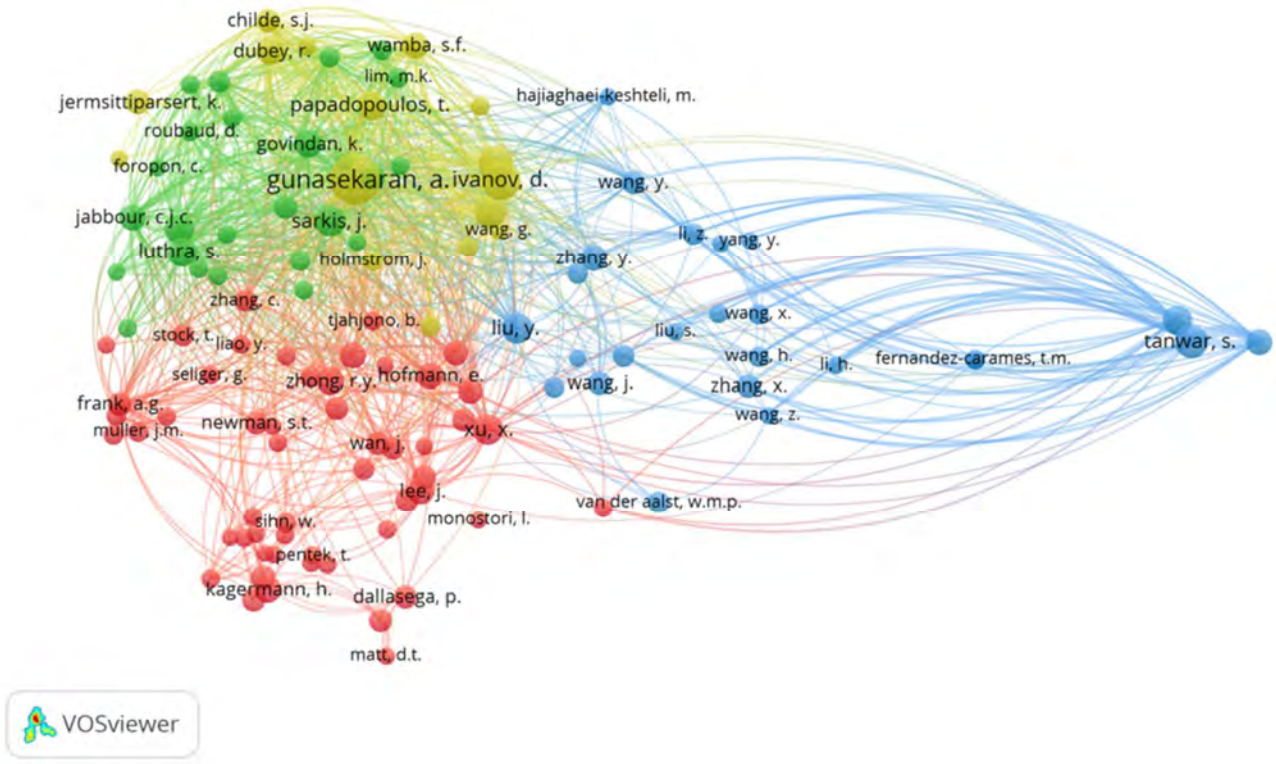

Figure 16 Author citation network of SCM 4.0

4 Results

The overall results of the bibliometric analysis and findings obtained from VOSviewer, publications by year, countries, and citations of studies related to SCM, Global SCM, Green SCM, Sustainable SCM and SCM 4.0 are discussed in this section of the paper.

4.1 Summary of publications by year

According to the results of a keyword search in the Scopus database, the first article about SCM was published in 1969. However, the increase in the number of publications gained popularity in 1993. SCM was found to be mentioned in 1454 articles out of a total of 62547 articles (while using the keyword Supply Chain Management). According to the bibliometric analysis, the advent of Global SCM began in 1990, with a total of 7891 articles found between 1990 and 2021. A total of 1055 articles were found to be more significant to Global SCM. It should be noted that, while Covid 19 has had a significant impact on businesses around the world, in the year 2020, there were 115 significant articles related to Global SCM were published. Concerning the bibliometric analysis of Green SCM, a total of 3767 research articles were published. Using Boolean operators to filter articles, 419 articles for Green SCM analysis were discovered. Since 2004, the publication trend of Green SCM has increased as industries all over the world strive to create more environmentally-friendly environments for their businesses. There is a steady increase in publications in Sustainable SCM, indicating that researchers are becoming more interested in this field as industries and economies place greater emphasis on Sustainable SCM. 1864 articles were found to be relevant for Sustainable SCM out of 7413 published research articles, with the highest publication count in the year 2020. Out of 1194 articles, 466 were considered for analysis in SCM 4.0 after filtering and Boolean operators were applied. The findings of the bibliometric analysis emphasise that there will be an increase in SCM 4.0 publications in the coming years, as most businesses begin to implement automation and researchers seek out new areas in which to conduct research. The net results of the analysis clearly show that the year 2020 has the highest number of publications in all the five branches of SCM.

4.2 Summary of Geographical Analysis of Publications

Based on data obtained from the bibliometric analysis, it is fascinating to learn that SCM and its advancements were regarded as the most desired subject for global supply chain researchers. Studies on SCM were conducted frequently in the United States of America, which has the most publications (378), followed by the United Kingdom and India, with Sweden ranking tenth with 47 publications. In comparison to SCM, Global SCM received worldwide attention, with published articles distributed among 80 countries, with the United States of America holding first place with 333 articles and France holding tenth place with 34 publications. With 86 articles, India leads the list of the gradually emerging Green SCM, followed by Indonesia and Australia in tenth place. Concerning Sustainable SCM, it can be seen that the United States has the most publications, totaling 351 articles, followed by the United Kingdom (315 articles), India (189 articles), and Iran ranking the tenth position with (81 articles). The emerging SCM 4.0 is gaining its popularity, with India ranking first with 57 articles and Australia ranking tenth with a total of 20 articles. The overall network visualization of country-wise publications generated by VOSviewer shows the clusters of India, the United States, and the United Kingdom are well-exposed, implying that they are linked to many countries with the highest number of SCM publications.

4.3 Summary of Analysis of Citations

The author citation network obtained from VOSviewer shows the American author Gunasekaran as one of the authors mentioned most often for SCM, Global SCM and SCM 4.0 concerning studies with the total strength link of 5082 and citations of 103, total link strength of 2518 and citations of 100 and total link strength of 6891 and 158 citations, respectively. Similarly, the American author Joseph Sarkis citations networks are highly linked with other studies regarding Green SCM and Sustainable SCM with the total strength link of 77853 and citations of 1023 and total strength link of 137995 and citations of 1396, respectively. The researchers have shown the overall summary of the results in Table 6.

Table 6 Summary of overall Results

Types of SCM	Total Number of Publications	Top 10 Countries by Publications	Total Number of Clusters of Coauthorship by country	Total Number of Clusters of Citation Network	Renowned Author	Most Cited Article
SCM	1454	USA, UK, India, Australia, China, Finland, Germany, Italy, Canada and Sweden	9	5	Gunasekaran	[47]
Global SCM	1055	USA, UK, India, Australia, Germany, Italy, China, Canada, Taiwan and France	7	4	Gunasekaran	[81]
Green SCM	419	India, China USA, UK, Iran, Brazil, Malaysia, Taiwan, South Korea and Australia/ Indonesia	7	5	Joseph Sarkis	[82]
Sustainable SCM	1864	USA, UK, India, China, Germany, Italy, Canada, France, Australia and Iran	8	4	Joseph Sarkis	[83]
SCM 4.0	466	India, USA, UK, Italy, Germany, China, Brazil, Spain, France and Australia	6	4	Gunasekaran	[84]

5 Discussion

According to the foregoing study of literature, it can be seen that several researchers have undertaken distinct studies related to Supply Chain Management [2-4,6,88-90], Global Supply Chain Management [88-93], Green Supply Chain Management [45,94-101], Sustainable Supply Chain Management [17,23,54,62,86,102-104] and SCM 4.0 [66,105-109].

Though many studies were conducted individually, there is no such study has been carried out to comprehend all five branches. For instance, the study by Croom et al. focuses on only two criteria of SCM: content and methodology-based review papers, whereas the current paper focuses on accurate information about the highest-ranked country, author and articles published related to SCM. Similarly, Closs and Mollenkopf's study on the conceptual framework of Global SCM focuses on the

United States, with data from Australia and New Zealand (ANZ) being compared, whereas the current study focuses on SCM globally. Likewise, Luthra et al., research look into the impact of organisational size on the adoption of Green Supply Chain Management practises in the Indian industry, but the current study looks at the impact of Green SCM globally. On the other hand, Brandenburg et al. study focused on Sustainable SCM and was limited to six journals, whereas the current study has no such constraints. The study by Princes discusses the disruptive challenges that SCM 4.0 presents to the modern manufacturing industry, whereas the current study examines both the strengths of SCM 4.0's artificial intelligence advancements as well as the drawbacks of cybercrime.

The novelty of the present study stands here, as this research analyse main five SCM topics in the literature and quantitative trends of their aperance together with authorship, citations and authors' geographical affiliation as well as authors interrelations, and in this way, it differs from the previous researches. Further, it can be noted that the present findings of the study fulfil the gap in the development of a comprehensive conceptual framework that integrates all of the five SCM branches as a single entity left in previous studies. The current study distinguishes itself by using a VOSviewer that combines graphical analysis of the biblometric network via cluster maps with a detailed study and systematic review of published papers from 1990 to 2021, yielding a new study in the SCM trends.

Furthermore, accurate information on the publication period of SCM, Co-authorship of each country and citations have been obtained using standard research tools from the commencement of SCM to the present day. As a result, the study discovers that countries like India, United States of America and United Kingdom have the most publications relating to SCM and its advancements, thereby promoting and encouraging readers to develop its significance relevant to the modern commercial world. On the other hand, the study raises awareness among countries with lower publication rates by alerting them to gain a better understanding of SCM and its advancements in the globalised era.

6 Conclusion

The current study focuses on a historical overview of the Supply Chain Management concept, from its commencement to the recent development of Supply Chain Management 4.0. The review of literature provides a comprehensive overview of SCM and various dimensions of all five types of SCM derived from papers published in scientific journals indexed in the Scopus database, a highly regarded database for academic and scientific articles.The methodology of this study incorporates VOSviewer software to classify and analyse bibliometric data distribution and network in a graphical way via cluster maps using a detailed examination and systematic review of literature based on bibliometric reviews published in each research field. The findings of the study illustrate that the present study is unique in its construction as it exposes all five branches of SCM using VOSviewer in which no previous research has been conducted to date. Though the study thoroughly explains SCM and its advancements, it does have certain limitations, as it only looks at articles in the Scopus database, excluding journal articles from other databases like Web of Science, Dimensions, PubMed, etc. Furthermore, only English-language literature are taken into account, which gives scope to future researchers to explore and obtain insight on work done in different languages related to SCM.

The study not only ends with comprehending the SCM and its advancements but also it recommends and provides opportunities for future researchers. The detail recommendations and opportunities are as follow; for SCM – Only a few countries have conducted the majority of SCM studies, hence there are many chances for researchers in areas where studies have not been performed, for Global SCM – nowadays, due to the impact of Covid 19 the studies related to Global SCM were declined, researchers all over the world take this opportunity to investigate further into the impact of Covid 19 on Global SCM, for Green SCM – only a few countries, especially the top ten countries listed in Table 3 has 94 percent, conducted most of the studies in relation to Green SCM, so researchers from other countries may concentrate on this field, and it give a lot of opportunities to them, for Sustainable SCM – there are a lot of opportunities to the researchers to conduct the studies in different industries as the past studies focus only the limited industries that concerning the environmentally friendly, and for SCM 4.0 – only very few articles in relation to technology adoption were published in the recent years related to SCM 4.0, so the future researchers have a lot of opportunities to conduct research concerning SCM 4.0 in line with the hosting countries' industries that deal with SCM 4.0.

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