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Green supply chain management in the platform economy: a bibliometric analysis

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ABSTRACT
This paper aims to provide a bibliometric analysis of green supply chain management in platform economy (GSCM-PE) literature. Based on the bibliometric approach, a descriptive analysis is engaged in the literature published from 2003 to 2020 in *Web of Science*. There are 1404 publications in this field of GSCM-PE. The number of publications has increased steadily since 2013. China is an essential contributor to this field, with the largest number of publications (356), followed by the USA (175) and England (116). However, China's total citation is 0.5 times that of the USA, which indicates that China needs further strengthened in quality. In addition, the cooperation between European and American countries is relatively active. Six clusters are identified from co-word network, and their main conclusions are as follows: (i) based on Internet technology, the application of SCM in business is the hottest topic and (ii) network risk and security requires further exploration.

1. Introduction

Supply chain management (SCM) is a comprehensive and effective management method from purchasing to meeting the end customer of the supply chain, which aims to optimise the operation with minimum cost. With people gradually raising the awareness of environmental protection, SCM has become environmentally proactive in recent years, and then the role of the supply chain in promoting recycling, reuse, and resource reduction has increased (Paulraj 2011). Therefore, the sustainable characteristic in supply chain management has been interested in scholars all over the world (Mariadoss et al. 2016; Mardani et al. 2020; Lee et al. 2020). Within this status quo, the SCM has been recently connected with the platform economy, which has an important carrier of supply chain management innovation (Brettel et al. 2014). The platform economy is a new economic system based on digital technology, which has gained momentum as the core organisational form of informational transformation. In the recent two decades, the platform economy has been highly applied in various industries, such as commercial transactions, financial intermediation and ride sharing (You 2020). Behemoth digital platforms economy such as Tmall.com and JD.com has a continuously ignited capital market with the method of SCM, enterprise value and so on.

Compared with traditional supply chain management, green supply chain management is deemed as environmental innovation, which takes environmental and social factors into account (Song et al. 2019). Therefore, Rajeev et al. (2017) thought green SCM is an interdisciplinary domain that consists of management and environmental sciences. In the past 20 years, both research workers and scholars in this topic have carried out a train of works for a series of problems. In particular, with the digital and information age coming, the platform economy provides new

opportunities and development space for green SCM (Guttentag 2015; Hamari, Sjöklint, and Ukkonen 2016). The platform economy plays an essential role in green SCM. On the one hand, the rapid rise abruptly of cloud computing, big data, Internet of things (IoT), artificial intelligence and other technologies provides perfect basic services for the development of platform economy (Drewel et al. 2020). On the other hand, platform economy can establish the point-to-point whole process supply chain system that realises the docking of supply chain information system and logistics system, and improve the operation efficiency of green SCM. Besides, green SCM in the platform economy is also facing some challenges, such as governance issues of platform economy (Dellarocas 2006), the demand for interdisciplinary talent, technical barriers (Sutherland and Jarrahi 2018). De Reuver, Sørensen, and Basole (2018) found in their research that the first challenge is capturing the scale and heterogeneity of the platform system, which is the premise of realising green SCM. Meanwhile, the commercial value brought by the platform economy has been paid more and more attention, this encourages entrepreneurs to achieve a breakthrough of supply chain innovation with help of entity and virtual platform. In general, platform economy can not only facilitate the promotion of technological innovation and improve the level of performance management (Ciulli, Kolk, and Boe-Lillegraven 2020), but also add new impetus to green SCM.

In recent few years, there has been increasing interest in green SCM because sustainable development is fully carried out. Some researchers are combining green SCM with platform economy to stimulate the effective operation of supply chain (Sun et al. 2020; Chauhan 2020; Zhao et al. 2019). To the best of our knowledge, although the available researches have covered some specific areas, there is no literature review about green SCM in the platform economy. Therefore, this paper employs bibliometric analysis to make the quantitative investigation and visual analysis on authors, keywords, and so on, which is aimed at providing a comprehensive overview for green SCM in the platform economy from 2003 to 2020.

In detail, this paper mainly answers the following question: (1) What is the research situation of the exiting papers in the field? (2) Who is the most influential author? (3) Which are the most influential publications and countries? (4) What is the hottest research topic? (5) Which countries have cooperative relations? (6) What discusses the research direction and trend of future development under the existing studies?

The rest of this paper is organised as follows. Section 2 is the development of the green SCM in the platform economy. Section 3 introduces the methodology and shows a descriptive analysis. The bibliometric analysis is provided in Section 4. In Section 5, the network analysis is shown. Finally, Section 6 draws the main conclusion.

2. Development of green supply chain management in the platform economy

Supply chain management was first proposed in the 1980s. It was mainly used in the particular company to coordinate strategy and the tactic across these business functions within the supply chain, to improve the long-run term enterprise performance and promote the enterprise value (Mentzer et al. 2001; Wolters, James, and Bouman 1997). However, the increasingly serious resource consumption and environmental deterioration have become a challenging and imperative issue for the business organisation in recent years (Tung, Baird, and Schoch 2014; Testa and Iraldo 2010; Zhu and Sarkis 2006). This leads many scholars and businesses to explore new research directions and solutions. Green SCM seems to be a novel management and organisation way to deal with these issues (Srivastava 2007).

The framework of green supply chain was first proposed by Beamon (1999), which is an extension of the traditional supply chain. It aims to minimise the impact on the environment in the whole life cycle of products, such as reducing emissions, saving energy, recycling harmful substances. It creates a new method for the sustainable operation between the production process and the company itself and is an essential practice of traditional supply chain management (Linton, Klassen, and Jayaraman 2007). In addition to promoting environmental performance, green supply chain also

plays an essential role in improving corporate profits and market share (Ding, Wang, and Zheng 2018; Ma et al. 2018). In general, the implementation of supply chain management in enterprise operations can enhance the competitive advantage of enterprises to a certain extent (Wouters et al. 2009). However, due to the pressure of government regulations (mandatory environmental regulations), consumers and customers, enterprises have to incorporate environmental performance into supply chain management to meet government goals or reduce concerns of customers. When an enterprise can effectively solve the environmental problems of products, green supply chain management will bring more business opportunities. Besides, green supply chain management also involves the transformation of enterprises themselves, such as the transformation from high energy consumption and high emission enterprises to low energy consumption and low emission enterprises (Thun and Müller 2010).

As environmental management and supply chain management are relatively new practice fields, there is still no unified definition (Zhu and Sarkis 2004). The definition of green supply chain management was created by Green, Moeton, and New (1996), and then a series of evolution have been made by scholars (Zsidisin and Siferd 2001; Hervani, Helms, and Sarkis 2005; Srivastava 2007; Carter and Rogers 2008; Walker and Jones 2012; Lee et al. 2014; Das and Posinasetti 2015; Sharma, Chandna, and Bhardwaj 2017). On the basis of the original definition, Hervani, Helms, and Sarkis (2005) brought green marketing and reverse logistics into the green supply chain. Carter and Rogers (2008) made an organic integration of green supply chain management from the perspective of economy, environment and society. Lee et al. (2014) incorporated environmental factors into the long-term relationship process of purchasing decisions. Sharma, Chandna, and Bhardwaj (2017) took into account the biological footprint of products. This greatly enriches and consummates the connotation of green supply chain management. Due to the different definitions of green supply chain management in the literature, there are different terms for it, such as sustainable supply management (Beske, Land, and Seuring 2014), supply chain environmental management (Sharfman, Shaft, and Anex 2009), closed-loop supply chain management (Chen, Yücel, and Zhu 2017).

Since the concept of green supply chain management was invented, many industries are reluctant to accept the notion of green procurement due to the cost problem (Wang et al. 2018b). However, with the implementation of mandatory policies and the improvement of public awareness of environmental protection, green supply chain management has developed rapidly. Enterprises commence realising the significance of environment management, which put green manufacturing and waste utilisation into operation management. Especially after 2010, due to the stricter environmental regulation and the complexity of more advanced supply chain technology, the vast of companies put 'green' throughout the whole production process (Mardani et al. 2020). And then, numerous existing papers have researched the effect of green SCM in different fields, industries, and enterprises (Green, Toms, and Clark 2015; Bhatia and Gangwani 2020; Esfahbodi et al. 2017; Lee, Tae, and Choi 2012; Stindt 2017; Lim et al. 2017; Sauer and Seuring 2017; Gong et al. 2019). For instance, Green, Toms, and Clark (2015) investigated the demand of customers for green products and services in implementing green SCM practices from 225 manufacturing businesses. Lee, Tae, and Choi (2012) explored the importance of large sourcing companies for promoting small- and medium-size enterprises suppliers' green management and innovation capability. Gong et al. (2019) investigated the effect of customer awareness and information environment in pushing the sustainable development of firms and green SCM from 2206 firms. This also lays a solid foundation for the combination with the platform economy.

Platform economy is defined by Evans (2003), which is research on the unique economic phenomenon of the specific bilateral market in traditional market economics. In recent years, the platform of digital-driven business models appears in succession all over the world such as Google, Baidu, Alibaba stands out on the Internet, which reshapes the whole market structure (Xue, Tian, and Zhao 2020). In the era of Internet plus, the platform economy includes many forms, such as sharing economy and circular economy. Enterprises realise digital transformation with the help of Internet of things, blockchain and other technologies. As the development of

the platform economy is booming, some scholars start to pay attention to the important role of the platform economy in green SCM (Esmaeilian et al. 2020; Kousiouris et al. 2019; Di Vaio and Varriale 2020) For example, Papetti et al. (2019) proposed a web-based platform capable of tracking the related process of suppliers and consumers in the whole supply chain for improving the leather shoe supply chain's environmental sustainability. Hu et al. (2019) examined the sustainable practice of sharing economy platform from a sustainable SCM perspective, the research results demonstrated that investment recovery practice and corporate social responsibility play an essential role in maintaining a long-term sustainable market.

Although scholars have carried out some related studies in this application area, it is in its developing stage. Many limitations in the application of green SCM in the platform economy are in existing literature, consisting of the privacy and security within the platform network (Esmaeilian et al. 2020; Yadav and Singh 2020), the lack of trust among stakeholders (Yadav et al. 2020), and so on. Therefore, Green SCM in the platform economy must overcome those shortcomings to achieve its maximum potential.

This paper reviews the relevant literature on green supply chain management and the latest development on the combination of platform economy and green supply chain management in the wave of digital revolution. However, we discover that few articles focus on the field of bibliometric. To fill this gap, this paper is intended to use bibliometric analysis to summarise the study of the field and offer a relatively complete reference for future research.

3. Methodology and descriptive statistics

The bibliometric analysis employs the literature information in the publication database to establish a scientific and reasonable network and structure image (Wang, Lim, and Lyons 2018). It is also a significant and effective method to describe, analyse and summarise the published research in related fields. Based on cluster analysis, co-citation analysis, visual analysis, etc., bibliometric has the capacity to in-depth analyse the correlations among papers, authors, keywords, et al., to provide reliable research information for scholars (Tang, Liao, and Su 2018). Therefore, this paper exploited the aforementioned method to conduct a quantitative analysis of the literature review of GSCM-PE.

3.1 Data collection

Web of Science database (www.webofknowledge.com) is an important database platform to obtain global academic information, which is usually utilised for data collection of literature information. To define the scope of the relevant literature, 'platform economy' and 'supply chain management' are our focus, in this study, and are also essential keywords. In addition, sharing economy, circular economy, 'Internet +' and other economic formations are a specific form of development of platform economy, which need to be combined with supply chain management to search in the *Web of Science* database. And then, we future study and discuss green SCM. After searching the aforementioned combination of keywords and their related extensions in the *Web of Science* database, the related literature about green SCM in the platform economy is sorted out. The formal formation of platform economics theory is in 2003, so this paper sets the period of the literature search between 2003 and 2020. Finally, a total of 1596 related papers are obtained from the *Web of Science* database, and duplicates are removed. We set the 'title' of the article as the comparison field, and the similarity coefficient is set to 1. Excluding 192 duplicate data, this paper employs 1404 articles for quantitative analysis and research. Table 1 presents the collection information.

3.2 Descriptive statistics

Figure 1 presents the time trend of publications and total citations in this study field from 2003 to 2020. Since 2013, the number of publications has increased steadily. The annual number of

Table 1. The information on data collection.

Search terms	Results
Supply chain management and platform economy	93
Supply chain management and sharing economy	122
Supply chain management and circular economy	224
Supply chain management and digital (economy/platform/ transformation)	105
Supply chain management and Internet (economy/plus/+)	821
Supply chain management and IoT platform	18
Supply chain management and blockchain technology	213
Duplicate value	192
Total	1404

Note: The contents in brackets are parallel. For example, Internet (economy/plus/+) shows that we select the two keywords of 'Internet economy', 'Internet plus' and 'Internet +'.
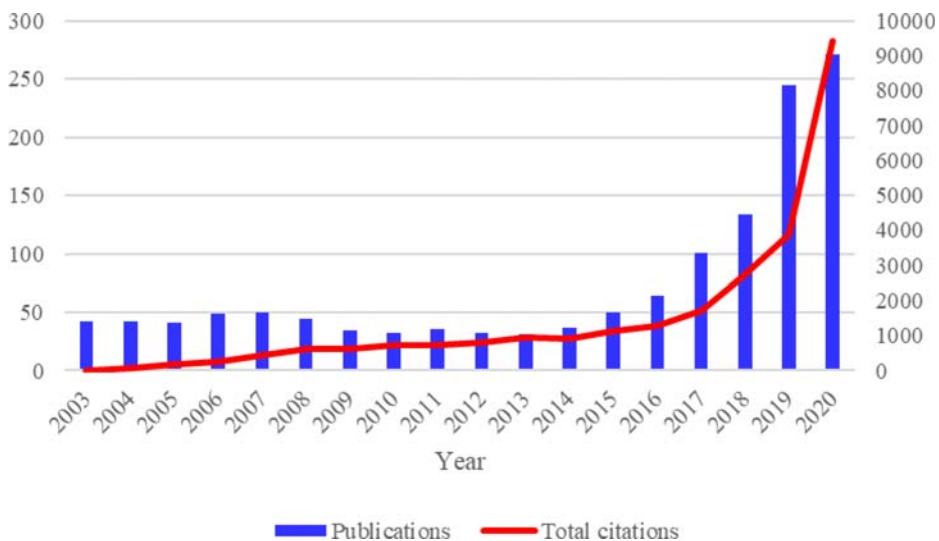

Figure 1. The publications and total citations trends from 2003 to 2020.

publications is not exceeded 50 before 2013, whereas the number of publications has steadily increased since 2013. In 2019, the number of literature in this field is 244. As of 31 December 2020, the total number of papers in the field is 1404, and the average annual number of articled published increases by 14.28%. Similarly, the time trend of total citations is also increasing year by year and the annual average citation pre year is 1473. This result expresses that more and more researchers and scholars are paying attention to this specific research field. At present, it is in its rising stage and there is great potential in this field.

4. Bibliometric analysis

In the information and digital era, scientific quantification and analysis of literature in a specific research field can help researchers quickly grasp the development of the field. Moreover, this function can track some specific information more accurately, such as the influence of the author, the distribution of publications. In general, *Gephi, VOSviewer, CitNetExplorer*, *Citespace, Connectedpaper* and *R* are the software for bibliometric analysis. This paper mainly uses *R* and *VOSviewer* for quantitative analysis and visualisation analysis of literature, respectively.

4.1 Author analysis

Table 2 shows the top 10 authors with the largest number of published papers in the field. The result presents that both Liu Y. and Wang Y., the authors with the highest amount of publication, have published 14 articles in this field, the rest of the top 10 authors have more than 9 papers on the whole. Most of these authors are from Asia, North America, and Europe. In the past 2 years, the number of related papers published in China has increased explosively. The reason may be the term of platform economy first appeared in the 2019 Chinese government's work report. Besides, Table 2 also suggests that because there are not many high productivity authors, this field is still in its developing stage.

To identify the influence of authors on green SCM and platform economy, this paper applies the dominance factor (DF) to sort the authors' influence in the field, as shown in Table 3. The DF is the ratio of the first-authored publications and multi-authored publications. In addition to the dominance factor, Table 3 also includes the number of single-authored, multi-authored, and first-authored published articles. In Table 3, Zhong is the most influential author, where he has four first-authored papers in this field. In his representative article, he researched that the Internet of things technology plays an important role in promoting the transformation and upgrading of logistics and sustainable supply chain management (Zhong et al. 2017). Besides, although Liu is the most productive author, his influence ranks 6 because he only has 3 first-authored articles in his 14 papers.

4.2 Sources analysis

The information of publications is extracted by R in the literature database, which is further analysed to obtain the top 10 sources of journals (Table 4). Those top 10 journals are almost related to the topic of sustainable development, green economy and environment, and supply chain management. In 1404 related articles, 57 papers are published in *Journal of Cleaner Production*, accounting

Table 2. Top 10 authors with most published papers

Author	Publications	Country	Institution
Liu, Yi	14	China	Fudan University
Wang, Yacan	14	China	Beijing Jiaotong University
Sarkis, Joseph	13	USA	Worcester Institute of Technology
Wang, Jun	13	Australia	Curtin University
Wang, Xiaojun	13	England	Bristol University
Gunasekaran, A	12	USA	University of Massachusetts Dartmouth
Chen, Yi-Chian	10	China	National Chung Hsing University
Huang, George Q	10	China	University of Hong Kong
Luthra, Sunil	10	India	Ch. Ranbir Singh State Institute of Engineering and Technology
Mangla, Sachin Kumar	9	India	Graphic Era University

Note: The author is not just the first author.

Table 3. Top 10 influential authors

Author	DF	Single author	Multiple authors	First author	Sort by Articles	Sort by DF
Zhong, Ray Y.	0.444	0	9	4	9	1
Wang, Jun	0.385	0	13	5	3	2
Gunasekaran, A.	0.333	0	12	4	6	3
Chen, Yi-Chian	0.300	0	10	3	7	4
Wang, Xiaojun	0.231	0	13	3	3	5
Liu, Yi	0.214	0	14	3	1	6
Wang, Yacan	0.214	0	14	3	1	6
Sarkis, Joseph	0.154	0	13	2	3	8
Mangla, Sachin Kumar	0.111	0	9	1	9	9
Luthra, Sunil	0.111	0	10	1	7	10

Table 4. The sources of publication.

Sources	Articles	IF2019
Journal of Cleaner Production	57	7.246
Sustainability	40	2.576
International Journal of Production Research	38	4.577
Supply Chain Management-An International Journal	34	4.725
International Journal of Production Economics	31	5.134
Production Planning & Control	31	3.605
European Journal of Operational Research	27	4.213
Industrial Management & Data Systems	25	3.329
IEEE Access	20	3.745
International Journal of Information Management	17	8.210

Note: IF is impact factor; data source: https://www.home-for-researchers.com/.

for 4.06% of the total number in this field. In this journal, the latest related articles discuss the potential of Industry 4.0 and Internet of things in improving economic, environmental, and social sustainability in supply chain management (Mastos et al. 2020). Besides, among these top ten journals, although *International Journal of Information Management* ranks lower in the light of publications, its impact factor is the highest (IF = 8.210).

Figure 2 depicts the spatial distribution of the publication's number in this field. In this paper, all countries or regions of published articles are coloured on this map. In this map, the lightest colour indicates the countries and regions that have not published articles or have one published article. The darker the colour, the more publications in this country or region. Obviously, China has the darkest colour in Figure 2, implying that China has come out with the most papers in this field, with 356 papers, accounting for 25.4%. The second is the USA, which published 175 related papers. Besides, some European and American countries (England, France, Italy, Spain and Germany) are second only to China and the USA, which shows their enthusiasm in this field. Other Asian countries (India) are also stepping up their efforts to explore the research direction. Unfortunately, South American countries, except Brazil, do not seem to be particularly interested in this direction at this stage.

4.3 Citation analysis

The number of citations is an important index to evaluate the influence. If an author or a country has a high number of citations, it is considered to play an essential role in this field (Hallinger and Chatpinyakoop 2019). Table 5 shows the top 10 most cited countries involving a total citation and
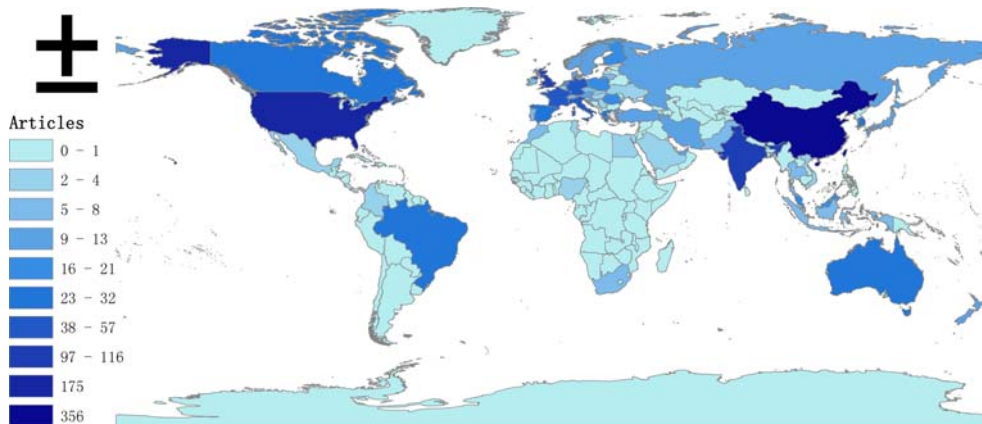

Figure 2. Spatial distribution of publications' number in all countries.

Table 5. Top 10 countries of total citation

Country	TC	AC
USA	9063	51.79
China	4276	12.01
England	2789	24.04
Italy	969	17.62
India	838	8.64
Netherlands	676	32.19
Spain	582	21.56
New Zealand	570	57.00
Greece	549	23.87
France	520	13.68

Note: TC is total citations; AC is average citations.

average article citations. The most cited country is the USA, with 9063 total citations and 51.79 average article citations. This indicates that the USA has not only explored this field for a long time (Figure. 2), its research results also have attracted the extensive attention of scholars. Also, although New Zealand is only 570 total citations, its average article citations are similar to that in the USA, which is 57. In all selected papers, Rai, Patnayakuni, and Seth (2006) published in the *MIS quarterly* (IF = 5.370) has proved popular (TC = 785). The paper explored that digital platforms play a key role in sustainable supply chain management and partnership and can bring performance benefits to enterprises. In addition, although the number of publications in China is the largest, its total citations are 0.5 times that of the USA. This result shows that China needs further strengthened in quality and the influence may have room for further development.

4.4 Keyword analysis

The keyword represents the main topic and idea of the article. The keyword analysis can summarise the overall characteristics of related articles in this field, reveal the internal relationship between those papers, and clarify the general research direction (Zhu et al. 2019). Therefore, the frequency of keywords in the 1404 papers is examined and ranked. The top 10 keywords are shown in Table 6. The most frequently used keywords are 'Supply Chain Management', 'Block-chain', 'Supply Chain', 'Circular Economy', and 'Internet of Things'. Although there is no direct emergence of the keyword 'Platform economy', block-chain technology, circular economy and IoT technology are a means and form of platform economy (Sutherland and Jarrahi 2018), which also reflects the research topic of this paper. Besides, 'Logistics' and 'Industry 4.0' are also featured as high-frequency keywords. In the digital and Internat age, logistic industry will usher in the opportunity period of platform economy development. Logistic economic platform relies on platform for resource integration to obtain more value space, so as to realise the sustainability of supply chain management.

Figure 3 exhibits the cumulative trend of the top 10 keywords plus that are used computer algorithms to extract from the title of references (Zhang, Yu, and Zhang 2020). Obviously, apart from

Table 6. Top 10 most frequent keywords.

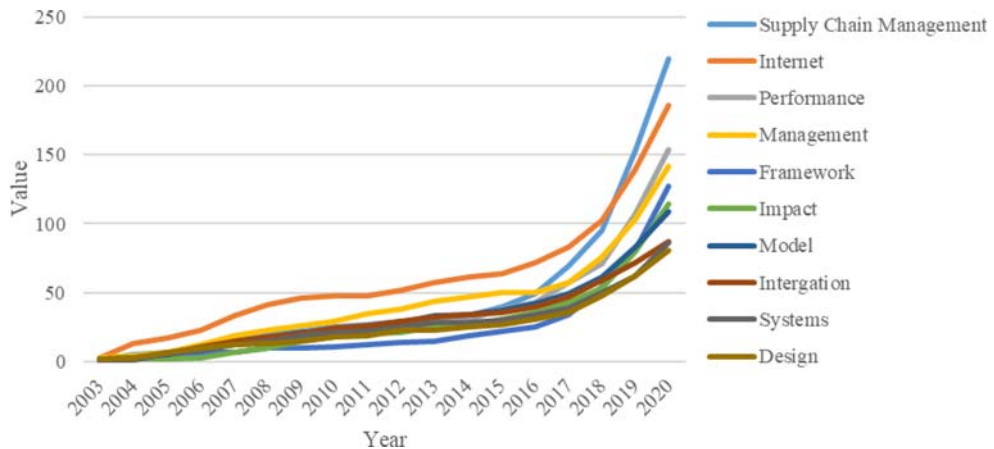| Keywords	No. of papers
Supply Chain Management	416
Block-chain	165
Supply Chain	149
Circular Economy	114
Internet of Things	108
Sustainability	78
Management	65
Internet	59
Logistics	55
Industry 4.0	53

Figure 3. The cumulative trend of top 10 keywords plus.

those keywords plus of 'supply chain management', 'Internet' and 'performance', 'management', and 'framework' appear most frequently in the title of the reference. The main reason is that it is in the developing stage. The main contributions of scholars are about the construction of the digital platform (Xiao, Kuang, and Chen 2020), the innovation of technology, performance improvement and integration of resources which has not reached a mature situation. This also requires scholars to explore the compatibility, network externality, and other issues between platform economy and supply chain management in the future.

5. Network analysis

Driven by big data and data visualisation technology, network analysis has become a scientific analysis tool to analyse the complex relationship among actors in various research fields (Su, Yu, and Zhang 2020). Network analysis regards all players as a system, rather than as an independent individual. At present, some software, such as *VOSviewer* and *CitNetExplorer*, can perform network analysis. *VOSviewer* is an available computer program designed by Van Eck and Waltman (2010) to construct and view bibliometric maps. This paper uses the software because it is apt to operate and build the relationship between knowledge units in an intuitive way.

5.1 Co-authorship analysis

Co-authorship analysis includes the analysis of the collaboration network of authors, institutions, and countries or regions. Due to cooperation between countries is the premise of other forms of cooperation, this paper analyses the cooperation network from the macro national level.

Figure 4 presents the analysis of countries' collaboration networks by *VOSviewer*. Each dot in the chart expresses a country or region, and each color represents a cluster. Clustering is the process of dividing a collection of physical or abstract objects into multiple groups composed of similar objects. The cluster generated by clustering is a set of data objects, which are similar to the objects in the same cluster and different from the objects in other clusters. When there is a co-authorship between scholars of two countries or regions, the nodes of two countries or regions will be connected by curves. The thicker the curve, the closer the communication and cooperation between the two countries or regions in this field. As shown in Figure 4, academic cooperation between countries is relatively close, and a complete international academic exchange system is being formed. In all countries or regions, China, the USA, and England seem to be the most involved
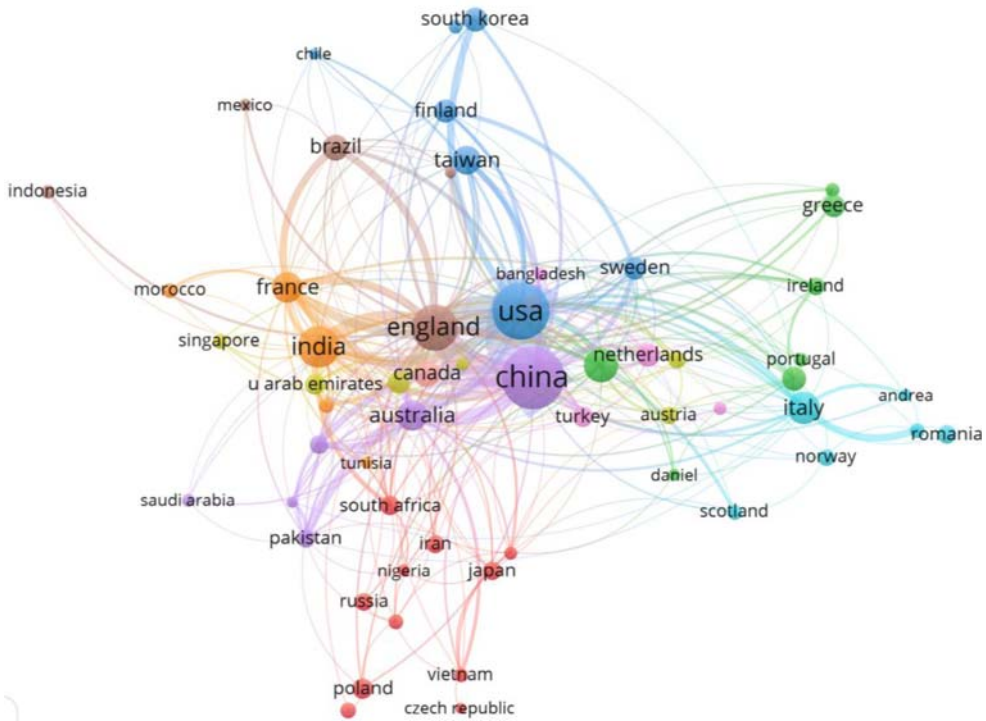
Figure 4. Co-country network.

in academic cooperation. Cooperation between the Netherlands, Greece, France and other European countries has also closely academic exchange. Moreover, the academic cooperation within Asian countries (e.g. India) and American and European countries are also relatively active, which implies that international cooperation is limited by its geographical location in the developing period of this field, to a certain extent. But that limit is weakening. From another perspective, the size of the nodes represents the number of publications in a country or region. This is consistent with the result in Figure 2.

5.2 Co-word analysis

Co-word analysis is proposed by Callon et al. (1983), which is mainly through the common frequency in the text of subject words and keywords to count the correlation strength. It can generate a complex network relationship between keywords by *VOSviewer*. The author keyword describes the main topic of an article, which is usually used to analyse emerging trends in research. (Zhang, Xie, and Ho 2010) First, the initial statistics are carried out on the collected information with *R* to achieve 3805 author keywords. Next, this paper sets the minimum of occurrences of a keyword 10, and 73 keywords were extracted. Last, the network map of the author keywords is depicted in Figure 5.

As shown in Figure 5, the cluster 1 (green) is the application of supply chain management in the business field and related management strategies under the Internet platform. Salvini et al. (2020) discuss how to strengthen the digital transformation of the virtual supply chain from Dutch floriculture. Mondal, Giri, and Maiti (2020) analyse the pricing and green strategy of the closed-loop green supply chain. The cluster 2 (red) is related research on the combination of circular economy and sustainable supply chain management. Bag and Pretorius (2020) analyse the relationship
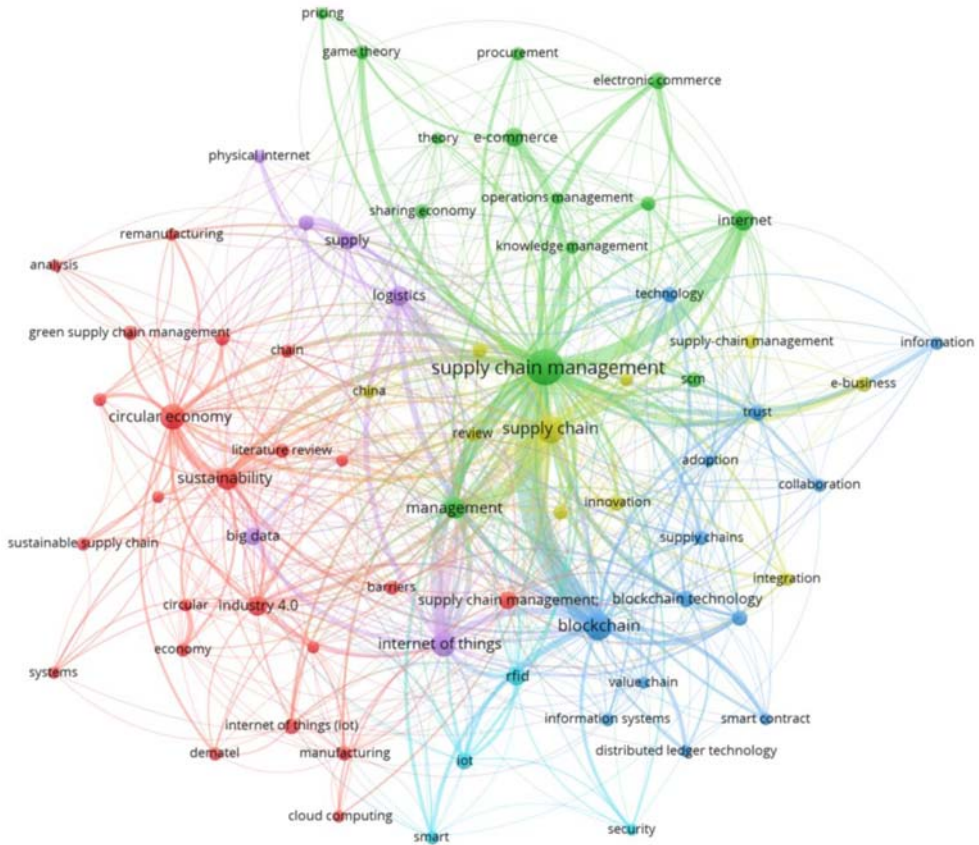
Figure 5. The network map of author keywords.

among industry 4.0, sustainable manufacturing, and circular economy in the context of digital revolution. Meherishi, Narayana, and Ranjani (2019) discuss the relationship between packaging and supply chain management in sustainable development and circular economy. Cluster 3 (blue) is the application of blockchain technology in supply chain management. Choi (2019) discusses different operation modes and emphasises the value of diamond certification platform supported by blockchain technology. Di Vaio and Varriale (2020) explore the impact of blockchain technology on operation management and study the decision-making process of SCM from the perspective of sustainable performance. Cluster 4 (yellow) is the issue of technology innovation, information sharing, and data integration in green supply chain management. Wei, Wang, and Lu (2020) investigate the optimisation strategy of information sharing of e-platform in the green supply chain. The cluster 5 (purple) is the application of Internet of things in logistics industry. Rejeb et al. (2020) summarise the research progress of IoT in the field of supply chain management and logistics and point out the existing knowledge gap. The cluster 6 (Cyan) is the security of Internet technology, including RFID, Internet of things technology, and so on. Boiko, Shendryk, and Boiko (2019) research the uncertainty, risk, and cyber security of supply chain management information systems.

Therefore, we can see that there are several directions worthy of research. On the basis of the Internet platform, the application of supply chain management in the business field and related management strategies are the hottest topics. Various fields are exploring ways of digital transformation. Relying on sharing economy, circular economy, blockchain technology, Internet of things technology, and other means to achieve the sustainability of supply chain management. In addition,

technological innovation, information sharing, and other issues under the platform economy is also an essential direction, which is the guarantee to realise the sustainability of the supply chain. However, according to the existing literature, the application direction of Internet of things technology in the logistics industry needs to be further explored. In the Internet platform, the risk and security of supply chain management information systems is a more concerning problem. How to solve this problem still requires further research and deepening.

5.3 Co-citation analysis

Co-citation is put forward by Small (1973), which measures the similarity between two co-cited papers. With the later development, the co-citation analysis of author and journal also emerges as the times require. This section mainly analyses co-citation from the perspective of authors and journals.

From the perspective of co-citation authors, to select influential and highly cited papers, this paper makes the following setting. First of all, 35,633 authors are extracted from 1404 existing literature in this field. Secondly, this section only stipulates that the minimum number of citations for a cited author is 30. Finally, 165 authors are selected from those authors, which are formed to the co-citation analysis chart (Figure 6). Different colours in Figure 6 indicate different groups, and 65 authors are divided into four clusters. The larger the label area is, the more times the authors are cited. Unsurprisingly, the paper of Zhu, Q has been cited the most, with 269 times, which plays an essential role in the development of this field. The paper, published in the *International Journal of Production Research*, reviewed the relationship between production management and environmental sustainability (Sarkis and Zhu 2018).

From the perspective of co-citation sources, this paper describes the co-citation network of cited journals (Figure 7). For simplicity, we set the minimum number of co-citation journals as 30, and 284 journals are selected to establish the network relationship. Clearly, the *Journal of Cleaner Production* is the most-cited journal and has the most extensive influence (the number of citations is 3484). Besides, the effect of *International Journal of Production Economics* (2081 citations), *International Journal of Production Research* (1608 citations) and *Journal of Operations Management* (1132 citations) can not also be substituted.

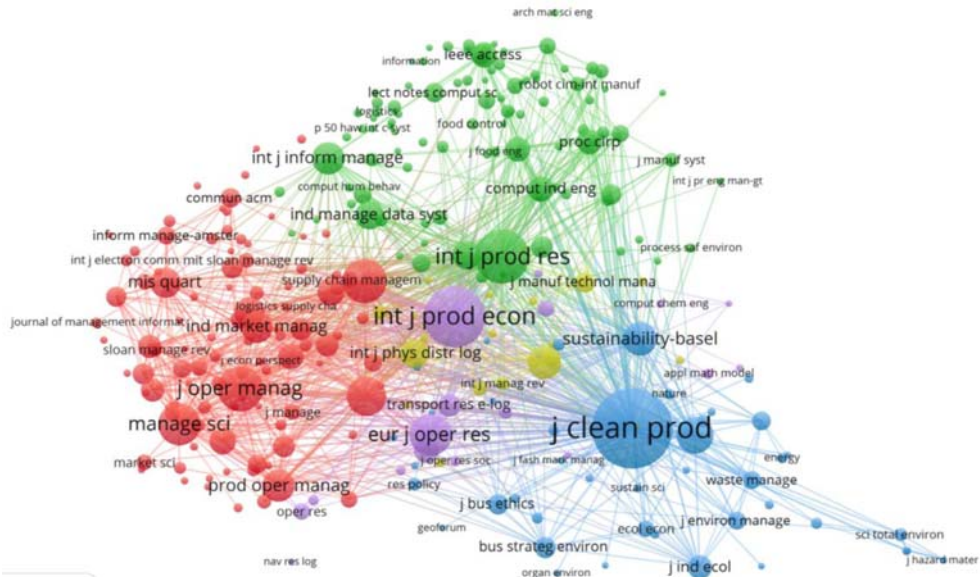**Figure 6.** The cited authors' co-citation network.

Figure 7. The cited sources' co-citation network.

6. Conclusion and discussion

Green supply chain management has become the most concerned issue all over the world. With the practice of platform economy in some specific field, the research of combining platform economy and green supply chain management is a novel emerging area in recent years, which pays attention to interested researchers. In the paper, a total of 1404 papers about green SCM in the platform are collected in *Web of Science*, and the bibliometric analysis and network analysis are carried out by *R* and *VOSviewers*, respectively.

This research shows that, in terms of the number of publications, the study level of the application of supply chain management in the platform economy is constantly improving. Moreover, since 2003, the total citations has increased significantly. The author analysis shows that Zhong is the most influential author in this field on the basis of the DF value. Besides, China is an essential contributor to the literature of supply chain management in the platform economy, with the largest number of publications (356), followed by the USA (175) and England (116). However, China's total citation is 0.5 times that of the USA, which indicates that the influence of China in this field may have room for further development.

The research also finds that ten primary journals, namely *Journal of Cleaner Production*, *Sustainability*, *International Journal of Production Research*, *Supply Chain Management-An International Journal*, *International Journal of Production Economics*, *Production Planning & Control*, *European Journal of Operational Research*, *Industrial Management & Data Systems*, *IEEE Access*, and *International Journal of Information Management*, account for about 22.8% of the total journal papers. From the perspective of keyword analysis, the research focused on sustainable development, blockchain technology, circular economy, Internet of things, and so on. This shows that this topic is an emerging multidisciplinary research field based on Internet technology and supply chain.

The cooperation analysis of countries shows international cooperation has not yet been fully formed. At present, most of them are inter-regional cooperation, which is limited by their geographical location to a certain extent. Therefore, efforts need to be made to encourage more cooperation among researchers from different regions to solve related problems in this field.

This may be of great help to developing countries with a low level of technology and no clear understanding of issues related to green and sustainability.

The co-keyword analysis that there are several hot topics in the field of GSCM-PE. First, the application of supply chain management in the business field of Internet platforms and related management strategy research. Second, relying on circular economy, blockchain technology, Internet of things technology, and other means, how to realise the sustainability of supply chain management. Third, technological innovation, information sharing, and other issues in the platform economy. Of course, there are still some deficiencies and gaps in the research direction. First, on the basis of the existing literature, the direction of the application of Internet of things technology in the logistics industry remains to be explored. Second, in the Internet platform, the risk and security of supply chain management information system is a more concerning problem, how to solve this problem still needs further exploration and deepening.

In addition, China is the most productive country in the research field of green supply management in platform economy, because the term 'platform economy' first appeared in the Chinese government work report in 2019. Platform economy not only plays an essential role in supply chain management but also can promote the development of economy towards a more refined direction. This also clearly shows that the platform economy and supply chain management are coming into the public's sight.

In view of those issues, we can also draw the following policy implications. First, the government can strengthen the promotion of supply chain innovation and improve the efficiency of platform economy in supply chain management. Second, it can actively encourage and enhance the international cooperation of supply chain to promote common development. Lastly, the government can also legislate on the security issues of supply chain management in platform economy and govern them from the source.

Even though this study reveals several overall characteristics of research in this field, it still has some limitations. The only Web of Science database is used, and merging with other databases is not considered. Such as the co-occurrence of keywords is difficult to capture all the information of literature. Furthermore, based on the above keywords, some related literature may be omitted in the search process.

As will be readily seen, research in green supply chain management under the platform economy stays in its developing stage. There are still abundant issues and directions for scholars to continue exploring in the future.

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