Green Supply Chain Management in Research Trend: Bibliometric Analysis Study

Kusmendar[1*], Dyah Ari Susanti[1], Bimo Sunarfri Hantono[2], Atik Febriani[3], Nada Iman Muvidah[1]

[1]*Industrial Engineering Program, Universitas Sarjanawiyata Tamansiswa, Indonesia*
[2]*Electrical Engineering and Information Technology, Universitas Gadjah Mada, Indonesia*
[3]*Industrial Engineering Program, Institut Teknologi Telkom Purwokerto, Indonesia*
**Corresponding author: kusmendar@ustjogja.ac.id*

ABSTRACT
Impact on the environment has become an essential obligation for every company, both in products and services. Inter-supply chain management has transformed in responding to the need to pay attention to environmental impacts into environmental management in line with sustainable development goals (SDGs) called green supply chain management (Green SCM). Green SCM has been widely applied to large industries, but it is still a new thing for small and medium industries and lacks information about the concept and its application. This study explores the published Green SCM indexed in the Scopus database. We conducted a bibliometric analysis of 1,776 Scopus indexed documents from the first year of 1996 to determine the progress of GSCM research. Research trends and keywords that are still relevant and emerging have been explored and explained. Research gaps that require follow-up have been identified, and future research directions have also been discussed.

Keywords: *green supply chain management, bibliometric, reserch trend)*

1. INTRODUCTION

The supply chain generally collaborates to meet market demand by coordinating from the upstream industry to the downstream industry. Industries coordinate work from raw materials to products to consumers. The purpose of supply chain coordination is to increase supply chain efficiency with organizational effectiveness by distributing products and services to consumers at low costs and as soon as possible[1]. In general, supply chain management tends to focus on costs and regulation of finished products. Still, it barely addresses the environmental impact, giving rise to the concept of sustainability called green supply chain management (GSCM). The GSCM concept aims to integrate environmental issues into supply chain management which refers to efforts to deal with the environment[2].

The role of Supply Chain in the product and service industry cannot be separated from the impact on the environment, so competition has succeeded in overcoming environmental problems. The emphasis on industrial sustainability concerning the environment is mainly carried out by developing strategies to reduce the environmental impact of products and services. There are many publications published on green supply chain management, both literature reviews and research results in the field, but this green supply chain is growing[3]. The relevance of previous research with current research continues to grow, so new research is needed to update research related to bibliometric analysis. The bibliometric analysis demonstrates the evolution of influential and contributing articles in the field by further mapping the relationships among higher impact but unfinished analytical and objective works[4].

Bibliometric analysis of Green Supply Chain Management has been carried out by Fahimnia et al. (2015)[4], Mishra et al. (2017)[5], Maditati et al. (2018)[6], (de Oliveira et al. (2018)[7], Balon (2020)[8], Carvalho et al. (2020)[9], dan Choudhary & Sangwan (2022)[3] but have not analyzed the thesaurus keyword approach to remove the duplication of meaning or meaning of keywords that refer to the same concept[10]. In this study, the thesaurus is used for processing using VOSviewer.

The research question is what keywords are still emerging and relevant to research now and in the future. This study aims to identify keywords expected to be used to explore future Green Supply Chain Management research. Although many bibliometric analysis studies have been carried out by combining literature reviews, there has not been much emphasis on the thesaurus, even though this thesaurus is essential to minimize errors in identified keywords when using VOSviewer software.

2. METHODS

This study uses bibliometric citation and content analysis techniques to analyze the GSCM literature from relevant keywords established and eligible for future research on major GSCM topics. The research methodology has been adopted by Maditati et al. (2018)[6]. Still, the database used was sourced from the Scopus database on April 4, 2022, as shown in Figure 1. The search term used was 'green supply chain management' in the article title, abstract, and keywords within a time frame of 1996 to 2022. Finally, 1,776 documents have been retrieved from 1,851 documents after filtration. The VOSviewer application is used to build a co-occurrence keyword network map[11].

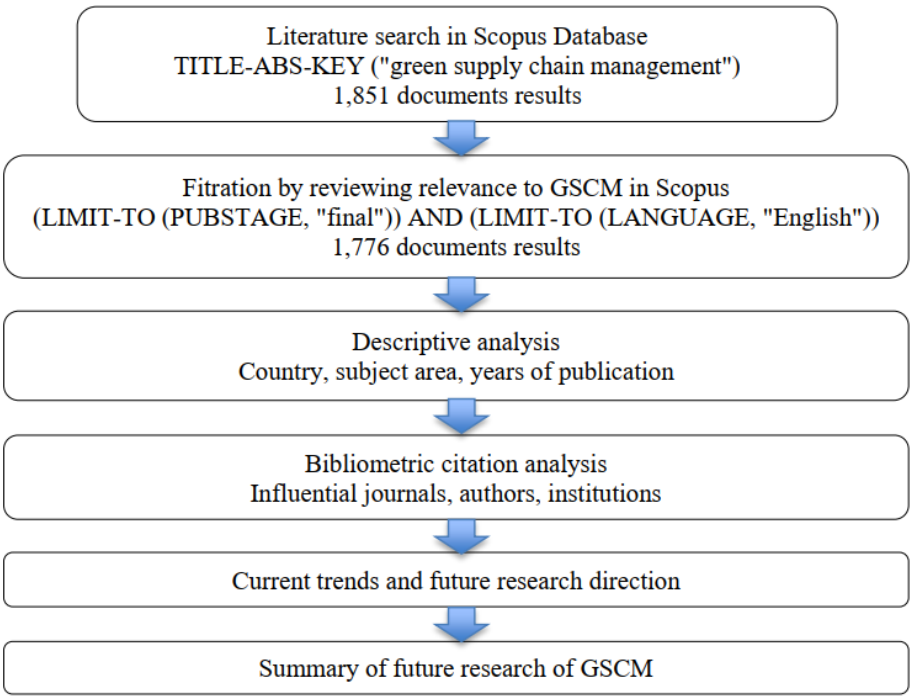

Figure 1. Methodology research

3. RESULTS AND DISCUSSION

Descriptive Analysis

In Table 1, China has the highest publication of documents related to the topic of Green Supply Chain Management, followed by India, the US, the UK, and Malaysia in the top 5. The number of publications in China is almost double the number in India, three times in the US, four times in the UK, and Malaysia, which means much research has been carried out in China to other countries. Publications in China can be considered more experienced and can then be used as a reference for future research references. The subject area of publication in table 2 shows that GSCM is mainly in the category of Business, Management and Accounting, followed by the field of Engineering and the field of Environmental Science. GSCM emphasizes a lot of environmental impacts, but Environmental Science is not the main publication area. It shows that research publications on GSCM are mainly in the field of management itself, followed by the field of Engineering. Journal of Cleaner Production as a publishing institution has the highest number of publications whose value is

almost two times the second largest in Sustainability Switzerland, as shown in Table 3. The number of publications based on publishing institutions is not limited to journals; all publishing institutions are identified as publishing institutions about GSCM.

Table 1. Number of documents in gscm (1996-2022)

Country	n documents	Country	n documents	Country	n documents
China	434	Australia	54	United Arab Emirates	29
India	276	Italy	47	Viet Nam	22
United States	191	South Korea	45	Saudi Arabia	20
United Kingdom	126	Turkey	45	Spain	20
Malaysia	125	Pakistan	41	Jordan	19
Taiwan	117	Denmark	40	Greece	18
Iran	91	France	39	Morocco	18
Indonesia	83	Canada	37	Poland	18
Brazil	74	Germany	33	South Africa	18
Thailand	56	Hong Kong	30	Bangladesh	17

Table 2. Number of subject area document in gscm (1996-2022)

Subject Area	n documents	Subject Area	n documents
Business, Management and Accounting	922	Agricultural and Biological Sciences	30
Engineering	752	Earth and Planetary Sciences	28
Environmental Science	438	Physics and Astronomy	18
Decision Sciences	434	Multidisciplinary	12
Computer Science	420	Arts and Humanities	11
Social Sciences	255	Biochemistry, Genetics and Molecular Biology	11
Energy	243	Chemistry	11
Economics, Econometrics and Finance	171	Psychology	7
Mathematics	126	Pharmacology, Toxicology and Pharmaceutics	3
Materials Science	45	Health Professions	1
Chemical Engineering	35	Neuroscience	1
Medicine	35		

Bibliometric Analysis

Bibliometrics is a method of statistical analysis of published articles and their citations to measure their impact[6] in the field of research based on author and institutional characteristics[5]. Using thesaurus in bibliometric analysis using VOSviewer aims to combine keywords with the same general meaning as the representing keywords so that keywords with the same meaning do not appear separately and are recognized as other keywords. This step is to minimize the repetition of keywords that have the same meaning but appear and are recognized as other keywords so that they have an impact on their occurrence. Analysis using VOSviewer from 6149 keywords to 692 keywords.

Keywords Analysis

The results of the network map of the relationship between keywords from VOSviewer can be seen in Figure 2 and Figure 3. Figure 2 produces six large clusters of keywords: environmental management (32 keywords), green supply chain (30 keywords), and decision-making (22 keywords).), management practices (28 keywords), performance measurement (16 keywords), and aspects (3 keywords). Figure 3 shows the

research keywords based on the year of publication from dark to light, meaning that the more muted the color is, the more up-to-date the keywords in the study are.

Table 3. Top 10 of publication source title in gscm (1996-2022)

Journals	n documents
Journal Of Cleaner Production	120
Sustainability Switzerland	69
International Journal of Supply Chain Management	58
International Journal of Production Economics	36
International Journal of Logistics Systems and Management	33
Benchmarking	23
Business Strategy and The Environment	23
International Journal of Production Research	23
Uncertain Supply Chain Management	19
Resources Conservation and Recycling	18

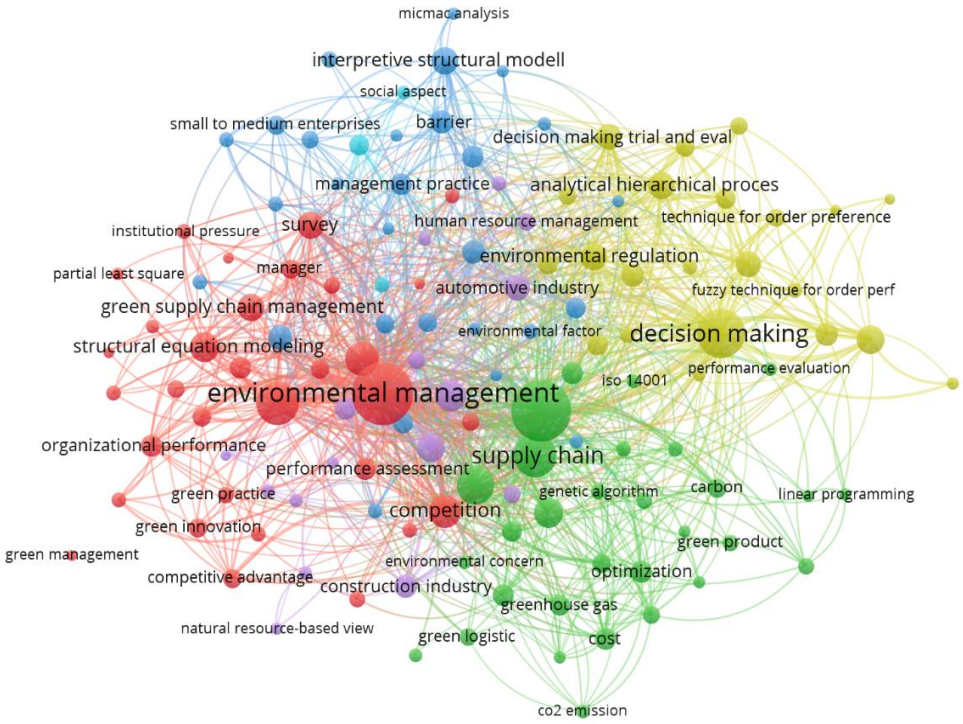

Figure 2. Network visualization of GSCM studied based on keywords co-occurrence analysis

Enhanced Strategic Diagram (ESD) was developed by Othman et al. (2022), which represents centrality (x-axis), density (y-axis), and time in a three-dimensional plane (z-axis). Centrality describes the total link strength, density describes the occurrence, and time in the three-dimensional plane or the average year of publication describes the novelty[11].

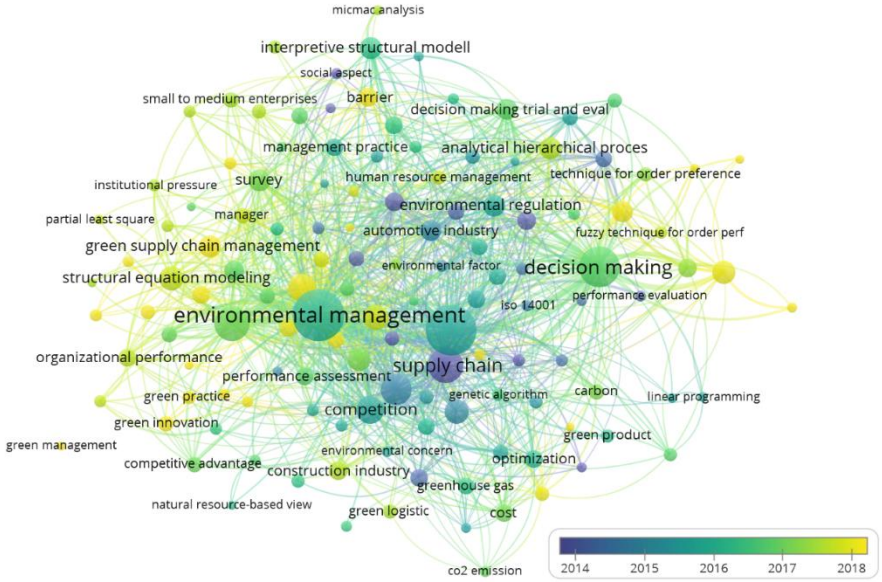

Figure 3. Temporal overlay on keywords GSCM co-occurrence map

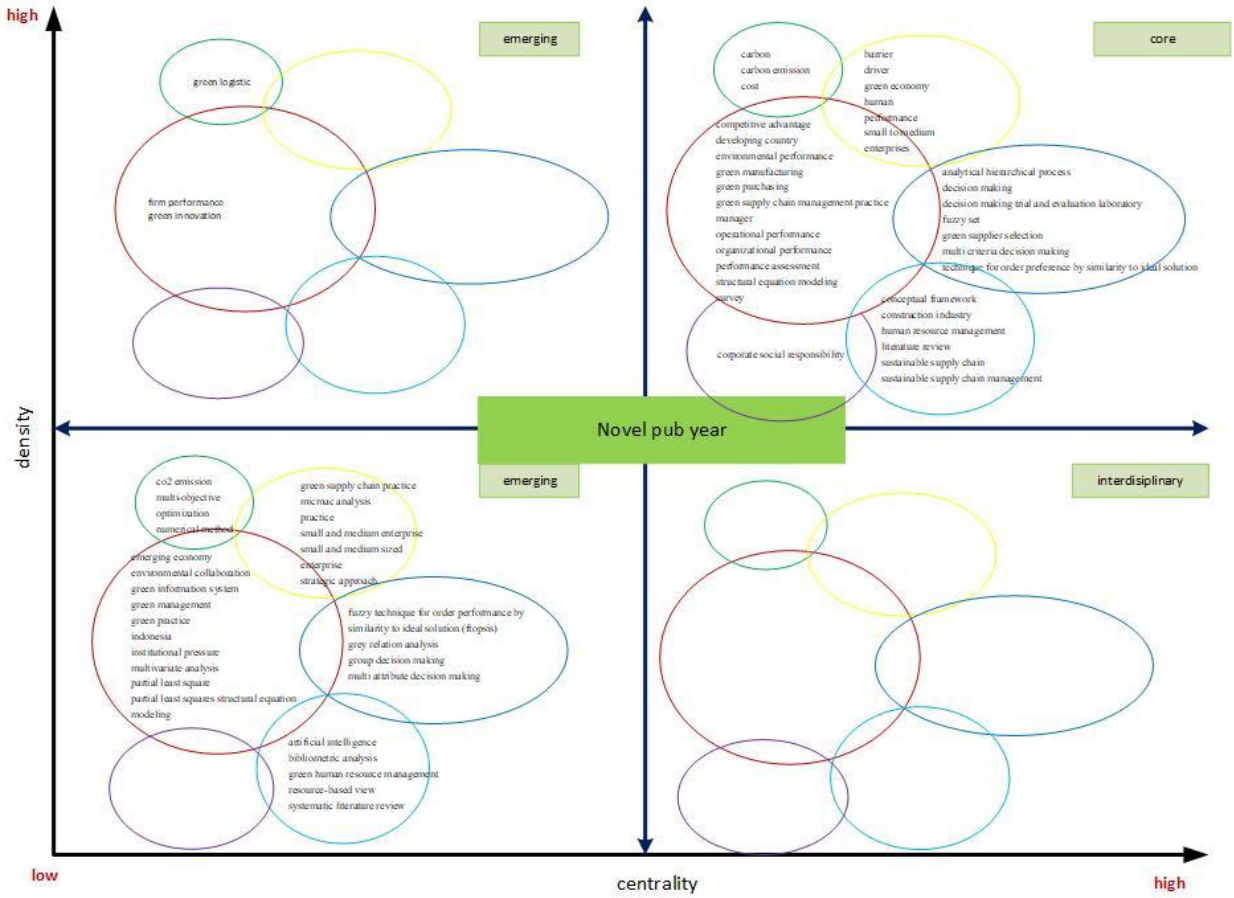

Figure 4. Novel publication year diagram

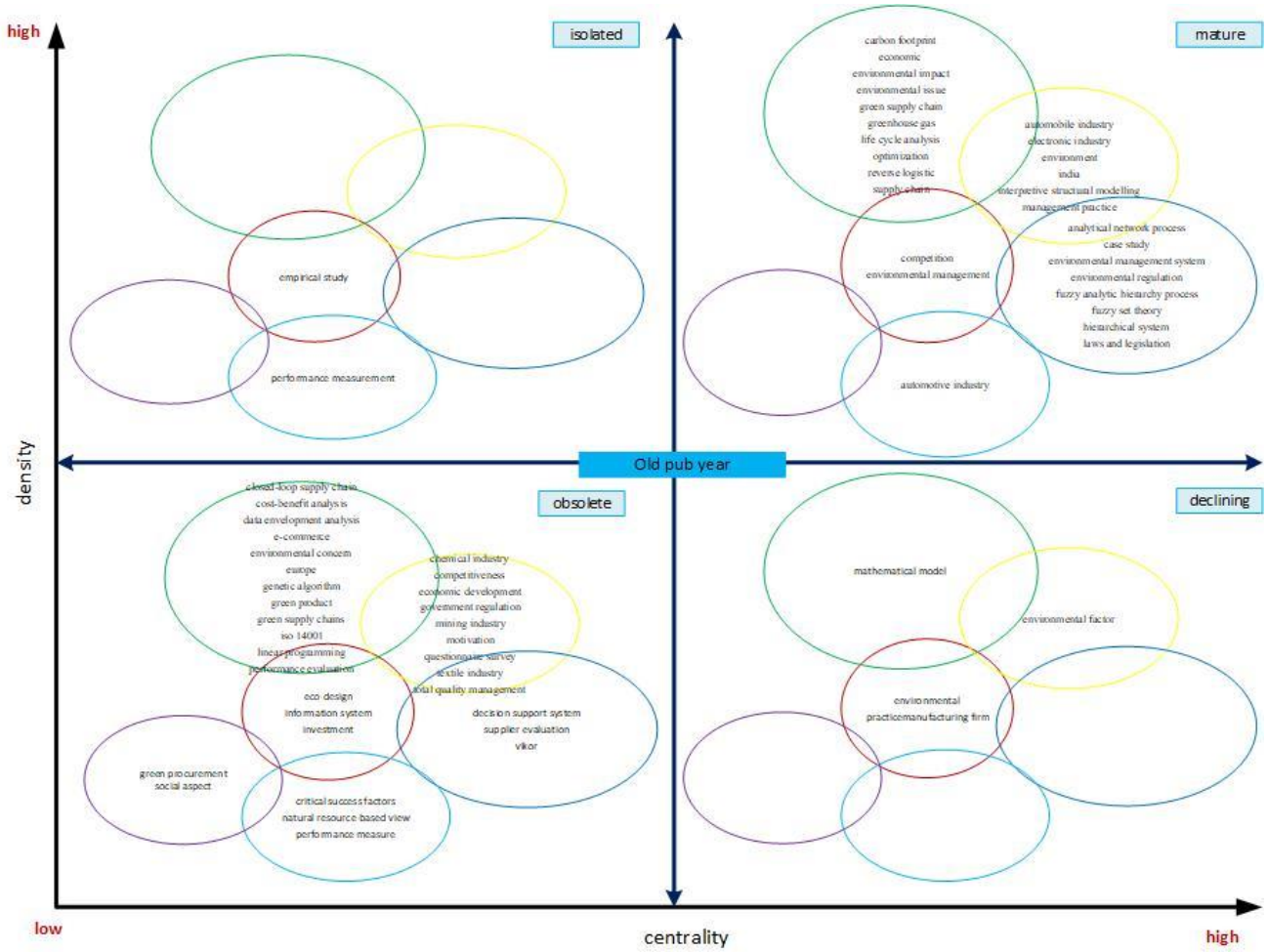

Figure 5. Old publication year diagram

Figure 4 shows a data diagram consisting of 4 quadrants, and what is of concern is the core quadrant with indicators of high centrality and high density. This quadrant shows research keywords that are still relevant and are still widely used in current research, and can be used as references for future research topics. Keywords in the core quadrant consist of 6 clusters, cluster 1 (competitive advantage, developing countries, environmental performance, green manufacturing, green purchasing, green supply chain management practices, managers, operational performance, organizational performance, performance appraisal, structural equation modeling, surveys), cluster 2 (carbon, carbon emissions, costs), cluster 3 (barriers, drivers, green economy, people, performance, small and medium enterprises), cluster 4 (hierarchical analysis processes, decision making, decision-making trials, and evaluation laboratories, fuzzy sets, green supplier selection, multi-criteria decision making, techniques for order preference based on similarities with ideal solutions), cluster 5 (conceptual framework, construction industry, human resource management, literature review, sustainable supply chain, sustainable supply chain management), and cluster 6 (corporate social responsibility). Relevant research keyword sequences were carried out for future all quadrants on the novel publication diagram (figure 4). However, the number 5 is relevant for future research only in the mature quadrant, while the other quadrants are starting to be abandoned due to decreased centrality and density.

4. CONCLUSION

This research results in keyword grouping based on total link strength, density/centrality, and novelty. Each cluster is part of an enhanced strategy diagram quadrant. However, this study has limited analysis that has not been carried out and can be a suggestion for further research. The analysis is about keyword clustering in

VOSviewer to find research insights. The data in this study is also only sourced from the Scopus Database, so there is an opportunity to add other database sources and enrich research subject references in bibliometric analysis.

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