

Supplier development: A bibliometric review

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<https://doi.org/10.15017/7325756>

出版情報：経済論究. 177, pp.1-22, 2024-03-28. 九州大学大学院経済学会
バージョン：
権利関係：



Supplier development: A bibliometric review

Duong Ngoc Anh[†]

Abstract

Supplier development, integral to effective supply chain management, fosters strategic partnerships and enhances supplier performance. This bibliometric review systematically examines the evolving landscape of supplier development literature via a comprehensive dataset of 212 publications between 2000 and 2023 from Web of Science Core Collection databases. Based on investigating citation patterns and network mapping, the study unveils the dynamic structure and identifies emerging topics and collaborative trends, offering valuable insights for shaping future research agendas of supplier development research.

Keywords: Supplier development, Literature review, Bibliometric analysis

1 . Introduction

Establishing and maintaining buyer-supplier partnerships is essential in dealing with uncertainty and disruption in operation. Three choices buying firms could employ to manage their supply networks include vertical integration (setting up manufacturing capability in-house), supplier switching (searching for alternatives for capable suppliers), and supplier development - SD (enhancing supplier capabilities) (Belotti Pedroso et al., 2021). However, the availability of alternative suppliers or high switching costs would limit vertical integration and supplier switching (Belotti Pedroso et al., 2021). As a result, SD has attracted a growing consideration in both theoretical and practical perspectives and become a critical topic in operation and supply chain management.

As a result, a certain number of literature reviews explore the SD process in both theoretical framing and conceptual consolidation of specific SD factors (Glock et al., 2017; Jia et al., 2023; Krause et al., 2007). For example, Yawar and Seuring presented a comprehensive review and conceptualization of SD, emphasising the interrelationship of five critical elements of SD, including direct and

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indirect strategies, enables, relationships, and performance (Yawar & Seuring, 2020). Besides, Pedroso et al. studied the adoption of SD's triple bottom line outcomes (TBL – economic, environmental, and social practices) since it is a relatively new topic for sustainable SD (Belotti Pedroso et al., 2021). However, these studies mainly implied content or contingency analysis to create a systematic or meta-literature review.

In addition to meta-analysis and systematic literature review, the bibliometric review is a frequently utilised review technique (Donthu et al., 2021). Specifically, there is a substantial growth in publications using the bibliometric technique, increasing from 170 published papers in 2005 to around 2,000 papers in 2020 across various business and management fields (Donthu et al., 2021), including finance (Khan et al., 2022), management (Pimenta et al., 2021), and marketing (Zhao, 2022). The rise in popularity of bibliometric analysis can be attributed to the advancement and accessibility of software that handles a large volume of data to provide objective views with significant research impact (Donthu et al., 2021). Despite its benefits in drawing a comprehensive picture of origin, current state, and development, there is no bibliometric analysis of SD to the best of the author's knowledge. The study would fill this literature gap by using the “bibliometrix” package in R and VOSviewer software to visualise the structure and impact of scientific knowledge within the theme of SD.

The following sections of this paper present the concept of SD and a methodology of data processing and preparation from the Web of Science – WoS source. Then, the main results section will describe the key metrics of the main techniques. The section after that outlines enrichment results, including future research directions based on the thematic map. Consequently, a discussion and conclusion would be remarked upon with limitations.

2. Supplier development

Krause and Ellram defined SD as “any effort of a buying firm to increase the performance and/or capabilities of the supplier and meet the buying firm's short- and long-term supply needs” (Krause & Ellram, 1997). The primary objective of SD is to create stronger, more reliable, and mutually beneficial relationships between buyers and suppliers. Various activities, including quality improvement, technology transfer, training and skill development, process optimisation, risk management, cost reduction, or long-term partnership building, are part of the SD process, which aims to increase the efficiency, quality, and competitiveness of suppliers (Gu et al., 2021; Krause et al., 2007; Su et al., 2018).

Yawar and Seuring categorised SD concepts into five key constructs. Direct SD, such as training, education, and technical or financial investment, would help establish long-term relationships and improve performance outcomes. Meanwhile, indirect SD, such as supplier evaluation, helps assess

and enhance supplier development. Besides that, enablers of trust, commitment, information sharing, communication, or top management support are vital stimulants for firms to adopt SD efforts. Then, these enablers-based strategies result in the buyer-supplier relationship and enhance performance outcomes, as illustrated in Figure 1 (Yawar & Seuring, 2020).

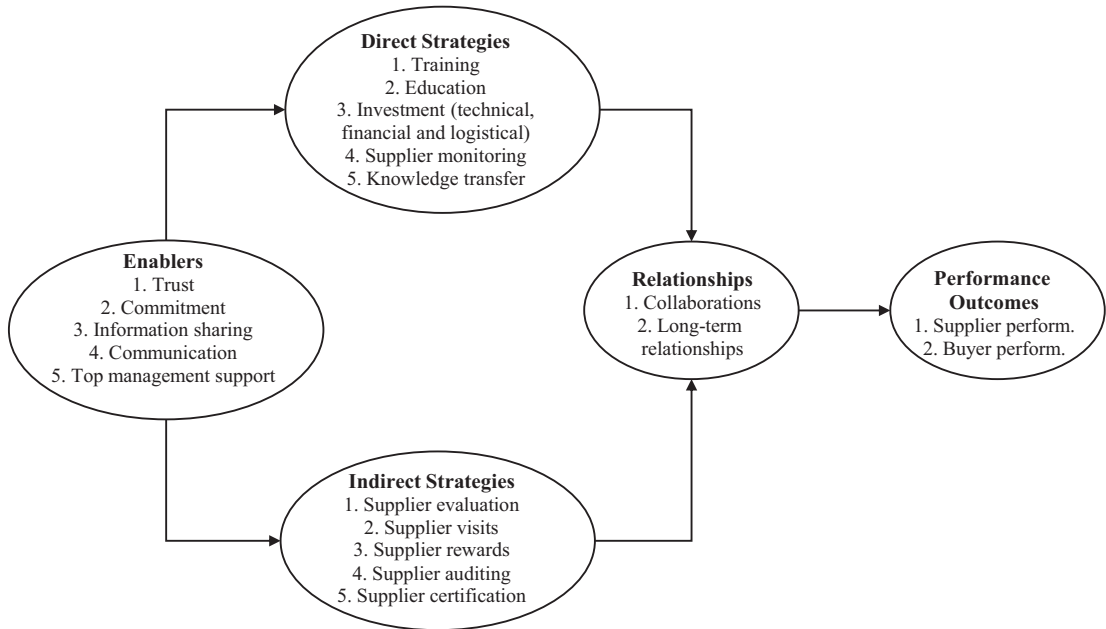


Figure 1: Concept model of fundamental construct in supplier development
(Source: Yawar and Seuring, 2020, p.2567)

Similar to other topics in the management field, emerging trends in SD studies consider critical perspectives such as cultural issues or sustainable development. More specifically, there is a growing emphasis on sustainability and corporate social responsibility via integrating environmental, social, and governance (ESG) criteria (Krause et al., 2007; Wang et al., 2021), or barriers and implications of green SD (Lo et al., 2018) or TBL-SD practices (Belotti Pedroso et al., 2021). In addition, the increasing use of digital technologies, such as artificial intelligence (AI), the Internet of Things (IoT), and data analytics in SD, has improved real-time monitoring for more transparency, better communication, and more vital collaboration. The advent of technology also enables increasing cooperation between buyers and suppliers in joint development projects for products and process improvements and utilising big data to identify trends, predict performance, and optimise supply chain processes (Nguyen et al., 2022; Petersen et al., 2003).

3. Methodology

3.1. Analysis method

Bibliometric analysis is a quantitative method to analyse and evaluate scholarly literature and scientific publications. It implies statistical and mathematical techniques to identify patterns, trends, and relationships within a specific field, allowing for an adequate understanding of scientific knowledge structure (Mukherjee et al., 2022). In general comparison, bibliometric analysis focuses on quantitative patterns in bibliographic data. At the same time, a meta-analysis involves statistical synthesis of results from individual studies, and systematic literature reviews provide a comprehensive qualitative synthesis of existing literature. It is noteworthy that bibliometric analysis incorporates both qualitative and quantitative analysis, whereas systematic literature reviews only rely on qualitative analysis and meta-analyses primarily on quantitative research (Donthu et al., 2021).

According to Donthu et al., the bibliometric analysis is categorised into two main toolboxes: main techniques and enrichment techniques (Donthu et al., 2021). On the one hand, the main techniques manifest two subcategories: performance analysis and science mapping. Performance analysis highlights descriptive metrics relating to the publication, citation, and combination of publication and citation. Meanwhile, science mapping would examine the relationship among publications to find the most influential one (citation analysis), among cited publications to find the foundational themes (co-citation analysis), or among citing publications to find periodical or present themes (bibliographic coupling).

On the other hand, network analysis is the principle for enrichment techniques to provide greater clarity with visualisation. Three enrichment pathways for network analysis are network metrics (centrality and PageRank), clustering, and visualisation. It is noteworthy that the combination of science mapping techniques and network analysis demonstrates the conceptual and intellectual structure of the study field. This study would imply the well-known and widely used Bibliometrix package under the R environment for bibliometric data analysis and VOS Viewer (version 1.6.20) for bibliometric analysis and graphical visualisation.

3.2. Data extraction process

WoS is a multidisciplinary citation database that provides access to scholarly articles, conference proceedings, and research literature (Sousa et al., 2022; Zhao, 2022). The database facilitates comprehensive bibliographic information, including publication index, information on authors, journals, and citations for subsequent analysis. The author implies a set of embedded criteria to extract the most pertinent data for precise analysis. More specifically, the keyword “supplier

development” is carried out in search of three fields: Title, Author keywords, and Keyword plus. The initial search results were 343 articles published between 2000 and 2023 (the search timespan is 1900 to 2023, but the first article in this theme was not published until 2000). Then, other cleaning filters, including subject area, language, document types, and duplication, reduced the dataset to 212 results for further analysis. The detailed search query is presented in the Appendix.

4. Main results

4.1. Performance analysis

Since the first publication in 2000, there has been a persistent interest in researching SD, with an annual growth rate of 5.81%. There are 447 authors who studied SD during the period; among them, only 20 were authors of single-authored documents and produced 23 single-authored publications. Besides, the average number of co-authors per document equals 2.71, contributing 41.51 % international co-authorship and 700 authors' keywords. Moreover, with 10,669 total citations, it is 50.33 average citations per doc, while the document's average age is 8.49 years. Figure 2 illustrates the growth of publications and average total citation per year in studying SD along its timespan.

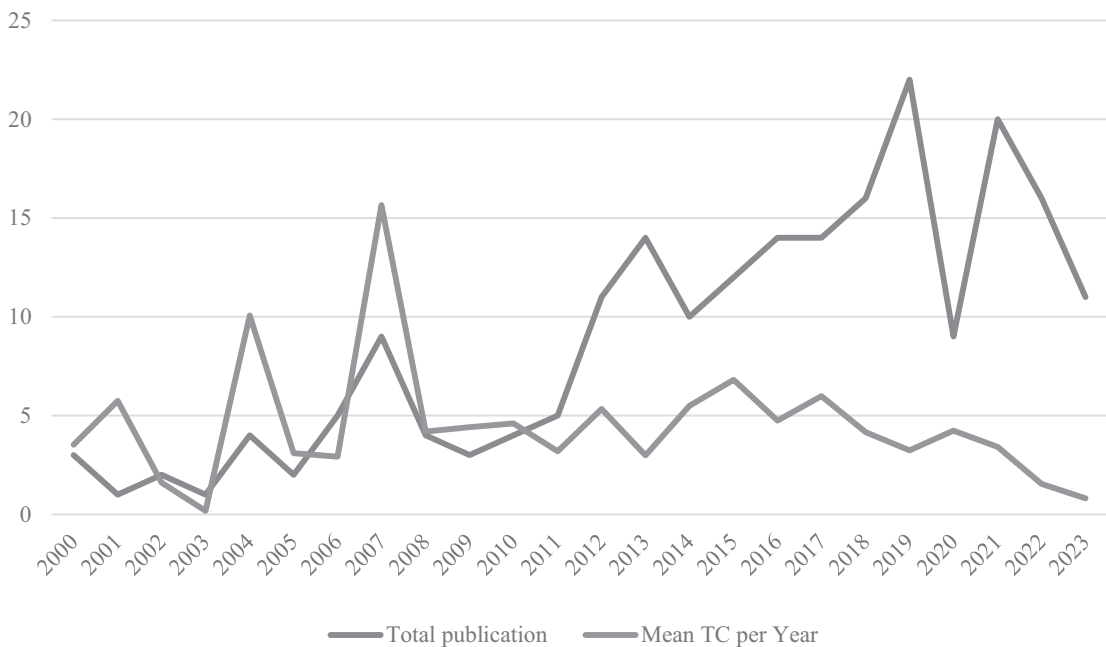


Figure 2: Annual scientific production description (Source: author)

4.2. Citation analysis

Citation analysis is a core approach in scientific mapping based on the fundamental concept that intellectual linkage is reflected through citation (Donthu et al., 2021). As citation is the most objective and straightforward measure of a publication, citation analysis determines the most influential publications, authors, or journals in the research field.

Table 1 lists the top ten journals ranked by the number of publications and total citations in the field of SD. As shown in Table 1, the leading influential journals include top-tier journals in operation and production management (i.e., *International Journal of Production Economics*, *International Journal of Production Research*, or *Journal of Operation Management*), marketing (i.e., *Industrial Marketing Management*), or supply chain (i.e., *Journal of Purchasing and Supply Management* or *Journal of Supply Chain Management*). The total number of citations is 10,669, and the top ten journals cover 65.33% of total citations. Meanwhile, the top ten journals, in terms of the number of publications, account for 41.51% of the total publications.

Table 2 lists the top ten contributing authors, institutions, and countries in the SD field. Routroy S, Wagner SM, and Sarkis J are the top three authors devoting their effort to 11, 9, and 6 publications, respectively. However, Krause DR, Handfield RB, and Tyler BB are the top three cited authors with over 900 total citations for their works. Among over 200 relevant affiliations, Birla Institute of Technology and Science ranked at the top with a frequency of 22, followed by the Swiss Federal Institution of Technology (16) and Hong Kong Polytech University (13) – the only institution outside America and Europe in the top ten. In addition, the USA, UK, and China keep their rank in the top three regarding both frequency and total citations.

4.3. Co-citation analysis

In brief, co-citation analysis examines the relationships among cited publications based on the frequency with which they are cited together. It helps identify clusters of related research and influential works (Donthu et al., 2021; Lim & Kumar, 2024). It is noteworthy that 79 journals, 48 authors, and 34 papers meet the minimum number of citation thresholds of 25 for co-citation analysis regarding the journal, author, and document and visualisation in Figure 3.

Figure 3a reveals the top influential journals similar to citation analysis, including the *Journal of Operation Management*, *International Journal of Production Economics*, *International Journal of Production Management*, *Strategic Management Journal*, and *Industrial Marketing Management*.

In addition to identifying influential scholars, Figure 3b helps understand the distribution of common authors' research topics via three main clusters. Kaurse DR, studying the supplier-buyer relationship, is the most influential author in the three clusters. At the same time, Dyer JH, Wagner SM, and Modi SB are the most influential authors in each cluster, covering foundational structure, impact, and sustainable/green SD, respectively.

Table 1: Top ten journals in SD research

Top ten journals by publications	TP	Top ten journals by citations	TC	h-index	g-index	m-index
Int. J. of Production Economics	18	Journal of Operations Management	1,903	8	8	0.381
Benchmarking – An International Journal	11	Omega – Int. J. of Management Science	1,097	4	4	0.160
Int. J. of Operation & Production Management	9	Int. J. of Productions Economics	1,010	14	18	0.737
Industrial Marketing Management	8	Expert Systems with Applications	536	3	3	0.214
Journal of Operations Management	8	Int. J. of Production Research	531	7	7	0.368
Production Planning & Control	8	European Journal of Operation Research	419	5	5	0.333
IEEE Transactions on Engineering Management	7	Journal of Purchasing and Supply Management	386	7	7	0.467
Int. J. of Production Research	7	Journal of Supply Chain Management	378	4	4	0.235
Journal of Purchasing and Supply Management	7	Int. J. of Operations & Production Management	366	6	9	0.333
Annals of Operation Research	5	Industrial Marketing Management	344	6	8	0.500

Note: Int. J. – International Journal, TP – Total publications, TC – Total citations, h-index – h number of publications cited at least h times, g-index – g number of publications receiving at least g^2 citations, m-index – h-index $\div$ the number of years since the first published paper of the scientist.

Table 2: Top ten contributing authors, institutions, and countries

Top authors by papers			Top institutes by frequency			Top countries by frequency		
Authors	TP	Authors	TC	Institutions	Freq.	Countries	Freq.	TC
Routroy S	11	Krause DR	1,027	Birla Institute of Technology and Science	22	USA	141	2,772 (=1)
Wagner SM	9	Handfield RB	928	Swiss Federal Institution of Technology	16	China	83	1,878 (=2)
Sarkis J	6	Tyler BB	927	Hong Kong Polytech University	13	UK	81	1,031 (=3)
Bai C	5	Chan FTS	793	Michigan State University	10	India	57	262 (=10)
Kumar CVS	5	Kumar N	793	University Kassel	10	Germany	43	749 (=4)
Pradhan SK	5	Wagner SM	727	University Lancaster	9	Canada	26	720 (=5)
Chen L	4	Sarkis J	662	University Southern Denmark	9	Netherlands	19	486 (=7)
Cheng TCE	4	Prahinski C	555	Arizona State University	8	Denmark	18	70 (=20)
Humphreys PK	4	Humphreys PK	480	Aalto University	7	Switzerland	18	526 (=6)
Seuring S	4	Zhu Q	450	Clark University	7	Finland	17	82 (=18)

Note: TP – Total publications, TC – Total citations, Freq. – Frequency.

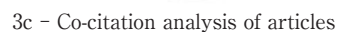
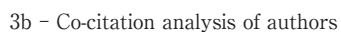
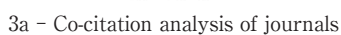


Figure 3: The network of co-citation analysis (Source: author)

Document co-citation analysis also generates three clusters of SD studies, as illustrated in Figure 3c. In specific, the first cluster built up the fundamental structural concept of SD (Krause et al., 2007; Krause & Ellram, 1997), while the second cluster examined SD under the contemporary perspectives of knowledge transfer (Modi & Mabert, 2007), green SD (Blome et al., 2014; Lo et al., 2018) or sustainable SD (Sancha et al., 2015). Last but not least, the third cluster hardly relates to methodology in SD literature – a common bias in surveys (Armstrong & Overton, 1977) or evaluating structural equation models (Fornell & Larcker, 1981).

4.4. Bibliographic coupling

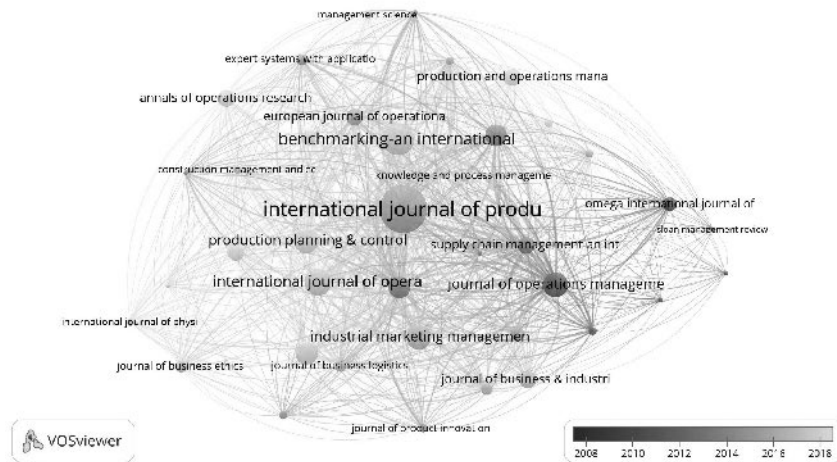
Bibliographic coupling, as compared to co-citation analysis, established knowledge clusters based on citing publications. Bibliographic coupling quantifies the degree of similarity between two documents by analysing the common references they share. The underlying assumption is that documents citing the same or similar sources are likely related in content or subject matter (Donthu et al., 2021; Lim & Kumar, 2024).

Since the average author per paper is 2.71 and the average citation per doc is 50.33, the setting criteria for bibliographic coupling of journals, authors, and documents would be different. In particular, the journals must have at least one publication, while this value for authors is two publications. However, the journals and authors share the same threshold of minimum citation as 25, while the documents must have 50 citations or more for analysis. The results of 39 journals, 51 authors, and 56 papers satisfied the criteria for bibliographic analysis. Figure 4 visualises the network of bibliographic coupling analysis regarding journal, author, and document.

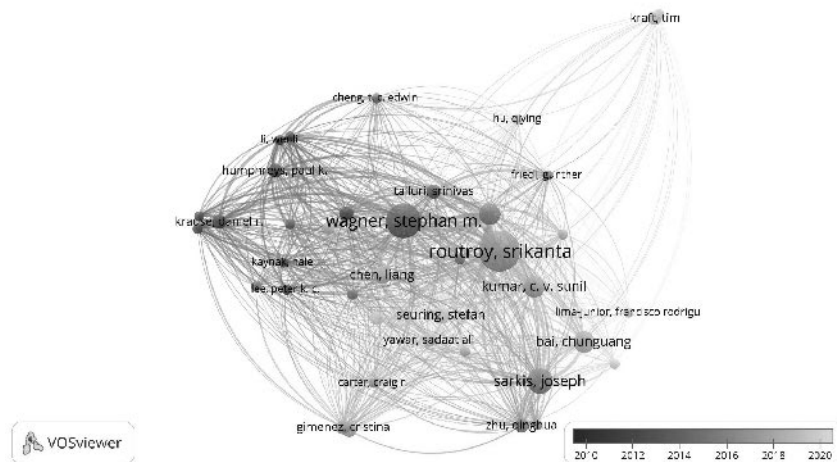
Figure 4a discloses the most constructive journals at the early stage of SD literature development, including the Journal of Operation Management and Omega - International Journal of Management Science. Gradually, more journals have productively published SD studies, such as the International Journal of Production Economics, International Journal of Production Research, International Journal of Operation Management, and Industrial Marketing Management.

Figure 4b illustrates the most active time of the top influential authors. Wagner, Stephan, Krause, and Humphrey established the groundwork of the SD literature from 2010 to 2014. Then, in the following phase, the concept is expanded by Routroy S, Sarkis J, or Bai CG between 2014 and 2018. The most prominent authors would be Karft T and Seuring S.

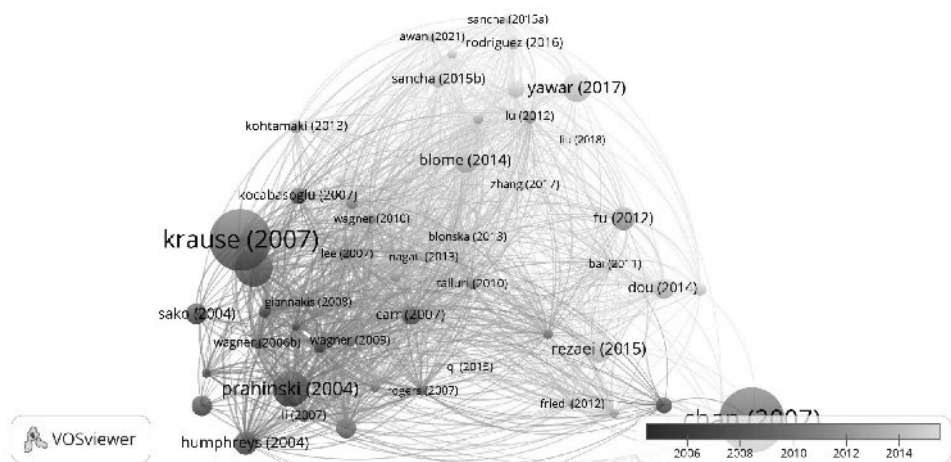
Figure 4c reveals that the most eminent articles were in the early phase of framework establishment (before 2008), and the most recent phase (after 2014) adopts diverse perspectives of green SD (Blome et al., 2014; Lo et al., 2018) or sustainable SD (Sancha et al., 2015).



4a - Coupling analysis of journals



4b - Coupling analysis of authors



4c - Coupling analysis of articles

Figure 4: The network of bibliographic coupling analysis (Source: author)

5. Enrichment results

5.1. Historiography

The intellectual structure of SD is described by not only co-citation analysis (as above) but also historiography. Figure 5 illustrates the historical evolution of the most fundamental works, and Table 3 summarises these papers. These 14 articles established the foundation for the literature structure of SD along the timeline as concept, impact, and case study at the initial stage. Then, researchers moved to other factors influencing the SD activities, such as knowledge transfer, communication, commitment, or cooperation. The latest knowledge base is more concerned with stakeholder, social, and environmental effects.

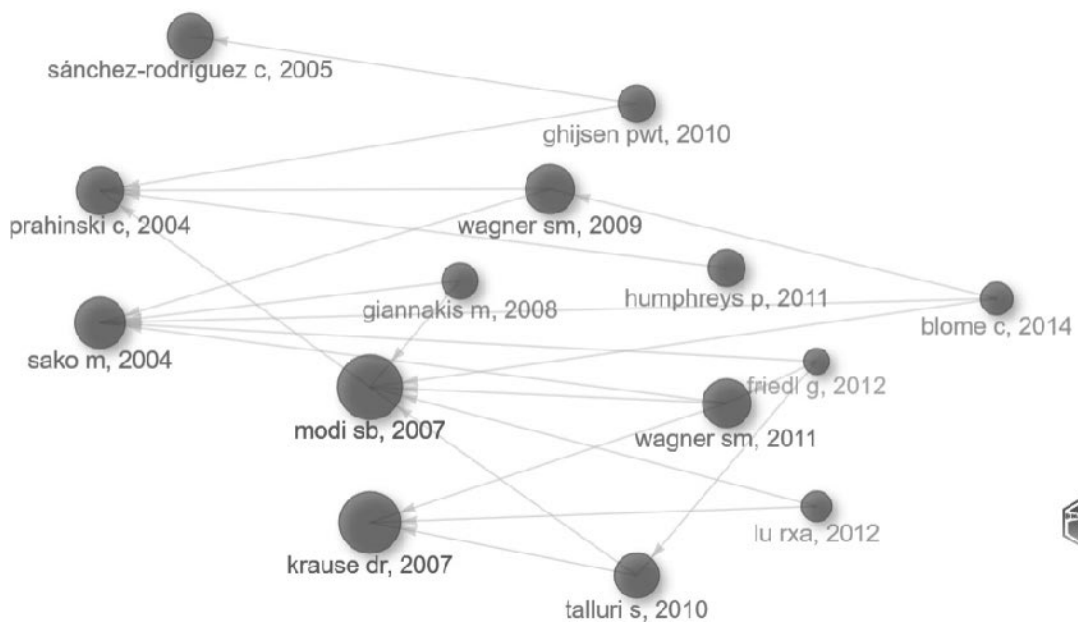


Figure 5: Bibliometric historiography graph (Source: author)

5.2. Keywords and trend topics

Figure 6 and Table 4 illustrate the result of all keywords (author keywords and keyword plus) co-occurrences analysis. Of the 1,090 keywords, 89 meet the threshold of 5 as the minimum number of occurrences, creating five clusters of keywords. Figure 6 points out some influential keywords (bigger-sized nodes), including SD (occurrences: 138), performance (101), impact (70), management (63), chain management (28), or model (28). Moreover, the top 4 keywords outperform the other keywords in terms of occurrence weight. The difference in occurrence weight among the key terms also indicates a potential niche in literature, demanding more intense studies of these low occurrence

Table 3: Foundational papers in historiography

Articles	Titles	GCS	LCS
(Prahinski & Benton, 2004)	Supplier Evaluations: Communication Strategies to Improve Supplier Performance	387	41
(Sako, 2004)	Supplier Development at Honda, Nissan, and Toyota: Comparative Case Studies of Organizational Capability Enhancement	195	48
(Sánchez-Rodríguez et al., 2005)	The Effect of Supplier Development Initiatives on Purchasing Performance: A Structural Model	95	36
(Krause et al., 2007)	The Relationships Between Supplier Development, Commitment, Social Capital Accumulation and Performance Improvement	736	78
(Modi & Mabert, 2007)	Supplier Development: Improving Supplier Performance Through Knowledge Transfer	401	89
(Giannakis, 2008)	Facilitating Learning and Knowledge Transfer Through Supplier Development	77	23
(Wagner & Krause, 2009)	Supplier Development: Communication Approaches, Activities, and Goals	99	44
(Ghijsen et al., 2010)	Supplier Satisfaction and Commitment: The Role of Influence Strategies and Supplier Development	82	24
(Talluri et al., 2010)	Manufacturer Cooperation in Supplier Development Under Risk	82	35
(Humphreys et al., 2011)	An Investigation into Supplier Development Activities and Their Influence on Performance in The Chinese Electronics Industry	46	24
(Wagner, 2011)	Supplier Development and The Relationship Lifecycle	103	42
(Friedl & Wagner, 2012)	Supplier Development or Supplier Switching?	70	18
(Lu et al., 2012)	Socially Responsible Supplier Development: Construct Development and Measurement Validation	105	19
(Blome et al., 2014)	Green Procurement and Green Supplier Development: Antecedents and Effects on Supplier Performance	236	20

Note: GCS – Global Citation Score, LCS – Local Citation Score

weight terms.

Besides, the literature about SD is categorised into 5 clusters based on all keyword occurrences analysis. Specifically, the first cluster covers how to design a procurement to enhance buyer-supplier relations via collaboration or cooperation. The second cluster focuses on implementing SD to achieve corporate social responsibilities (CSR), environments, or green SD. The third cluster emphasises integrating knowledge or supplier involvement in new product development while enhancing supplier relations and trust. The fourth cluster studies the determinants of successful SD, SD as a competitive advantage, and the impact of SD on performance, quality, and satisfaction. Last but not least is the fifth cluster, which is about antecedents or strategies to avoid uncertainty in the network by SD.

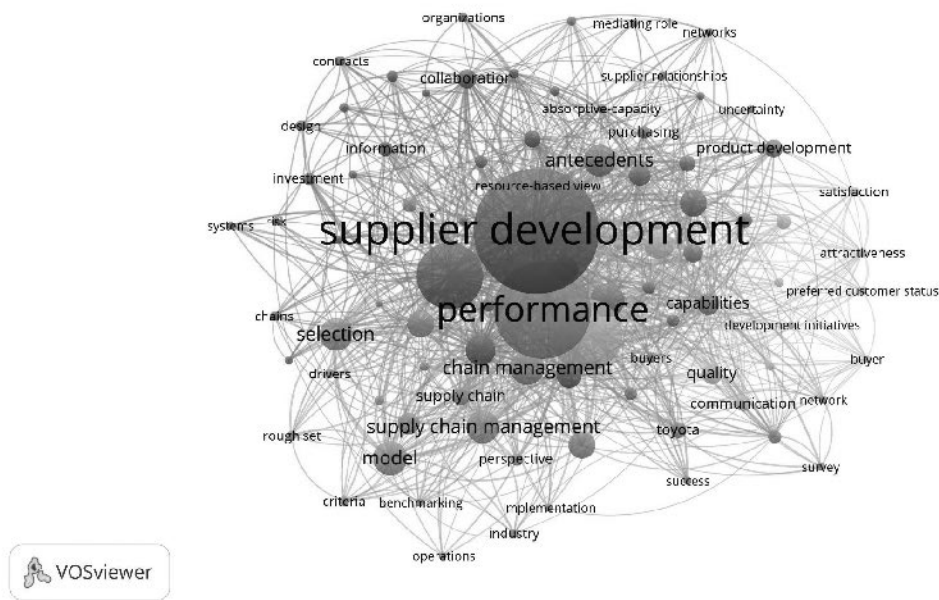


Figure 6: Co-occurrence networks for all keywords (Source: author)

Figure 7 shows the trend topics each year based on keyword plus with a word minimum frequency of 5. Among them, “quality” has been a trending topic for a long time, from 2006 to 2019, as quality is one metric used to measure the performance of SD. Besides that, the contemporary trends are driven by a sustainability perspective, focusing on CSR or green SD, and knowledge-based resources, such as innovation or research and development.

Table 4: Co-occurrence analysis results for all keywords

	Keywords	OC	TLS	APY	AC	ANC
Cluster #1	Supplier development	138	726	2015.82	47.14	0.89
	Management	63	393	2016.11	41.37	0.90
	Chain	24	146	2015.67	50.04	0.65
	Innovation	19	106	2017.42	22.37	0.76
	Collaboration	14	108	2016.71	73.21	0.85
	Capability	12	84	2017.42	9.92	0.25
	Information	10	69	2018.20	27.50	0.84
Cluster #2	Performance	101	571	2016.22	36.71	0.94
	Chain management	28	173	2016.11	57.64	1.14
	Model	28	164	2014.96	73.36	1.44
	Selection	27	160	2016.93	82.59	1.79
	Supply chain management	27	142	2013.37	67.11	1.01
	Sustainability	21	115	2019.33	52.90	1.57
	Commitment	19	125	2015.53	57.32	1.39
Cluster #3	Integration	21	144	2015.00	56.24	0.84
	Trust	16	112	2014.44	90.63	0.91
	Product development	13	76	2015.77	67.62	0.89
	Firm	11	76	2013.73	130.55	0.81
	Knowledge transfer	10	57	2016.80	29.50	0.74
	Strategy	9	59	2014.78	56.89	1.24
	Financial performance	8	49	2017.88	89.13	2.30
Cluster #4	Impact	70	414	2016.50	40.11	0.84
	Competitive advantage	23	145	2015.09	56.78	0.98
	Development programs	15	103	2018.33	16.13	0.99
	Quality	15	84	2012.67	78.67	0.75
	Communication	10	67	2014.10	48.40	0.74
	Determinants	10	60	2012.40	85.10	0.95
	Buyer competitive advantage	8	53	2017.50	18.00	0.44
Cluster #5	Strategies	28	179	2015.18	45.25	0.93
	Antecedents	26	179	2017.27	34.81	1.29
	Firms	21	107	2014.33	62.00	0.85
	Capabilities	16	112	2015.25	74.81	1.37
	Knowledge	14	102	2013.86	105.07	1.13
	Toyota	11	76	2014.45	37.73	0.75
	Buyer-supplier relationships	9	55	2014.67	54.11	1.16

Note: OC – occurrences, TLS – Total link strength, APY – Average publish year, AC – Average citation, ANC – Average normalised citation.

There are 89 keywords that satisfy the minimum occurrences of 5 for network visualisation and analysis. This table only included the top seven keywords based on occurrences for each cluster.

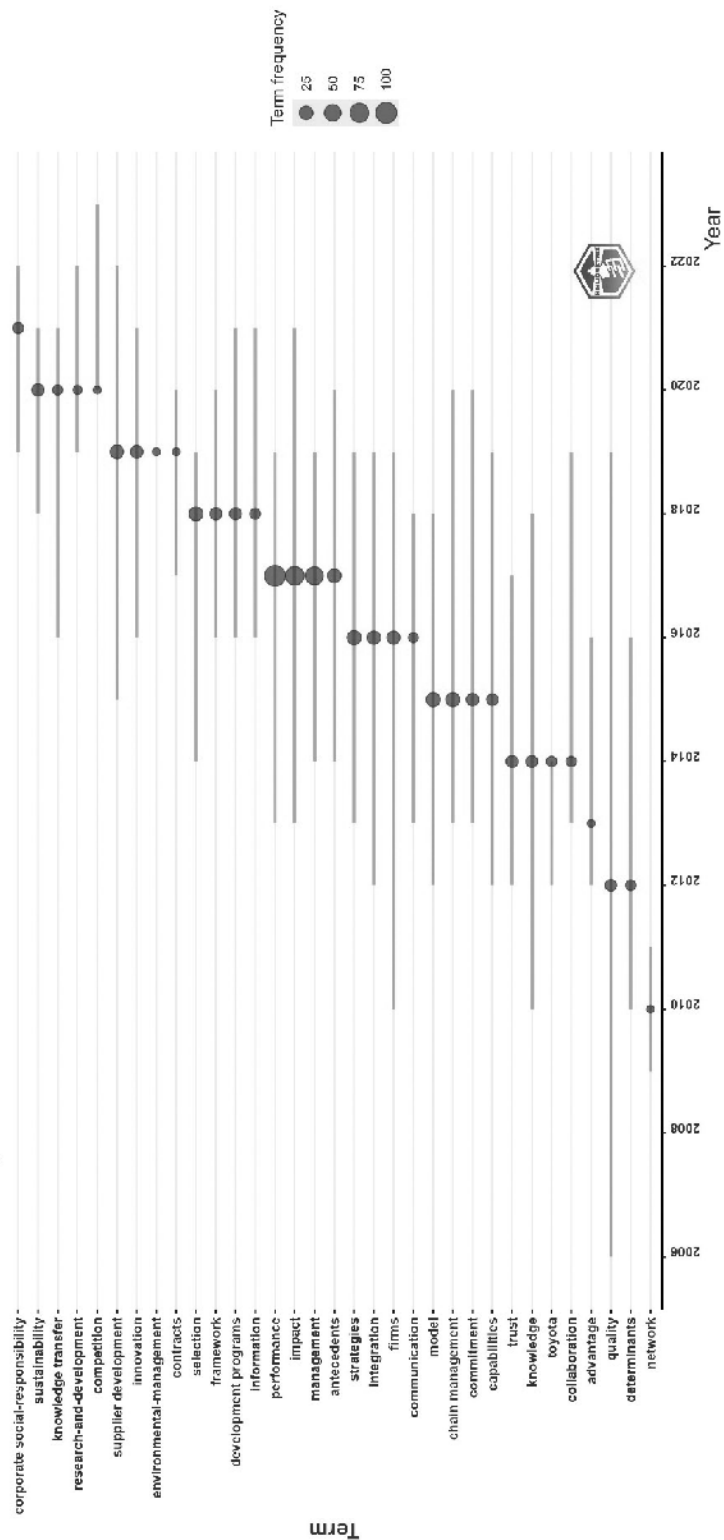


Figure 7: Trend topics in the SD field along the timespan (Source: author)

5.3. Thematic evolution and map

Thematic evolution illustrates the top keywords in different time slices along the timeframe of the research field. Figure 8 presents the thematic evolution of SD literature in 23 years with two cutting points in 2014 and 2019 to create three-time slices with almost the same number of publications. The figure reveals that researchers devoted effort to establishing the foundation of the SD concept in limited terms relating to their impact on performance and effective implementation of the model or program. Then, the major terms expanded widely to other aspects of risk avoidance, SD in the supply chain, or environmental concerns. Lately, the advance of AI and IoT has driven attention toward information, absorptive capacity, SD in product development, and the possible measurement of the financial performance of SD.

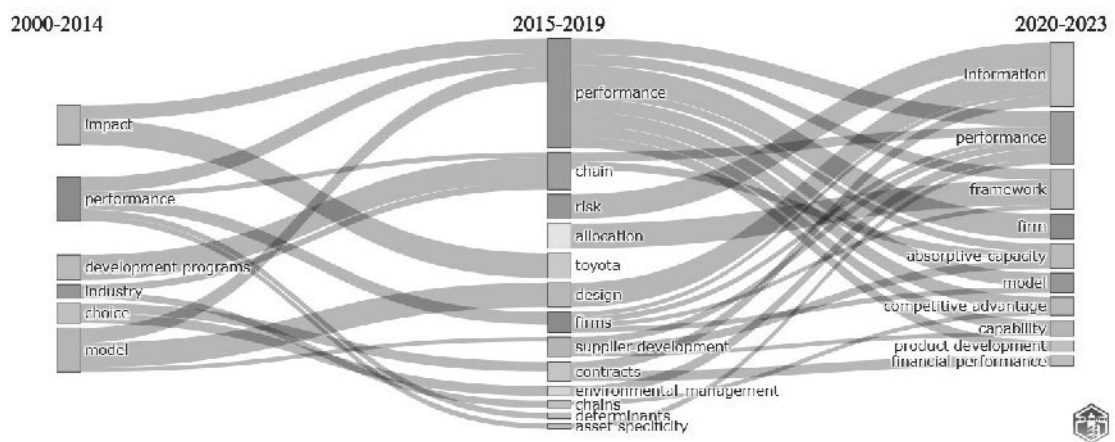
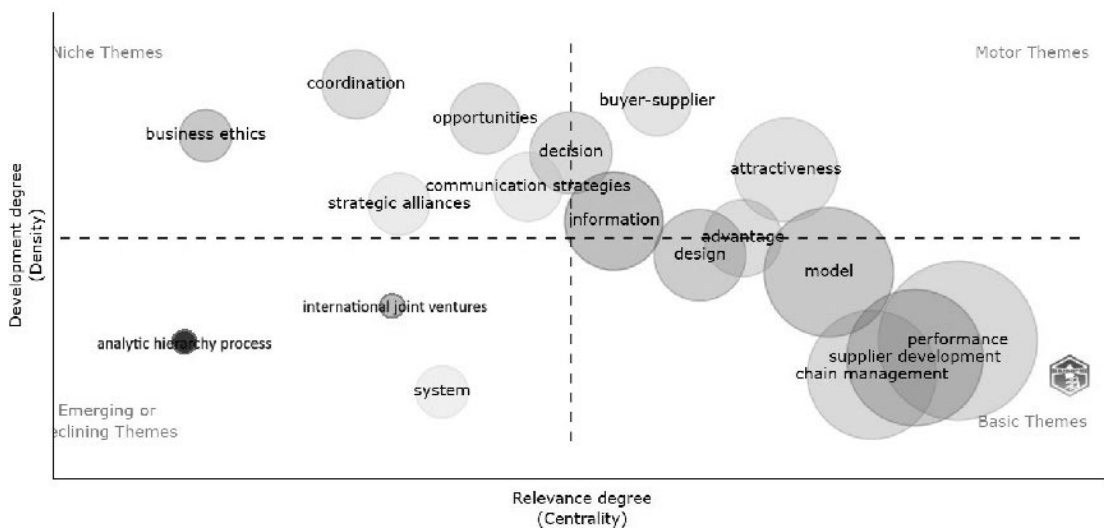


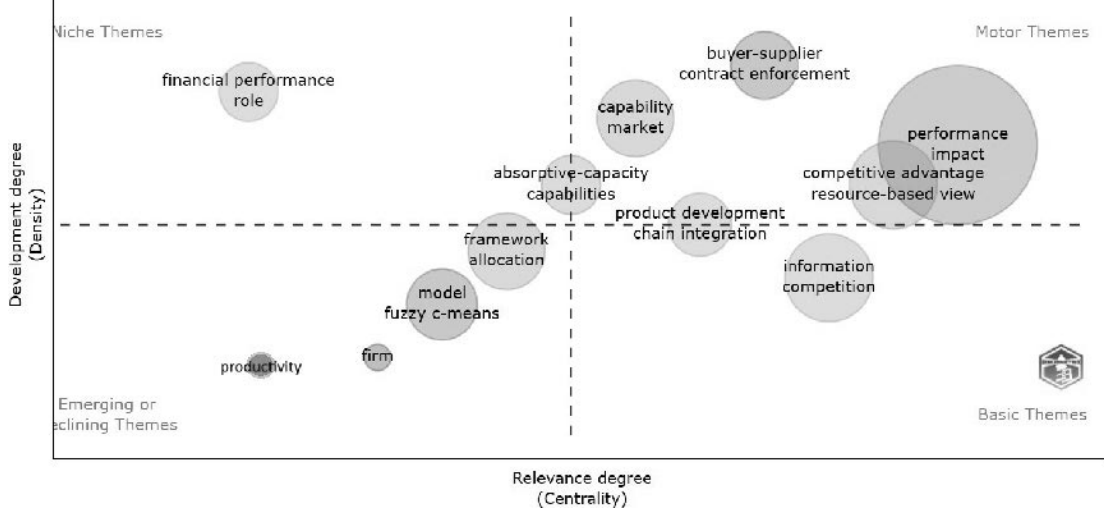
Figure 8: Thematic evolution (Source: author)

In addition, the thematic map displays specific themes regarding relevance and development degree. Then, these themes would be categorised into four quarters, including basic, declining, motor, or niche themes. Young researchers can decide the research directions based on this map to fill the niche or avoid the emerging themes. The thematic map of SD literature for 23 years and the latest time slice (2020-2023) are shown in Figure 9.

In Figure 9a, three research themes, analytical hierarchy process, international joint ventures, and system, had become the emerging or declining themes in the SD literature. Performance, SD, and chain management are three fundamental themes with giant nodes in the basic quarters. Similar to the previous analysis, it also exposes the motor and niche themes, such as (1) structure or program design to extract and integrate information for better decisions, (2) coordination and communication strategies to enhance trust and buyer-supplier relations, (3) the attractiveness of SD as a strategic alliance, or (4) business ethics for green SD or sustainable SD.



9a – Thematic map for the timespan 2000 – 2023



9b – Thematic map for latest time slice 2020 – 2023

Figure 9: Thematic maps (Source: author)

Moreover, Figure 9b and Table 5 refurbish the thematic map to the most recent time slice 2020–2023. In particular, five clusters (#1, #6, #8, #9, and #13) relating model or framework of SD inside firms have been extensively examined and considered as declining themes. Notably, cluster #9, disruptions, and cluster #13, productivity, have the same value of centrality and density to be at the same position in the thematic map. The themes relating to absorptive capability to extract and integrate information into product development or chain integration (#7, #10, and #11) remain in their

position in basic and motor themes. Themes concerning performance (#2) and buyer-supplier (#4) not only maintain their attraction but also expand the topics to other performances (in terms of sustainability, CRS, or innovation) or the dark side of buyer-supplier relations. Noteworthy, besides some modern themes, competitive advantages (#5), the resource-based view (#5), or trust (#3), financial performance (#12) and purchasing performance (#3) are ultramodern concepts as quality and supply chain performance are traditional performance metric for SD literature. They would be a new direction to evaluate SD dues to mass data and data analysis.

Table 5: Summary of 13 clusters in the thematic map for time slice 2020 – 2023

#	Freq.	Cen.	Den.	n	Keywords
1	2	0.25	50.00	1	firm (2)
2	178	11.58	76.32	33	performance (25), impact (21), management (12), antecedents (8), chain management (8), supplier development (8), sustainability (8), innovation (7), corporate social responsibility (6), selection (6)
3	11	1.56	76.67	5	capability (3), market (2), networks (2), organizations (2), trust (2)
4	8	2.25	93.75	4	buyer-supplier (2), contract enforcement (2), dark-side (2) mechanisms (2)
5	16	4.42	75.00	6	competitive advantage (5), resource-based view (3), development initiatives (2), governance (2), method variance (2), purchasing performance (2)
6	9	0.76	63.33	3	model (5), fuzzy c-means (2), rough set (2)
7	16	2.43	66.17	5	information (5), competition (4), risk (3), contracts (2), design (2)
8	11	1.28	68.75	4	framework (5), allocation (2), optimization (2), strategy (2)
9	2	0.00	50.00	1	disruptions (2)
10	7	1.75	69.44	3	product development (3), chain integration (2), dynamic capabilities (2)
11	6	1.50	75.00	3	absorptive capacity (2), capabilities (2), information technology (2)
12	6	0.00	83.33	3	financial performance (2), role (2), social responsibility (2)
13	2	0.00	50.00	1	productivity (2)

Note: Freq. – Frequency, Cen. – Centrality, Den. – Density, n – number of keywords in one cluster.

Cluster #2 has 33 keywords, only the top ten keywords are listed here.

The number in round brackets is the frequency number for the respective keyword.

6. Conclusion

SD has been a fundamental field in operation and management study for over 20 years. Despite the wide study of the topics, with 212 studies until the end of 2023, there is no study visualising the general view of how SD research has evolved. To fill this gap, this study used the “bibliometrix” package and VOSviewer software to present the SD research’s evolution and potential direction. Citation, co-citation, and coupling analysis have discovered the most affluent journals, authors, institutions, and countries in SD literature. They also reveal moderately the conceptual, intellectual, and social structure of the SD research area. Moreover, historiography, keyword co-occurrence analysis, and thematic evolution would complete the picture of conceptual and intellectual structure. Last but not least, trend topics and thematic maps would provide direction for future research examining SD.

From theoretical perspectives, this study discovers objectively (1) knowledge clusters, (2) the state of the field, (3) social patterns and processes supporting knowledge development, and (4) knowledge gaps in the field. From a practical viewpoint, this study enables objective assessments of research productivity and impact, which determine the coverage, dominance, or further examination of research. Then, researchers can make equitable decisions in terms of topics, directions, or methodologies.

While our study emphasised the strength of the bibliometric review of SD, it is important to acknowledge its limitations. Firstly, the bibliometric analysis highly depends on the databases and sources used. The data used in this study was solely extracted from WoS Core Collection which caused the missing database before 2000. This incomplete coverage (collection, language, or document types) affects the comprehensiveness and representativeness of the analysis. Besides, the natural disadvantage of bibliometric analysis lies in overemphasis on citation counts and equal weight to all authors. These drawbacks cause inadequate capture of the influence of a publication or author, as a high citation count does not guarantee the relevance of articles and contributions of individual researchers. Noteworthy, SD is a dynamic field with rapid changes in industry practices and technology support. Then, this study might not fully capture the emerging themes and underestimate the qualitative aspects of the SD literature. To overcome these limitations, future research can merge databases from different sources (Scopus, PubMed, or Google Scholar). Researchers can combine bibliometric and content analysis to gain a comprehensive contextual understanding of one motor and niche themes in the SD field as presented above.

Appendix – Query Description

Categories	Criteria	# refined documents
Query outcomes before search refine: Use the keyword “supplier development” in the title, author keywords, and keyword plus. Timespans is 1900-01-01 to 2023-12-31		343
Subject area	Limit to the following subjects: Management (142), Operation research management science (96), Business (75), Economics (12), and Business finance (4)	247
Document Type	Limit the documents to articles (208), review articles (12), and early access (9)	220
	Exclude all book series or correction	214
Language	Exclude all languages other than English	212
Final number of documents (after search refine and no duplication)		212

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