Green Supply Chain Collaboration: A Systematic Literature Review and Bibliometric Analysis

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***Abstract*— Green supply chain collaboration (GSCC) is an important enabler for the successful implementation of green supply chain management (GSCM). This article aims to systematically review the current knowledge structure in the GSCC field and suggest directions for a new research agenda. A systematic literature review and a bibliometric analysis are employed to evaluate 1,462 articles from five databases. After eliminating unrelated articles, 100 were classified on the basis of content analysis and a subsequent citation network analysis performed using Pajek software. The results align with those of supply chain collaboration - information sharing, decision synchronization, and incentive alignment [1]. In accordance with the results, five research directions are outlined for future research in the GSCC field. With the findings from this current review, researchers and scholars in the fields of Green Supply Chain can expand the knowledge and add more concrete findings to advance the field.**

***Keywords*—** *Green supply chain collaboration; Green supply chain; Sustainability; Systematic literature review; Bibliometric analysis.*

1. Introduction

Concern for the environment is one of the most critical issues for enhancing or diminishing a firm's competitiveness in the global market [2]. Green supply chain management (GSCM) incorporates environmental concerns into business activities [3]. It was found that the stronger the supply chain integration, the more likely the environmental management [4]. They also found that collaboration between suppliers and customers on environmental practices improved manufacturing performance [5]. Essentially, the effective execution of GSCM requires collaboration with both internal and external members, giving rise to the concept of green supply chain collaboration (GSCC) [6].

The previous literature demonstrated that companies in the UK and other countries view collaboration to provide a greener supply chain as a key factor in driving companies toward competitiveness and stakeholder satisfaction [7]. Collaboration within green supply chain is crucial and firms seek partners, (often suppliers) to access green technology, green material or green knowledge from their network [8], [9]. It is commonly acknowledged that being collaborative will enhance a firm's supply chain capability.

While the importance of GSCC is clearly recognized and previous relevant literature can be found on the subject, systematic literature reviews are lacking on the concept [10]. The majority of reviews focus on SCC [11], [12] or GSCM [13], [14] rather than GSCC specifically. The most relevant literature review on SCC sustainability was conducted by [15]. That said, this current review looks much more deeply into the area of environmental collaboration in supply chain. In addition, this review employs citation analysis to add further insight into how the GSCC concept is evolving and paving the way for future direct research. This article aims to identify the current research structure and knowledge gap and provide an agenda for the direction of future research to enrich the knowledge of GSCC by answering the following questions:

1. What are the current research streams in the GSCC field?
2. How is the concept of GSCC evolving and are there any knowledge gaps in the development of insightful implications for the direction of future research on GSCC?

In order to do so, a systematic literature review (SLR) and bibliometric (citation) analysis are

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employed to synthesize the findings in previous literature to move toward specific research in the field [16].

2. Methods

2.1 Systematic literature review (SLR)

This article adapts the SLR method from the past literature [17] whereby keyword searches are employed to identify articles published between 2000 and 2019 in five databases: Scopus, ABI, EBSCO, Springer, and Science Direct. Initial keyword searches are performed using terms from three areas, namely supply chain, collaboration, and green (Table 1.). The method of article selection divided into three steps [18].

2.1.1 Step 1

Initial keywords are combined from the three areas indicated in Table 1. The combined keywords are created using "and" and "or" during the search to ensure that the coverage as many relevant areas as possible. Titles and abstracts are selected in the search for objective articles. Only peer-reviewed articles are selected so as to ensure quality [19]. The language is set only for publications in "English," with 1,462 articles located in total.

2.1.2 Step 2

Titles and abstracts are read and screened during the first step and articles outside the research scope removed from the list. For example, articles passing through step 1 containing keywords such as "sustainable" AND "supply chain" AND "link" falling out of the area are removed from the list, with 325 articles in total being identified.

2.1.3 Step 3

Entire articles are read to justify whether they should be kept for further analysis or eliminated. The researcher thoroughly read all the articles from step 2 to ensure either relevance to the research area of GSCC, before finally selecting 100 articles.

2.2 Bibliometric analysis

Researchers use bibliometric analysis for two main reasons [20]. Firstly, it is used in performance analysis to evaluate the research and publication performance of individuals and institutions. Secondly, it is used in science mapping to identify the structure and explain scientific progress. Narrative literature reviews are often subject to bias by the researcher and regarded as less rigorous [21]. Bibliometric analysis incorporates a rigorous, quantitative, systematic, transparent, and reproducible review process into the evaluation of previous literature to provide proof of the findings.

Table 1. Search strings and keywords

Green Keywords:
(green) OR (green supply chain) OR (green supply chain management) OR (waste management) OR (eco-efficiency) OR (reverse logistics) OR (environment) OR (environmental impacts) OR (emissions) OR (energy efficiency) OR (ecology sustainability) OR (sustainable)
AND
Supply Chain (SC) Keywords:
(supply chain) OR (supply chain management) OR (value chain) OR (supply chain integration) OR (supplier integration) OR (customer integration) OR (buyer-supplier relationships) OR (information technology)
AND
Collaboration Keywords:
(collaboration) OR (support) OR (help) OR (mutual) OR (aid) OR (association) OR (relationship) OR (alliance) OR (cooperation contact) OR (interface) OR (relation) OR (communication integration) OR (incorporation) OR (assimilation alliance) OR (pact) OR (treat) OR (agreement) OR (coalition) OR (aggregation) OR (joint enterprises) OR (connection) OR (affiliation) OR (link)

Science mapping is used in this article since it provides a combination of field classification and visualization [22] and can examine how the dimensions of GSCC and individual articles relate to one another [23]. In this study, citations are divided into different groups to create a visual representation of the classified results.

Among five methods of bibliometric analysis, citation is the most popular [16]. Citation analysis or citation network analysis (CNA) involves the examination of frequency, patterns, and graphs of citations in documents [24]. The citation pattern is created using links from one document to another, revealing their proper-ties and forming lists of the most cited studies, authors, or journals in the area under examination. For this current review, a network of the most cited authors is displayed and used to measure the influence of a heavily cited

article. Specifically, citation network analysis enables researchers to identify key articles, methods of study, and scholars who have had an impact on shaping the field [25].

Once the article retrieval process is completed, each article is assigned a number between one and 100, which is then recorded to create the structure of a citation matrix. An image of the article matrix is produced by Pajek software and a visual representation created of the citation [25].

2.3 In-degree and closeness centrality in network

Pajek also provides centrality scores, referring to the number of times an article is cited by other articles or authors and for use in an objective comparison of the study. There are two types of centrality scores: in-degree and out-degree [24], whereby in-degree centrality scores represent how many other articles have cited a specific article while out-degree centrality scores show the number of articles cited by a specific article. This current review focuses only on in-degree centrality scores, suggesting the level of importance within a particular network.

Table 2. Collaboration dimensions

Dimensions	Definition
Information sharing	The extent to which a firm shares a variety of relevant, accurate, complete, and confidential information in a timely manner with its supply chain partners [30], [31].
Decision synchronization	The process by which supply chain partners orchestrate decisions in supply chain planning and operations to optimize supply chain benefits [32].
Incentive alignment	The process of sharing costs, risks, and benefits among supply chain partners [1].

Moreover, this current study looks at closeness centrality which relies on the length of the path from one node to all others in the network, defined as the inverse total length [27]. It describes the extent of node influence on the network [28]. In addition, this study also identifies the most cited articles and the citation structure surrounding each dimension of collaboration within the green supply chain in the literature. There-fore, CNA is finally analyzed and compared based on the three dimensions of the supply chain collaboration index, namely information sharing, decision synchronization, and incentive alignment [1]. As [29] pointed out the importance of evaluation of supply chain collaboration because it will help identifying and improving the areas that may need improvement within collaborative supply chain. Thus, three dimensions suggested by [1] will be applied in this study.

3. Results

3.1 Descriptive statistics by year of publication

Figure 1 shows that research in the field of GSCC is gradually growing from one published article in 2000 [33] to 11 in 2013, extending to 13 in 2017, and increasing dramatically to 20 articles in 2018. At the beginning of 2019, six articles were published, demonstrating that research related to GSCC issues is under expansion.

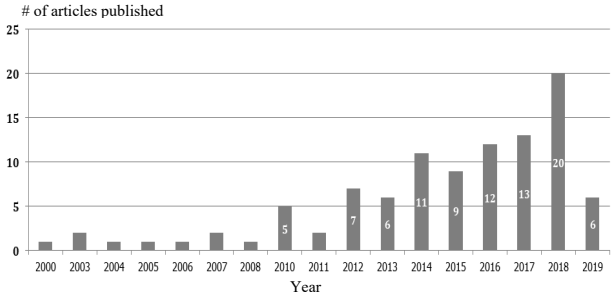


Figure 1. Number of articles published by year

3.2 Descriptive statistics by industry sector

Table 3 summarizes the type of industries and countries in which GSCC was studied. The majority of articles in the area of GSCC cover multiple manufacturing industries (20 articles), with 12 articles covering multiple manufacturing and service, and electrical equipment, respectively. Most articles fall into the electrical equipment manufacturing sector (12), food (5), automotive (4), package printing (4), chemical (2), steel (2), and textile and clothing (2), whereas only two relate to the service sector and others such as transportation, storage and communication (5), and wholesale and retail trade (3) (in black). In terms of country, Taiwan (11) is the most studied, followed by China (6) and the USA (5).

3.3 Descriptive statistics by journal

The number of papers published in each journal was calculated to examine the influence of each journal in the field of GSCC (see Table 4.). The 100 articles selected were published in 55 journals,

Table 3. Number of articles published by industry and country

Types of indutries	Countries														
	Taiwan	China	USA	India	Korea	UK	South Africa	Brazil	Canada	Malaysia	Turkey	Other	Multiple	N/A
Multiple manufacturing (20)		2		3	3	1	1	2	1	1	1	3	1	1
Multiple manufacturing & service (12)	1	3	2									1	2	3
Electrical Equipment (12)	8	1			1				1		1			
Food (5)												3	1	1
Transport, storage and communications (5)	2		1			1				1				
Automotive (4)				1								1	2	
Package Printing (4)			1										3	
Wholesale and retail trade (3)						1								2
Chemical (2)			1			1								
Steel (2)							2							
Textile & Clothing (2)												1	1	
Total by Country	11	6	5	4	4	4	3	2	2	2	2	9	10	7

with the top three being the International Journal of Production Economics in which 10 articles were published between 2008 and 2018, Journal of Cleaner Production Economics with nine articles published between 2003 and 2016, and the Benchmarking and International Journal of Production Research in which six articles were published equally between 2010 to 2019 and 2007 to 2016, respectively.

Table 4. Descriptive statistics by journal

Journal Names	Publish Year										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
International Journal of Production Economics				1			1	2	2	3		10
Journal of Cleaner Production					1	1	1	4				9
Benchmarking		1		1						3	1	6
International Journal of Production Research				2		1		1				6
Resources, Conservation and Recycling										2	2	4
Transportation Research Part E: Logistics and Transportation Review					1	2	1					4
Computers & Chemical Engineering				1						1	1	4
Sustainability (Switzerland)						1	1	1				3
Business Strategy and the Environment			1							1		2
Industrial Management & Data Systems										2		2
International Journal of Logistics: Research & Applications										2		2
International Journal of Operations & Production Management							1					2
International Journal of Physical Distribution & Logistics Management							2					2
Procedia CIRP							1	1				2
Production Planning and Control									2			2
Supply Chain Management					1					1		2
Others	4	1	1	3	6	1	3	9	6	2	38	

3.4 Descriptive statistics by article type

Table 5 classifies the 100 articles into four types: conceptual, empirical, analytical, and applied research (Kaur & Singh, 2016). The majority of published articles fall into the area of empirical research (53%) with a number of studies focusing on identifying the factors affecting GSCC [4], [34], [35], [36]. Moreover, some of the empirical research involves the factors impacting on GSCC performance [37], [38]. Conceptual re-search is the second most popular article type on GSCC (23%) with some research addressing problems and pressures in relation to GSCC [33], [39]. The least article type studied is applied research (8%).

Table 5. Number of articles by type

Article Type	No. of Papers
Empirical	53
Conceptual	23
Analytical	16
Applied	8

3.5 Content analysis by type

Collaboration can be divided into horizontal and vertical. Horizontal collaboration is between competitors, internal functions, and other organizations whereas vertical collaboration is among suppliers, internal functions, and customers [40]. Content analysis reveals that the majority of articles relate to vertical collaboration (94%), followed by both types (4%), with only 3.5% of articles involving horizontal collaboration.

The scope of collaboration can be divided into external and internal, involving collaborative activities within the organization or between functions and organizations such as suppliers, customers, and competitors, respectively. Content analysis shows that the majority of articles fall into the category of external collaboration (79%), followed by both types of collaboration (12%) with internal collaboration being the least studied (9%). There is a strong focus on customers and suppliers and less investigation into collaboration with competitors and other organizations in the previous literature on GSCC [41], [42].

Table 6. Number of articles by collaboration dimensions

Dimension	No. of articles
Decision synchronization	58
Information sharing	52
Incentive alignment	34
Others	3

3.6 Content analysis by collaboration dimensions

Based on the definitions of three GSCC dimensions, content analysis is performed to identify the use and conceptualization of GSCC. Table 7 shows examples of text coding in the 100 articles, according to the three GSCC dimensions. The first dimension is information sharing, defined as the sharing of information in relation to green supply chain management [42], [43]. For example, information sharing is used to help evaluate alternate partnerships and technologies and understand their impacts. The second dimension is decision synchronization, which is important for supporting environmental planning and joint action to address environmental problems [4]. The third dimension is incentive alignment, involving cost-sharing issues and con-tracts or mechanisms used in its facilitation [44], [45].

The results indicate that decision synchronization is the most studied GSCC dimension with 58 articles published, followed by information sharing with 52 articles published, and incentive alignment as the least popular dimension with 34 articles published (Table 6.). Three articles [46], [47], [48] could not be classified into any of the three dimensions, consequently, falling into "others" The "others" dimension suggests there is room for further study on GSCC, such as with system integration and review. Each article may involve more than one dimension, with the number of selected articles exceeding 100.

Table 7. Classification of GSCC dimensions

Dimensions	Authors	Content analysis
Information sharing	[43]	*"…examines how the perception of rival firms' green success influences a firm to pursue and produce environmental innovation through its green supply chain integration activities."*
Decision synchronization	[4]	*"…collaborate in environmental planning, establishing common environmental goals, and jointly addressing the environmental aspects of product and process-design."*

Table 7. Classification of GSCC dimensions (Cont.)

Dimensions	Authors	Content analysis
Incentive alignment	[44]	*"…explore the impact of cost sharing contracts on the key decisions of supply chain players undertaking green initiatives."*

3.7 Results of citation network analysis using Pajek

3.7.1 In-degree and closeness centrality scores

The in-degree scores in Table 8 show [4] as having the highest in-degree score (44), demonstrating their importance among articles in this network, followed by [5], [43], [49], [50] with scores 36, 15, 14, and 11 respectively. Evidently, in-degree scores align with the content analysis results for the most cited authors in the previous section. Therefore, it can be seen that decision synchronization and information sharing are currently the most important issues within GSCC compared to the dimensions of incentive alignment and others.

As well as the importance of examining in-degree scores, closeness scores (Table 8.) are also presented to confirm the influence of nodes on the network, in this case, authors. The top two and fifth highest scores belong to the same authors, Vachon & Klassen, with closeness scores of 0.565, 0.505, and 0.409, respectively which aligns with the in-degree score results. These authors have a high centrality score, representing the importance of their influence on other authors within this network. Whereas [51] and [13] just appear in the top ranks with scores of 0.415 and 0.413. This means they have a strong influence on others.

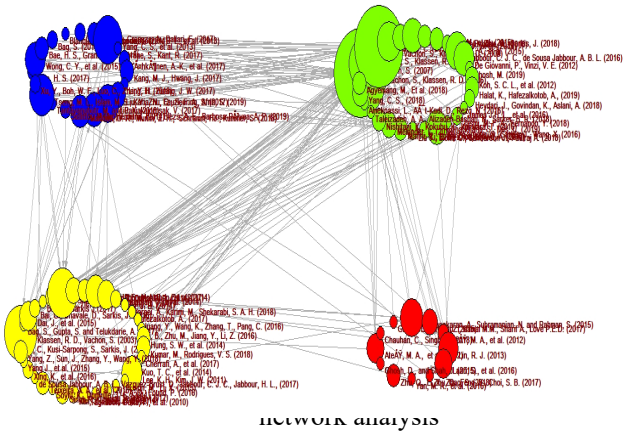
In-degree centrality		Closeness centrality	
Author	**Score**	**Author**	**Score**
[4]	44	[4]	0.565
[5]	36	[5]	0.505
[43]	15	[51]	0.415
[49]	14	[13]	0.413
[50]	11	[50]	0.409

Table 8. In-degree and closeness centrality scores

3.7.2 Citation network analysis results

Citation network analysis is based on the three-supply chain collaboration index dimensions: information sharing, decision synchronization, and incentive alignment [1]. The results of the CNA created by Pajek software (Figure 2.) are based on the content analysis of dimensions (Table 7.) and confirm that decision synchronization is the most studied dimension. Although incentive alignment is not as extensive as the other two dimensions, it is gradually growing. Incentive alignment is more complex than the other dimensions since it takes time for the supply chain to develop to this stage. Therefore, unsurprisingly, studies within this dimension are only just emerging.

The number of articles classified in each dimension and the links between them from CNA visualization help to identify the dominant dimensions within GSCC research. In Figure 3, the visualization of CNA shows the intensity of citation between dimensions where green-cluster decision synchronization is the most cited. The other



network analysis

synchronization and information sharing, respectively

3.8 Citation network analysis by cluster

In order to obtain a structure for each dimension, the most cited authors and a citation summary (Table 9.) are used to support the findings in previous sections and discuss them in more detail. The cited content of each article is recorded and analyzed to judge whether each cited sentence or phrase contains any relevant details on collaboration dimensions as shown previously in Table 5. The top ten most cited authors appear from 2003 to 2015. [4], [5] and [42] are the most cited authors, which can be expected because they are pioneers in the area of green supply chain collaboration. When considering the number of citations, this point appears to be relevant as the total and average number of authors per year move in the same direction as [4], which are still the most cited per year (3.38). One remarkable point is that the majority of the ten most cited authors are classified into decision synchronization and information sharing with four articles equally. Moreover, five articles studied external collaboration (vertical type) whereas only three studied both external and internal collaboration [38], [52],[53] and only one article studied both vertical and horizontal collaboration which is a review by [53].

3.8.1 Cluster 1: Decision synchronization

According to CNA visualization (Figure 2.), decision synchronization, represented by a green cluster, is the most crowded with 44 articles as explained fully in Table 8. The authors in this dimension making the largest contribution are [4], [5], [49], and [52], who studied technological integration with suppliers and customers, the selection of environmental technologies, and environmental collaborative activities.

Table 9. shows that the most cited content on decision synchronization. More importantly, some cited bodies relevant to decision synchronization also use the terms joint problem-solving session, joint planning, cooperation, and integration in decision-making/planning. Interestingly, this content is also cited in articles which relate to the information sharing dimension and also contain words such as environmental management techniques, knowledge sharing, knowledge transferring, policy sharing, and exchange of

information.

3.8.2 Cluster 2: Information sharing

The yellow cluster is the second most intense and represents information sharing with 36 articles. The top four most cited authors in this area are [50], collaboration and evaluation, customer-supplier - [43], [54], and [34], who studied supplier-customer integration and decision framework, and supplier involvement. The majority of published articles focus on supplier and customer collaboration while a few articles relate to internal collaboration or competitors. From Table 9., none of the cited content is relevant to information sharing.

Table 9. Analysis of the most cited authors and citation summary

Ranking	Authors	Citation	Citation per Year	Journal	Dimension	Citation Summary	Collaboration Dimensions
1	[4]	44	3.38	International Journal of Operations and Production Management	Decision synchronization	Green supply chain practices, GSCM, SSCM, GSCI, GSCC, environmental collaboration & monitoring, cooperation, logistical & technological integration, internal & external EM, firms' performance, integration of upstream and downstream, environmental performance, collaborative supply chains, buyer/supplier collaboration, manufacturing performance, environmental technology, Internal environmental management, internal & external collaboration, consumption & decisions on green products, green collaboration with supplier, green collaboration with partner, green collaboration with customer	Knowledge transfer, sharing policies, exchange of information, establishing common goals, joint problem-solving sessions, information sharing, joint planning, sharing activities, joint efforts, communication in the green supply design process, joint development of processes or products, cooperation & integration in decision-making/planning, decision synchronization, sharing environmental management techniques & knowledge, communicating sustainability goals to suppliers
2	[5]	36	3.27	International Journal of Production Economics	Decision synchronization	Environmental investment, environmental performance, environmental management, firms' strategies, GSCM, environmental collaboration/monitoring, operational performance, proactivity & coordination among supply chain members, manufacturers & customers environmental collaboration, external green collaboration, inter-organizational learning process, GSCC, supplier integration, sustainability, green design, selection of technologies	Suppliers & customers jointly plan for environmental management and solution, supplier joint efforts & communication in the green supply design process, joint environmental goal setting, shared environmental planning, exchange of information, knowledge transfer, joint environmental management, Joint environmental goal setting, shared environmental planning, shared environmental management techniques & knowledge
3	[50]	17	1.13	Production & Operations Management	Information sharing	ISO 14001 certificate, green supply chain, environmental collaboration, supplier integration, Green technologies investment, Monitoring & suppliers' selection, Customer collaboration & pollution prevention, purchasing & environmental management in operations, technology	N/A
4	[43]	15	0.94	Journal of Cleaner Production	Information sharing	GSC, GSCM, Collaboration of environmental practices, Decision-making models, Green information technology and systems, End-of-life practices, GSCM & manufacturing/design processes, Integration of suppliers, distributors & reclamation facilities, Procurement/operational characteristics	N/A
5	[49]	14	1.17	International Journal of Production Research	Decision synchronization	SSCM, SC integration on corporate sustainability, GSCI, environmental monitoring & collaboration, operational excellence, environmental technologies, Operational and logistical integration, proactive environmental problem-solving, IT investment	Environmental collaboration — suppliers or customers jointly to develop environmental solutions, knowledge-sharing activities

Table 9. Analysis of the most cited authors and citation summary (Cont.)

Ranking	Authors	Citation	Citation per Year	Journal	Dimension	Citation Summary	Collaboration Dimensions
6	[38]	7	1.17	Transportation Research Part E: Logistics and Transportation Review	Multi-dimensions	Internal & external green collaboration, green performance, competitiveness, GSCI, GSCM, green market practices, suppliers & operational performance, green shipping practices, external green collaboration with supplier, green collaboration with partner, green collaboration with customer, reduction of pollutants, environmental & social outcomes	Information & benefit sharing, making joint decisions, internal & external knowledge, skills & technology integration
7	[52]	5	0.71	International Journal of Production Economics	Decision synchronization	Internal & external GSCM collaboration, economic & environmental performance	Joint environmental planning, knowledge exchange
8	[53]	4	1.00	International Journal of Physical Distribution & Logistics Management	Multi-dimensions	GSCM, traditional supply chain management, integration for GSCM, NRBV, green/sustainable SCM, firms' relationship management, collaboration, GPI, innovation	N/A
9	[54]	4	0.80	International Journal of Production Research	Information sharing	Sustainability, GSCM, organizational performance; environmental, operational, or economic,	N/A
10	[34]	4	0.50	Business Strategy and the Environment	Information sharing	Communication, external collaboration, green practice integration, GSCI, green innovation, supplier integration, environmental impacts upstream & downstream	N/A

3.8.3 Cluster 3: Incentive alignment

From Table 8, it can be observed that none of the most cited articles fall within the incentive alignment area. However, in its own cluster, the top three most cited articles are by the authors [10], [55], and [35] who studied GSCC and incentives, supplier-customer collaboration and green design/green purchasing, and proactive environmental strategy and customer pressure respectively. It can be seen that the majority of articles relate to cost-sharing contracts.

The cited content is based on the following issues: effective collaborative strategy and SC performance, environmental performance, decision-making process, GSC evaluation and green design, customer environmental collaboration, and collaborative supply chain and employee training and education. The results indicate that only one cited article contains content relevant to incentive alignment relates to high green cost for suppliers and cost-sharing contracts.

3.8.4 Cluster 4: Multi-dimension and & others

Finally, the blue cluster represents the multi-dimension and others. Authors within this group can be divided into two sub-groups according to specific research areas. Sub-group 1 consists of review articles [12], [52], [53], and [13]. Sub-group 2 consists of articles [56], [57], [58], [59], [60], and [61] who studied innovation, capability, relationship development, institutional pressures, and eco-efficiency.

In terms of content, two articles from this dimension appear in the top ten most cited; [38] and [53], positioned sixth and eighth, respectively. There are only two articles in clusters 3 and 4 cited content relevant to the collaboration dimension using the following terms: information and benefit sharing, making joint decisions, internal and external knowledge, skills and technology integration.

4. Research Directions

Based on the descriptive statistics, content analysis, and bibliometric analysis, and CNA, the suggested research direction for the field of GSCC is shown in Table 10.

4.1 Industry sectors

The majority of articles relating to the top ten

industries are classified as being in the manufacturing sector, while only two industries are classified as being in the service sector, namely transportation, storage and communication, and the wholesale and retail trade. Therefore, to complete the puzzle of business and green supply chain collaboration, the service sector must be extensively studied. This research direction aligns with the study by [62] who suggested that environmental problems are as important in the service sector as in manufacturing. These authors mentioned transport and logistics as an example of service sector involvement in supply chain environmental issues, especially concerning emerging countries. Therefore, substantial effort is required to expand GSCC research into the service sector. There is evidence to support the existence of environmental issues in the transportation service. For example, [63] reports that international transport is responsible for 33% of world trade related emissions. Moreover, the global aviation sector was the sixth-largest source of carbon dioxide (CO2) emissions from energy consumption in 2015, and if treated as a nation, emitted more than the whole of Germany [64], [65].

4.2 Article type

The majority of published articles fall into the category of empirical research, where the most popular method used is the structural equation model (SEM) followed by regression analysis. Both SEM and regression analysis tend to analyze raw data from a survey, which is basically primary data. Research involving SEM or other empirical methods is still necessary for the provision of knowledge in the field of GSCC, although there are opportunities to employ secondary data, especially objective data. The problem with using primary data from a survey involves *"a social desirability response bias"* which can occur when dealing with questions about current social norms and standards [66]. Secondary data can be obtained from reliable sources such as census records, governmental information, financial reports, CSR, and sustainability reports, as well as other records [67]. Moreover, the research type can be extended to include analytical methods for quantifying the effects of various policies and solutions, while applied methods help to understand how GSCC is successfully implemented.

Table 10. Identifying the research direction for GSCC

	Category	Gaps	Research Direction
1.	Industrial Sector	Service sector	Expanding to focus more on the ***Service sector.***
2.	Article Type	Empirical Secondary data Analytical, Applied	Using ***Secondary data*** in ***Empirical*** research. Extending types to ***Analytical*** and ***Applied***
3.	Scope of collaboration	Internal, multi-tier	Exploring more on ***Internal collaboration*** within firms/organizations
4.	Type of collaboration (horizontal vs. vertical)	Horizontal	Extending to ***Horizontal collaboration*** with competitors and non-competitors - other organizations
5.	Collaboration dimension	Incentive alignment	Studying ***Incentive alignment*** more intensively

4.3 Scope of collaboration

According to content analysis and CNA, the majority of articles fall into the external collaboration category, followed by both types of collaboration with internal collaboration being the least studied. Since more than half the published articles relate to external collaboration, there is a gap in GSCC involving the type of collaboration. Supplier and customer collaboration are the most frequently investigated. However, there is a study gap in the exploration of internal collaboration, and the interface between internal and external collaboration. Consequently, there is room for further research into internal and other collaborations to provide essential knowledge on the GSCC field.

4.4 Type of collaboration

The majority of articles relate to vertical collaboration, thereby indicating a gap in collaboration type. Despite the diverse collaboration types examined in this study, ranging from a strong focus on customers and suppliers to competitors and other organizations [41], [42] there is still a gap. Greater attention should be paid to horizontal

collaboration as a way of filling the research gap in relation to collaboration knowledge.

4.5 Collaboration dimensions

Both content analysis and CNA within the GSCC field focus on decision synchronization and information sharing while other dimensions can be tracked to clearly observe their development in the literature. Moreover, this study shows that the most cited articles [4], [5] not only have high citation scores but also citations per year. Therefore, decision synchronization remains a critical area of GSCC research. In addition, the results of the closeness score indicate that two out of the five most influential authors: [4], [5], [51] fall under "decision synchronization." This supports the analysis that decision synchronization will remain a key area of GSCC. Studies on incentive alignment have also emerged.

Despite the content analysis of citation within and between dimensions indicating that not all citations are relevant to collaboration, some frequently refer to other unrelated aspects such as green supply chain, environmental management, and GSCM practices. However, there is evidence to suggest the presence of citation links between dimensions, especially decision synchronization which has cited content relevant to collaboration. Incentive alignment is the only dimension with no relevant collaboration citation n within and between groups. Overall, the results suggest that incentive alignment should be studied more intensively to fill the GSCC gap because in order to achieve a better understanding of collaboration, all dimensions must be studied.

5. CONCLUSION

An importance of incorporating Green aspect into supply chain management has been recognized [68]. As well as green aspect, "collaboration" has been pointed out as a critical factor for growing and sustaining supply chain [69]. This current study applies CNA to compliment SLR in the field of GSCC. The results of content analysis were combined with the visualization of CNA in order to highlight the main research area, current trends and gaps, and drive the direction of future research into GSCC. The current trends in GSCC were revealed by descriptive statistics and content analysis. Manufacturing was found to be the most studied sector, while empirical and conceptual methods are the most applied. The majority of articles fall into the category of external and vertical collaboration between suppliers and customers with decision synchronization and information sharing being the most popular dimensions studied, forming the results of SLR. Consequently, the research gaps were identified for further study and various research directions are suggested to fill the study gaps and enhance knowledge in the GSCC field. This current systematic literature review contributes to the field of supply chain by pointing out the gaps and suggesting the specific areas that scholars should focus more in order to add more comprehensive knowledge to enhance the field.

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