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Review

A Scientometrics Review on City Logistics Literature: Research Trends, Advanced Theory and Practice

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Abstract: The contradiction between the contribution of city logistics (CL) to sustainable urban development and its negative externalities is increasingly prominent. Policy supervision measures and the green logistics initiative are also in conflict with the management goal of logistics enterprises. Innovative solutions for CL have attracted increasing research attention worldwide. However, the description of the global research network in the field of CL, research trends, and the discussion of advanced theories and practices have not been systematically reviewed so far. Especially in the past three years, there has been an explosive growth of relevant literature. In this paper, the method of combining scientometric analysis and thematic discussion was adopted to systematically review 513 important works in the literature from 1993 to 2018, aiming to provide a holistic understanding of the status in quo, trends and gaps of CL research, and to further analyze prominent problems. The study has made statistical analyses of the publication year profile, journal allocation and research methods of the included literature, and constructed four kinds of visualized bibliographic information timeline maps for the authorship network, international collaboration network, keywords co-occurrence network and research topic clustering. Then, the three themes summarized by clustering are discussed, mainly focusing on CL strategies and policy, green supply chain management, planning methods, and advanced concepts and practices. Finally, the research gaps framework and agenda were reported. This study contributes to summarizing the research and development of city logistics on the whole, and can also serve as an explorative manual to support sustainable urban freight activities and innovative research.

Keywords: city logistics; sustainable transport; literature review; scientometrics analysis; thematic analysis

1. Introduction

City logistics (CL) is a vital facilitator of the supply chain vitality, economic development and business prospects, which ensures the continual and stable operation of large-scale freight transport activities between suppliers and consumers in urban areas [1,2]. However, the rapid increase in demand for urban distribution services caused by the development of e-commerce and the upgrading of urban consumption capacity has placed a great burden to urban mobility (e.g., congestion, low accessibility and inefficiency) [3], the environment (e.g., visual intrusion, greenhouse gas emission and resource waste) [4], social welfare (e.g., noise, accident and public health), and governance (e.g., informal freight sector, land scarcity and uncontrolled sprawl) [5]. More than 40% of atmospheric contaminations and

traffic hazards in city areas are caused by CL [6]. Obviously, the duality of CL has brought challenges to human health and the quality of life [7].

Strong interactions between freight transport and sustainable urban development have aroused widespread social awareness. Stakeholders have initiated numerous green logistics initiatives to reduce the negative externalities and improve the sustainability of CL, such as eco-friendly transportation technology, green supply chains, and resource reduction plan [5]. Decision makers are gradually considering and implementing the future CL industry from the perspective of urban infrastructure planning. At the same time, researchers are also enthusiastic about CL solutions under the requirements of urban sustainability. In the past decade, the number of articles and the diversity of studies in this field have increased significantly. Ogden (1992) [8] advocated the construction of CL theory and a practice knowledge body, which should be a complex system integrating technology, engineering, management, and policy, but it is still missing up to now [9]. Therefore, an exploratory scientometric analysis of the existing CL literature is conducive to a holistic understanding of the current research state and future directions.

Many review-based studies have been conducted to integrate the efforts and experience of CL development. Lagorio et al. [10] investigated the general publication resource, bibliometric citation network and main topics from 104 studies during 2000–2015. Dolati Neghabadi et al. [11] systematically reviewed 370 CL literature items published from 2010 to 2016 and summarized research topics based on keyword classification method. Allen et al. [12] reviewed 162 studies over the last 50 years and identified 12 different survey techniques that associated with the data collection issues in urban freight deliveries. A review oriented to 150 proceedings of the International Conference on City Logistics from 2009 to 2013 was provided by Behrends [4], in which the author indicated that more research was necessary to address the urban logistics in developing regions. Lindholm [13] critically reviewed 346 relevant literatures and proposed an improved framework for the measurement, monitoring, and performance indicators of urban freight transport from the perspective of the government. Existing reviews have made a significant contribution to outlining the CL research history and expanding the future horizon [9,14]; however, efforts to use objective and quantitative methods to map out the visualized relationships among the researcher clusters, collaborative institutions and high-frequency keywords in this field are limited.

To bridge the gaps, this study attempts to perform a systematic review aided by scientometrics techniques to explore the status quo, trend, focus and gaps of CL research. The review covers international peer-reviewed journals and major conference papers both published in English. The motivation of this review is to identify and analyze three part of issues in CL research process: (i) statistical characteristics of the scientific literature worldwide; (ii) key research themes and potential solutions for improving the sustainability of CL, and (iii) research gaps and agenda.

The contributions of this study, which differ from previous works, are summarized as follows:

i Based on the great academic progress of CL research in recent years, a total of 513 literature from multiple academic databases were retrieved, selected and described systematically, and the development trend of CL research in the future was determined;

ii The method of scientometrics was used to realize the visualization of literature, and the quantified bibliographical networks of authorship, co-citation, countries/institutions, and keywords co-occurrence for CL literature were established. This research strategy avoids subjectivity and arbitrariness of literature reviews, drawing more objective and effective conclusions;

iii The hotspots and academic frontiers of CL research were categorized and discussed in-depth. The framework of knowledge gaps revealed in the existing literature and the corresponding agenda were illuminated to enlighten future study.

In summary, the findings of this study contribute to obtaining accurate and complete information about CL research over time and offering insights into current intellectual landscapes, research frontiers and emerging trends.

2. Methodology

Systematic reviews are a fundamental but crucial approach for identifying, examining and appraising meaningful findings and knowledge gaps across all the relevant literature on a specific set of research topics [15]. Scientometric analysis is a quantitative tactic that could enhance the visual and logical perception of systematic review outcomes by assessing, clustering and mapping the quality and the relevance of articles through mathematical models and algorithms [16]. Figure 1 presents the three-stage schematic process of this study. The research framework is organized as follows: In the first stage, a comprehensive material retrieval was carried out, followed by setting criteria to select literature, and finally data synthesis was conducted. After an overview of indexed documents, the bibliographic network visualization and quantitative analysis were completed in Stage 2, where four branches of scientometric experiments were designed and performed. In the third stage, three themes were discussed separately based on the scientometric results. Finally, gaps and research findings were summarized. The four branches of scientometric experiments are as follows:

- Authorship collaboration experiments, using collaborative network to analyze (i) the relationship among co-authors, (ii) the frequency of authors co-cited, in the indexed documents.
- Geographical experiments, to investigate the geo-distribution of cooperative research institutions and countries in the indexed documents.
- Keywords co-occurrence experiments, to analyze the occurrence of correlated keywords in CL literature and their concentration by global researchers in different time span.
- Thematic clustering experiments, to identify the mainstream themes in the CL field.

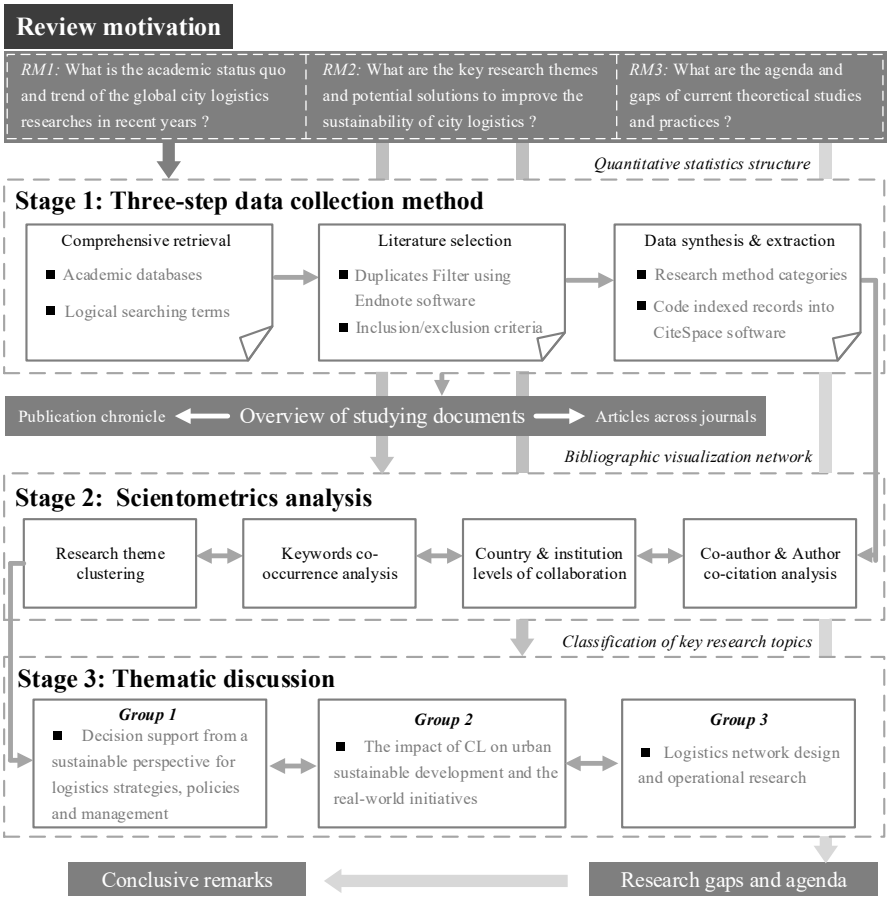

Figure 1. Systematic protocol for reviewing city logistics research.

The Java-based scientific data analysis software "CiteSpace" was adopted to investigate and map the knowledge network of CL literature. According to Chen et al. [17], CiteSpace is an open access application that developed for exploring the emerging trends and salient citation patterns from various visualized attributes. This tool has been widely used in a variety of review studies and has shown good capabilities [18,19]. Moreover, the software can provide users with a concise understanding of the relationships between different literature by measuring parameters such as node weight, linkage strength and centrality.

3. Data Collection

3.1. Material Comprehensive Retrieval

The target of the comprehensive retrieval was reviews and research articles published in academic journals, excluding other types of publications, such as book chapters, editorials, letters, proceedings and reports. Five online databases, *Elsevier*, *Web of Science* (*WoS*) *core*, *Scopus*, *Engineering* (*EI*) *Village* and *EBSCO Host* were designated considering the wide coverage of urban transportation and logistics publications. All the English-language papers during 1993–2018 were covered in the retrieval process. However, the preliminary search results showed that the literature volume of "city logistics" under the field of "Title/Abstract/Keywords" was very large (over 20,000 items), and most of the studies were actually irrelevant to the given topic. Accordingly, the search scope was restricted to the "Title" field to ensure that the obtained resources were relevant to the research target. Table 1 lists the detailed logical statement and the number of papers in five databases. A total of 3321 initial records were collected and imported into EndNote X8 software for filtering duplicates. Subsequently, 1379 duplicates were removed and the remaining 1982 records were available for further assessment.

Table 1. Comprehensive retrieval outcomes.

Database	*WoS core*	*EI Village*	*Elsevier*	*Scopus*	*EBSCO Host*	Initial Results	Valid Results
Number of papers	1396	175	302	758	690		
Logical statement	**TITLE** ((“city” AND (“logistics” OR “freight”)) OR (“urban” AND (“logistics” OR “freight” OR “goods” OR “delivery” OR “distribution”)) OR “last mile delivery” OR ((“urban” OR “city”) AND (“goods” OR “freight”) AND (“transport” OR “transportation”)) OR (“sustainable” AND “urban” AND (“logistics” OR “freight transport”)) OR (“urban logistics” AND (“land use” OR “environment”))					3321	1982

3.2. Literature Selection

The retrieval results need to be further checked for compliance with the credibility requirements of the systematic review [15], because the retrieval strategy adopted cannot guarantee the accuracy strictly. For example, this article "Utilization of *logistics* regression for *urban* food consumption" is not the desired result. To eliminate these discrepancies, the special inclusion/exclusion criteria as shown in Table 2 were defined. The exclusion criteria followed the screening values proposed by Vilela et al. [20] and Salim et al. [21] to comprehensively estimate the length of the article, journal of qualification, article integrity, homogeneity and correlation. Accordingly, two peer-reviewed proceedings journals, "*Procedia-Social and Behavioral Sciences*" and "*Transportation Research Procedia*", included in *Elsevier* were retained, in view of their high quality of papers. The inclusion criteria were derived from Dolati Neghabadi et al. [11], whose work summarized the leading research topics of CL development over the years. It is also important to check the recorded information one by one while reading the abstract in parallel. Additionally, some researchers have proposed the sustainable developing goals for urban transportation from the perspective of generic assessment of land use and environmental impact, but they do not lay their emphasis on the CL domain. Eventually, 513 qualified titles were included in our literature review portfolio. The acquisition method of all 513 documents are offered in the Appendix A. The data collection results and erased contents are illustrated in Figure 2.

Table 2. Pre-specified selection benchmarks.

NO.	Inclusion Criteria (CL Topics)	NO.	Exclusion Criteria
1.	Review on urban freight transport	1.	Less than 5 pages and grey literature
2.	Freight and urban sustainability	2.	Non-peer-reviewed journal
3.	Advanced technology and concept	3.	Repeated articles published in different journals with same authorship (only the earliest one is retained)
4.	Environmental, social and cost-benefit issues	4.	Articles do not relate to urban freight movement (e.g., inter-city transport, passenger traffic, water or gas distribution, urban planning, waste and energy)
5.	Planning and simulation of network operation	5.	Sustainability not related to urban (e.g., enterprise supply chain, nationwide logistics)
6.	Intermodal application and practice	6.	Lack of references, authorships or full text
7.	Policy making and developing strategy		
8.	Supply chain design and management		
9.	System evaluation and forecast		
10.	Risk and efficiency		

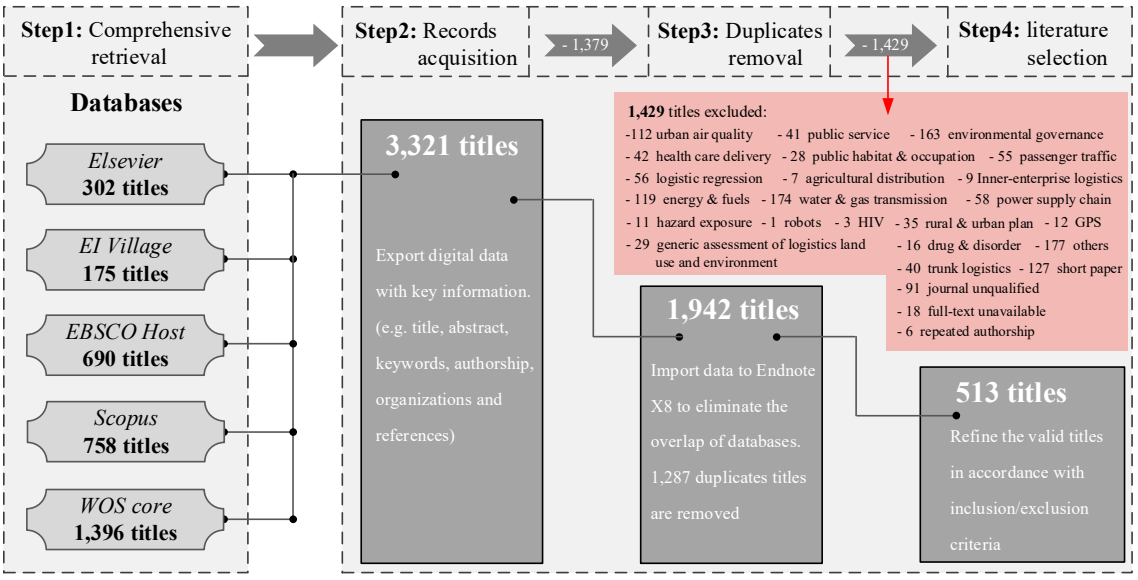

Figure 2. Flowchart of data collection.

3.3. Data Synthesis And Extraction

Data synthesis serves to summarize the methods applied in the research of CL; it is crucial to the integrity of a systematic review. The classification of research methods cannot be completed by scientometrics. Therefore, according to Lagorio et al. [10], the research methods are divided into six categories: "Review", "Qualitative and conceptual paper", "Modelling and simulation", "Questionnaire survey", "Empirical paper", and "Hybrid techniques". Smart group function of *Endnote* was utilized to sort the indexed records automatically by reviewing the Title, Abstract, and Keywords of each document. At last, 476 of 513 articles were identified and assigned to the appropriate categories (see Table 3). The result shows that modelling and simulation is the most applied, accounting for 36%. followed by qualitative and conceptual studies, accounting for 23%.

Then, the authors, journal name, institution, title, abstract, keywords, citation, reference and other digital statistical data of each article were organized and compiled into CiteSpace 5.3 R6 (64 bit) version for the next round of bibliographic analysis. The full-text of articles were evaluated in advance to make sure the correctness of software coding.

Table 3. Bibliometrics classified by research methodology.

Research Methodology	Description	Count
Review	A study that reviews and analyses the progress of current research	42
Qualitative and conceptual	A study that focuses on qualitative analysis or conceptual framework	111
Modelling and simulation	A study that uses a model from mathematical functions for decision-making purposes	174
Questionnaire survey	A research instrument consisting of a series of questions (or other types of prompts) for the purpose of gathering information from respondents.	17
Empirical research	A study of gaining solution proposal by means of direct and indirect case study or experience.	49
Hybrid techniques	A study that use a mixture of two or more methods described above	83

3.4. Overview of Selected Literature

A year profile of the selected papers from 1993 to 2018 is shown in Figure 3. Since 2010, the number of published papers has increased significantly year by year, and the total number has accounted for more than 90% (462 out of 513). Notably, 223 papers (44% of all) have been published in the past three years, with the highest proportion in 2018 (82 titles). The overall trend indicates that the planning and management of urban-level freight transport has become a focus in the field of research and continues to receive increasing attention.

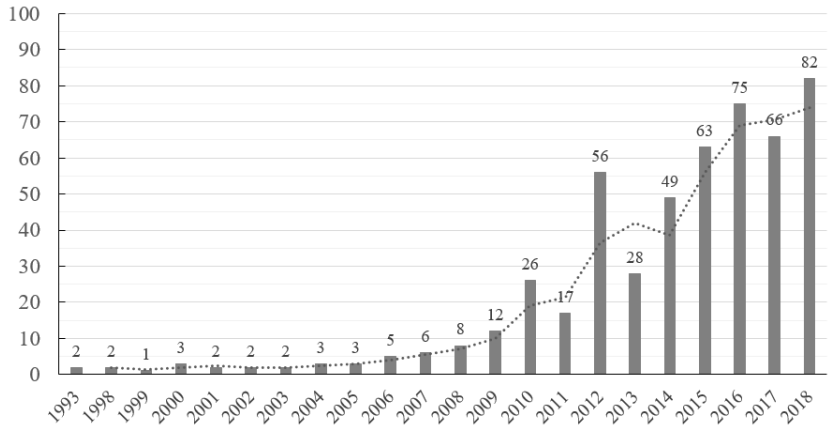

Figure 3. Distribution of the indexed papers published from 1993 to 2018.

Table 4 lists the total 17 journals covering 7 or more articles with highlighting their impact factor (IF) and H-index. Therein, two conference-oriented journals contributed to 170 articles, accounting for 33.1% of all. In terms of 343 journal articles, *Transportation Research Part E: Logistics and Transportation Review* published 15 articles (2.9%) on CL, ranking first, followed by *Transportation Research Part A: Policy and Practice* (14 articles) and *Transport Policy* (14 articles). With an overview of all journal titles, Europe is the main battleground for the study of CL.

Table 4. Rank of journals in CL research productivity.

Source Publication	Host Country	Count	Percentage	Impact Factor	H-Index
Regular Journal		**343**	**66.9%**		
Transportation Research Part E: Logistics and Transportation Review	UK	15	2.9%	3.289	85
Transportation Research Part A: Policy and Practice	UK	14	2.7%	3.026	101
Transport Policy	UK	14	2.7%	2.512	70
Journal of Transport Geography	UK	13	2.5%	2.699	75
Research in Transportation Business & Management	Netherlands	13	2.5%	NA	16
Journal of the Transportation Research Board (*Transportation Research Record*)	USA	13	2.5%	0.695	86
European Transport - Trasporti Europei	Italy	12	2.3%	NA	13
European Journal of Operational Research	Netherlands	11	2.1%	3.428	211
Transport Reviews	UK	10	1.9%	4.647	59
International Journal of Logistics Management	UK	10	1.9%	1.776	85
Research in Transportation Economics	UK	9	1.8%	0.992	30
Case Studies on Transport Policy	Netherlands	9	1.8%	NA	8
Transportation Science	USA	8	1.6%	3.275	93
Transportation Research Part D: Transport and Environment	UK	8	1.6%	3.445	74
Sustainability	Switzerland	7	1.4%	2.075	42
Unlisted journals (<7 titles)		177	34.5%		
Conference-oriented Journal		**170**	**33.1%**		
Transportation Research Procedia	Netherlands	89	17.3%	NA	11
Procedia-Social and Behavioral Sciences	UK	81	15.8%	NA	34

The journals' IF was obtained from *Journal Citation Reports* (2017), H-index was from *Scimago Journal & Country Rank*. NA: not available.

Citation statistics were obtained from the Google Scholar database. Table 5 lists the top 10 most influential research articles in the field of CL. The three most cited articles are Dablanc [22], Crainic et al. [23] and Crainic et al. [1], with 448, 404 and 395, respectively.

Table 5. Top 10 most cited documents in Google Scholar.

Document	Year	Journal	Count	Topic Related to CL
Dablanc [22]	2007	Transportation Research Part A	448	Policy & regulations
Crainic et al. [23]	2009	Transportation Science	404	Service network design
Crainic et al. [1]	2004	Transportation Research Part A	395	System integration
Muñuzuri et al. [24]	2005	Cities	321	Solution & initiative
Anderson et al. [3]	2005	Journal of Transport Geography	296	Policy strategy
Krajewska et al. [25]	2008	Journal of the Operational Research Society	276	Business cooperation
Taniguchi and Van Der Heijden [26]	2000	Transport Reviews	229	Traffic simulation
Ambrosini and Routhier [27]	2004	Transport Reviews	217	ITS
Hemmelmayr et al. [28]	2012	Computers & Operations Research	213	Vehicle routing problem
Taniguchi and Shimamoto [29]	2004	Transportation Research Part C	210	ITS

4. Scientometric Analysis

CiteSpace software can construct a visual network based on bibliographic data information for scientometrics analysis. In this visual network, a node represented a specific bibliographic information type, such as author, institution, country, keyword or reference, etc., while link described the co-citation

or collaboration between these nodes. The two options in CiteSpace, *top 50 levels of node values* and *minimum spanning tree optimization*, are the commonly used parameter presetting strategy for network generation. This strategy can get a reasonable number of nodes and can cut unnecessary branches in the network [18]. The *top 50 levels of node values* are selected from biennial slices used for CiteSpace analysis. Two metrics, the mean silhouette (S) and the modularity (Q) are used to reveal the "overall structural properties" of the network. The higher S value indicates a better matching degree between this node and its generic clustering while a higher Q value denotes a higher dispersion degree of the merged network [19]. Then, three experiments were carried out based on the network generation method.

4.1. Authorship Collaboration Experiments

According to the 513 bibliographic authorship, an initial co-author network with 1139 nodes and 1775 links was generated. The modularity and mean silhouette values of the network were $Q = 0.981$ and $S = 0.889$, respectively. In order to make the network more compact to display valuable information, the node position was adjusted and the minor nodes with less than 3 publications were weakened. As shown in Figure 4, the large nodes in the network represent authors who publish more. Links in different colors, such as blue, green, yellow and orange, links indicate the authors' collaboration relationship in different years of publication (from 1993 to 2018). Table 6 lists the active authors who have the contributed to CL research. Antonio Comi (University of Rome Tor Vergata), Michael Browne (University of Westminster) and Eiichi Taniguchi (Kyoto University) are the top three prolific authors. Meanwhile, three closed-loop research communities can be identified by taking the above 3 authors as the central nodes. For example, the node named Antonio Comi covers Agostino Nuzzolo, Francesco Russo and José Holguin-Veras, etc. Similarly, the research community, with Michael Browne and Julian Allen working at the same institution at its core, covered the likes of Hans Quak, J. H.R. Van Duin and Cathy Macharis.

According to graph theory, Freeman's betweenness centrality [30] is an effective indicator to evaluate the importance of nodes in the network, and it has been widely applied in the previous scientometrics review [18,19]. The betweenness centrality can be calculated via formula Equation (1), where μ_{mk} is the sum of shortest paths from node m to node k; and $\mu_{mk}(i)$ is the number of those paths that pass through node i. The node centrality score can be detected by the color of the rim in CiteSpace [18]. Nodes with purple rim have higher scores, indicating important relationships among large clusters they link. In Figure 4, the authors with purple rim include Michael Browne (centrality = 0.14), Hans Quak (centrality = 0.08), Christian Ambrosini (centrality = 0.03) and Laetitia Dablanc (0.02). These nodes show frequent collaboration with authors from different clusters.

$$Centrality\ \omega(node_i) = \sum_{m \neq i \neq k} \frac{\mu_{mk}(i)}{\mu_{mk}} \cdot (1) \quad (1)$$

The author co-citation analysis aims to find out the evolution of the collaborative relationship between academic communities or individuals who have made great contributions to CL research. After processing 9406 references from 513 publications, a network consisting of 1309 nodes and 3215 links (as shown in Figure 5) was constructed. The modularity of the network is $Q = 0.592$ and the mean silhouette is $S = 0.588$. The highest cited author is Eiichi Taniguchi (Freq. = 93, Japan), followed by Laetitia Dablanc (Freq. = 85, France), Hans Quak (Freq. = 68, Netherlands), Michael Browne (Freq. = 65, UK), Teodor G. Crainic (Freq. = 64, USA), Francesco Russo (Freq. = 49, Italy) and Maria E. Lindholm (Freq. = 48, Sweden). This shows that their work has been widely recognized and plays a fundamental role in promoting the CL research. Similarly, nodes with purple rims represent authors with high centrality metric. Eiichi Taniguchi (centrality = 0.25), Teodor G. Crainic (centrality = 0.20) and Amanda Stathopoulos (centrality = 0.17) ranked top three. Their work has served as a bridge between different authors and communities.

Table 6. Top 10 most productive authors.

Scholar	Affiliation	Country	Count	Percentage
Antonio Comi	University of Rome Tor Vergata	Italy	25	4.9%
Michael Browne	University of Westminster	UK	20	3.9%
Eiichi Taniguchi	Kyoto University	Japan	17	3.3%
Edoardo Marcucci	University of Roma Tre	Italy	15	2.9%
Agostino Nuzzolo	University of Rome Tor Vergata	Italy	14	2.7%
Julian Allen	University of Westminster	UK	12	2.3%
Valerio Gatta	University of Roma Tre	Italy	12	2.3%
Cathy Macharis	Vrije University Brussel	Belgium	11	2.1%
Russell G. Thompson	Monash University	Australia	10	1.9%
Laetitia Dablanc	University of Paris	France	10	1.9%

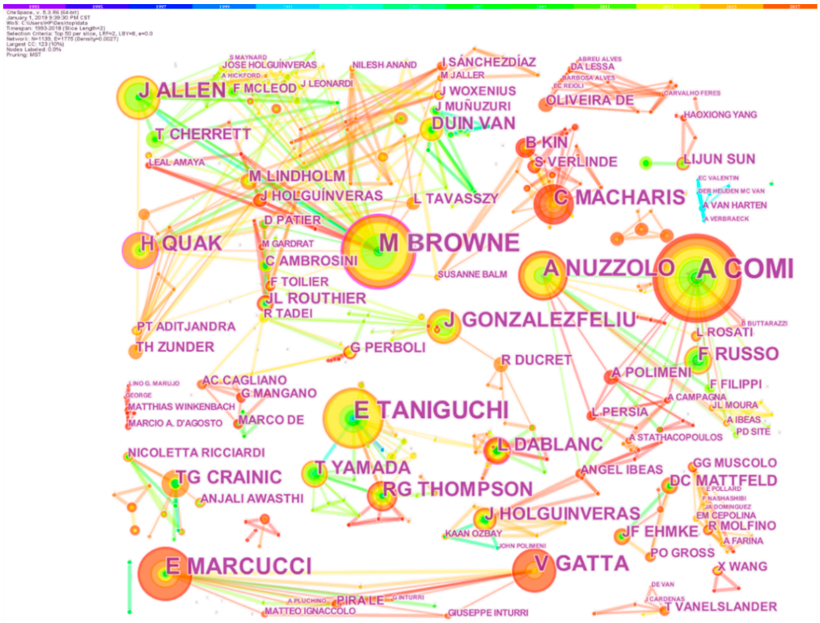

Figure 4. Co-author network.

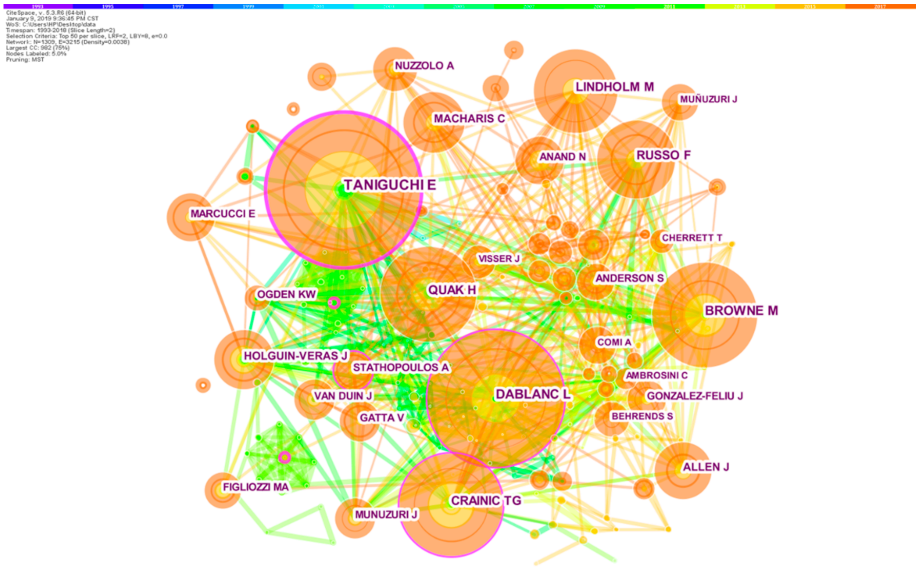

Figure 5. Author co-citation network.

4.2. Geographical Experiments

Geospatial experiment is conducted to evaluate the collaborative level among countries, regions and institutions in CL research. The location of one literature in the CiteSpace network is generated by the institution address of the corresponding author [31]. In the same way, a visual network (as shown in Figure 6) representing "country" category contains 74 nodes and 150 links, with the network parameter $Q = 0.4387$ and $S = 0.3133$. A total of 25 active countries have published more than 5 articles. USA (82 articles, 611 citations) and Italy (76 articles, 592 citations) ranked top two for number of publications and total citations, followed by UK (42 articles), France (40 articles), China (34 articles), Netherlands (33 articles) and Germany (30 articles). Swedish scholars held the highest average citation rate (25.65 times per article), followed by Netherlands (17.42 times) and USA (10.19 times). Countries such as USA (centrality = 0.74), Italy (centrality = 0.25), France (centrality = 0.19), Germany (centrality = 0.19), UK (centrality = 0.13), Spain (centrality = 0.11) and Canada (centrality = 0.10) were highlighted by purple rims (see, Figure 6). They are leading international collaboration in CL research.

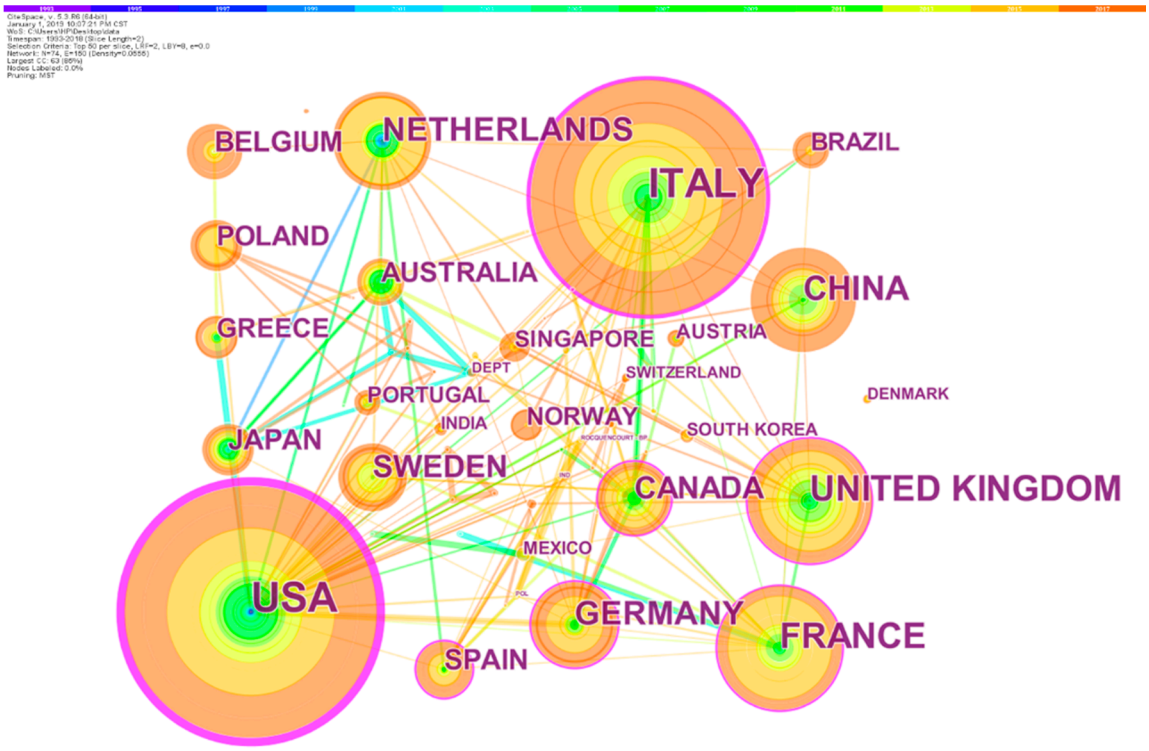

Figure 6. Network of countries.

Another indicator, burst strength (BS), which can be calculated via the algorithm introduced by Kleinberg [32], was embedded to reflect the dynamic growth of a citation over a short period of time. Nodes with extraordinary citation burst strength, including Australia (BS = 4.34, 2003 to 2011), China (BS = 4.02, 2011 to 2013), Japan (BS = 3.01, 2005 to 2009), UK (BS = 2.39, 2011 to 2014) and USA (BS = 1.68, 2000 to 2011), show the article which has received the most attention during a certain period. Note that in recent years (2015 to 2018), the number of published articles has increased greatly, but that there was no citation burst. This phenomenon indicates that the globalization trend of CL research has made it difficult for a single country to obtain a high citation in a short time.

The contribution of institutions was also identified. Specifically, the co-authorship information of all indexed digital records is analyzed through CiteSpace to generate Keyhole Markup Language (KML) files. These files were then imported into Google Earth software for real-world visualization. Figure 7 illustrates the geographical distribution of international collaboration on CL research at the institutional

level in the three high-density research regions of Europe, North America (NA) and Asia. Red nodes and cyan nodes represent the time span of literature publication before and after 2015, respectively. The connections between two nodes indicate the strength of the partnership. The graph shows the strong international cooperative research relationship between Europe and NA, with 54 articles published together, while Europe-Asia cooperation has published 23 papers, and NA-Asia cooperation has published 28 papers. In addition, University of Rome Tor Vergata (33 articles), Delft University of Technology (28 articles), University of Westminster (22 articles), Kyoto University (17 articles), Chalmers University of Technology (16 articles), University of Texas at Austin (10 articles) and other institutions are very active in the field of CL.

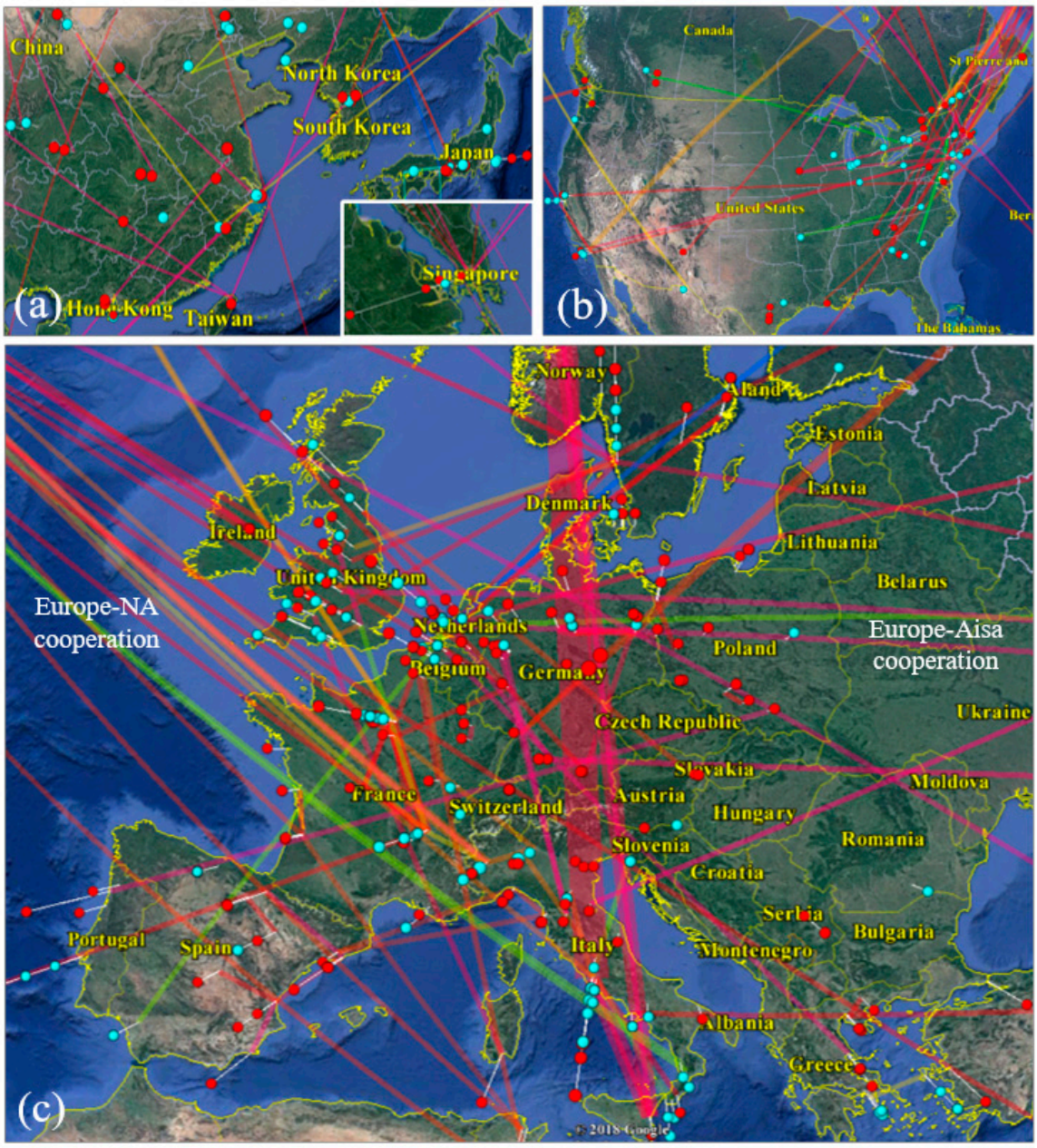

Figure 7. Geospatial distribution of published research documents in Asia (**a**), North America (**b**) and Europe (**c**).

4.3. Keywords Co-Occurrence Experiments

A keyword is a noun or phrase that not only reflects the meaning or core content of a literature, but also reveals the long-term development of a specific research field [33]. Therefore, the keywords co-occurrence experiments in the literature can dig out the current research hotspots of CL. The keywords analyzed in CiteSpace include two sources: (i) original keywords offered by authors in their articles, and (ii) extended keywords based on the subject classification of a journal or database. In the visualization process, terms with similar meanings were merged, such as "transportation" and "transport", "urban" and "city". Accordingly, a chronological network consisting of 659 nodes and 1814 links reflecting the co-occurred keywords was built, as shown in Figure 8. The value of modularity and mean Silhouette resulted in $Q = 0.298$ and $S = 0.501$, respectively. Different colored annular rings on the nodes symbolize the time when the keywords appeared, and the link between the two nodes indicates that the two keywords appeared in the same document.

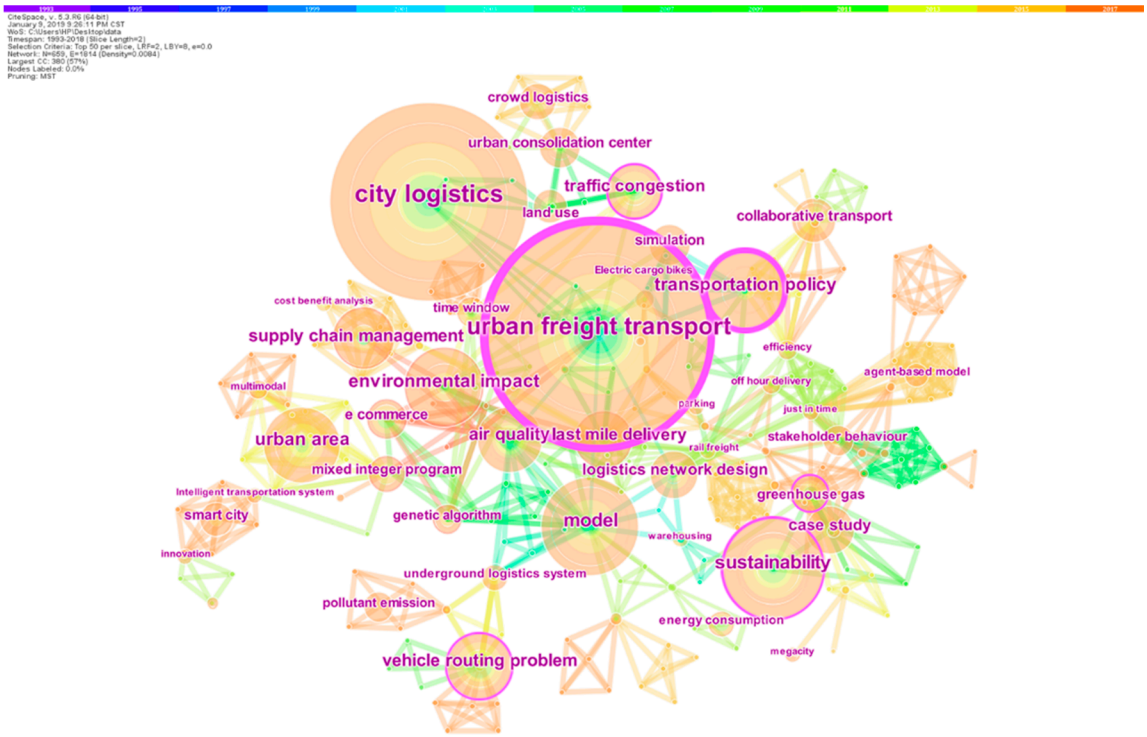

Figure 8. Network of co-occurring keywords.

The size of the node indicates the occurring frequency of the keyword. The top 10 high-frequency keywords are "urban freight transport" (Freq. = 241), "city logistics" (Freq. = 218), "sustainability" (Freq. = 60), "transportation policy" (Freq. = 56), "urban area" (Freq. = 43), "traffic congestion" (Freq. = 42), "air quality" (Freq. = 33), "last mile delivery" (Freq. = 31), "supply chain management" (Freq. = 30) and "model" (Freq. = 28). Additionally, the six nodes that scored high in centrality for the purple rim are "urban freight transport" (centrality = 0.25), "transportation policy" (centrality = 0.21), "sustainability" (centrality = 0.13), "traffic congestion" (centrality = 0.13), "greenhouse gas" (centrality = 0.13) and "vehicle routing problem" (centrality = 0.12). These keywords play a crucial role in forming CL research topics and connecting major branches of knowledge.

Table 7 listed the keywords with high burst strength and their corresponding burst durations. Among them, the use of "battery electric vehicle" [34], "underground logistics system" [35], "crowd logistics" [36] and "collaborative transport" [37] and other new technologies or business models to explore and solve the development of urban logistics problems has received great attention.

Table 7. Citation burst of keywords.

No.	Keywords	Burst Strength (BS)	Duration
1	city logistics	7.28	2008–2014
2	cost benefit analysis	3.86	2010–2015
3	battery electric vehicle	3.15	2015–2017
4	agent based model	2.81	2013–2014
5	mixed integer program	2.53	2013–2016
6	smart city	2.42	2014–2018
7	traffic congestion	2.41	2010–2013
8	underground logistics system	2.27	2016–2018
9	customer satisfaction	2.25	2013–2014
10	crowd logistics	2.21	2015–2018
11	collaborative transport	2.19	2015–2018
12	off hour delivery	2.04	2013–2016

Clustering analysis of keywords co-occurrence results based on Log-Likelihood ratio (LLR) metric was adopted to identify the meaningful CL research topics. Clustering analysis is an exploratory data mining technique that aims to depict patterns by grouping sources that share similar words or attribute values [38]. Figure 9 presents the timeline map of 22 noticeable clusters automatically output by CiteSpace. The cross points on the timeline represent the earliest year in which the literature review portfolio introduces a keyword. From 2016 to 2018, few new keywords were proposed, and majority of them appeared in the literature during 2010–2014. Table 8 illustrated the detailed classification results, where the clustering size represents the number of discrete keywords included. Cluster # 0 "multi-criteria decision" has 56 members, which is the largest, while cluster # 17 "integrated short-term planning", cluster # 19 "refunding strategy" and cluster # 20 "knowledge-based modeling" are the smallest, with only 3 members respectively.

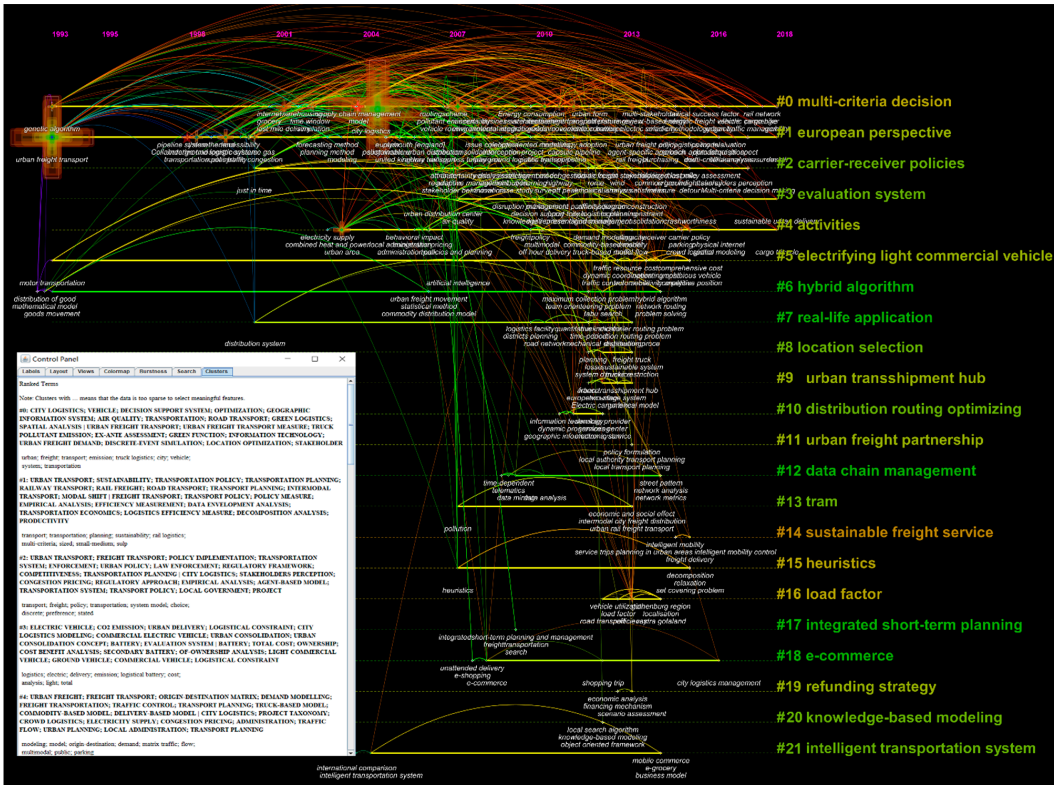

Figure 9. Timeline clustering map of research themes in CL field.

Table 8. Categories of CL keyword clusters (1993-2018).

Topic Group	Cluster ID	Size	Cluster Label (LLR)	Time Span
Group 1	# 0	56	multi-criteria decision	1993–2018
	# 2	33	carrier-receiver policies	2000–2017
	# 3	17	evaluation system	2007–2018
	# 11	4	urban freight partnership	2013–2013
	# 12	7	data chain management	2009–2014
	# 19	3	refunding strategy	2012–2013
	# 20	3	knowledge-based modeling	2012–2012
Group 2	# 1	51	European perspective	1993–2018
	# 4	22	activities	2003–2018
	# 7	11	real-life application	2000–2013
	# 14	4	sustainable freight service	2014–2015
	# 18	5	e-commerce	2008–2016
	# 5	10	electrifying light commercial vehicle	1993–2015
	# 9	6	urban transshipment hub	2011–2013
	# 13	4	tram	2007–2013
	# 21	5	intelligent transportation system	2004–2014
Group 3	# 6	12	hybrid algorithm	1993–2014
	# 8	6	location selection	2011–2013
	# 10	6	distribution routing optimizing	2010–2012
	# 15	4	heuristics	2007–2015
	# 16	6	load factor	2012–2014
	# 17	3	integrated short-term planning	2009–2009

In order to facilitate the thematic discussions on research priorities, the 22 clusters were manually classified into three groups, namely "decision support from a sustainable perspective for logistics strategies, policies and management (G1)", "the impact of CL on urban sustainable development and the real-world initiatives (G2)" and "logistics network design and operational research (G3)", ignoring the small differences among clusters.

5. Thematic Discussion

5.1. Decision Support from a Sustainable Perspective for Logistics Strategies, Policies and Management (G1)

G1 focuses on two basic topics in the field of CL, namely, the costs and efficiency of CL supply chain at industrial level, and the CL strategy and policy research at the governmental level. For the former research, here are some representative works. A questionnaire-based economic analysis was designed by Kim and Sohn [39] to evaluate the expected costs and profits of operating radio frequency identification (RFID) system in the transportation process from suppliers to customers. Hu and Sun [40] proposed an operational research method that incorporated experienced schedulers' knowledge to support the real-time disruption management of CL supply chain. The quantitative indicators considering time window and service quality were proposed by Deflorio et al. [41] for predicting the cost of end-to-customer supply chain. Sakai et al. [42] investigated the impact of decentralized migration and spatial distribution of CL facilities on the supply chain efficiency. In particular, logistics enterprise alliance strategy is an important research direction to reduce supply chain cost. Hensher and Puckett [43] discussed the interaction between congestion charging regime and cost sharing benefits in CL supply chain. Vanovermeire and Sorensen [44] has proposed the profit allocation mechanism among partners under the horizontally cooperative mode, which indicated that logistics efficiency and cost benefits increased with the measure of synchronized order consolidation. A survey conducted by Lin et al. [45] revealed that urban delivery consolidation strategy was economically and environmentally attractive, when the economy of scale or high customer density was ensured. For more knowledge on collaborative management of CL supply chain, readers may review [25,46]. Additionally,

the information retrieval tactics such as *data mining* [47], *case base reasoning* [48], *GPS* [49], *GIS* [50], *demand forecasting* [51], and *cloud computing* [52] has also popularized in the CL supply chain research.

For the latter, more studies link urban logistics with urban sustainable development. CL is considered as one of the main reasons for the unsustainability of road traffic [53]. The current decision support for improving CL sustainability is mainly from two aspects. One is to upgrade the efficiency and external performance of freight transportation via technological measures (e.g., new energy vehicles [34] and environmental engineering [10]). The other one is to coordinate and manage the rapid growing CL activities through various regulations, such as the policy of setting low emission zones, congestion charging, truck loading, access timetable and so on [3]. However, the fact is that the local authorities usually choose to sacrifice freight transport efficiency to give priority to the development of other forms of transportation [3]. Practice and experience from global economy, especially European countries, showed that the strict regulation upon CL activities might not be beneficial to the development of integrated urban transportation [54,55]. On the contrary, it greatly limits the potential of logistics market [35] and negatively affects delivery punctuality [56].

At the level of macroscopic development strategy, there is a consensus that urban freight planning is far less important than mobility of people or public transport [57,58]. The deep motivation therein is long being a hotspot. Anderson et al. [3] stated that stakeholders' behaviors would impact CL industries in different ways, and the differences in logistics modes and attributes should be considered. Dablanc [22] indicated that CL management should adopt a mixture of negotiated agreements, public private partnerships and solid governing laws to meet the heterogeneity existing in various logistics market. According to Quak and De Koster [7], both delivery time window and vehicle restrictive measures aiming at enhancing social sustainability would significantly increase the retailers' costs. Through the comparative study of CL policies in different countries, Ballantyne et al. [56] found that most local authorities solely treated urban goods movement as a commercial issue occurred with the logistics industry, but neglected the exogenous impacts such as culture and tradition. The actual performance of freight policy is determined by the external factors, local ecosystem and their dynamic interaction [59]. Le Pira et al. [60] pointed out that few stakeholders were willing to accept any policy that implied a substantial increase in executive costs.

Many scholars believe that the sustainable development of CL should be fully considered in the process of urban spatial exploitation [61], infrastructure construction [62], and even the strategic planning of urbanization [22]. Meanwhile, the creation of logistics market commitment was thought to be a mutual responsibility of the public sector and private sector [63]. However, an important issue is that the major stakeholders, especially freight carriers and shippers were rarely able to participate in the integrated urban planning protocol [64]. Lack of interaction among stakeholders [65], inadequate supply capacity of logistics services [22], and imperfect decision-making knowledge [66] are considered as the Achilles' heel of effective planning and regulation of road-based urban logistics.

5.2. The Impact of CL on Urban Sustainable Development and the Real-World Initiatives (G2)

Worldwide efforts and initiatives to reduce the negative externalities of CL and to improve the urban environment and livability are gaining momentum [67]. As shown in Figure 10, G2 covers a total of 162 literatures, accounting for 31.6% of the portfolio, primarily aiming to analyze the environmental impact, land use and sustainability issues of case-based CL activities. Woudsma et al. [68] pointed out that the logistics land use pattern was dynamically affected by the accessibility of urban traffic and varied with the change of the location of the urban gateway. The managerial performance of urban road freight transport operations is deeply affected by geographical location, land use patterns and trade imbalances [12]. Behrends [69] constructed a road-rail multimodal transport model from the urban dimension to explore the freight potential and environmental benefits. Morana and Gonzalez-Feliu [70] constructed an indicator framework for economic, environmental and social evaluation of sustainable CL supply chain management through expert evaluation.

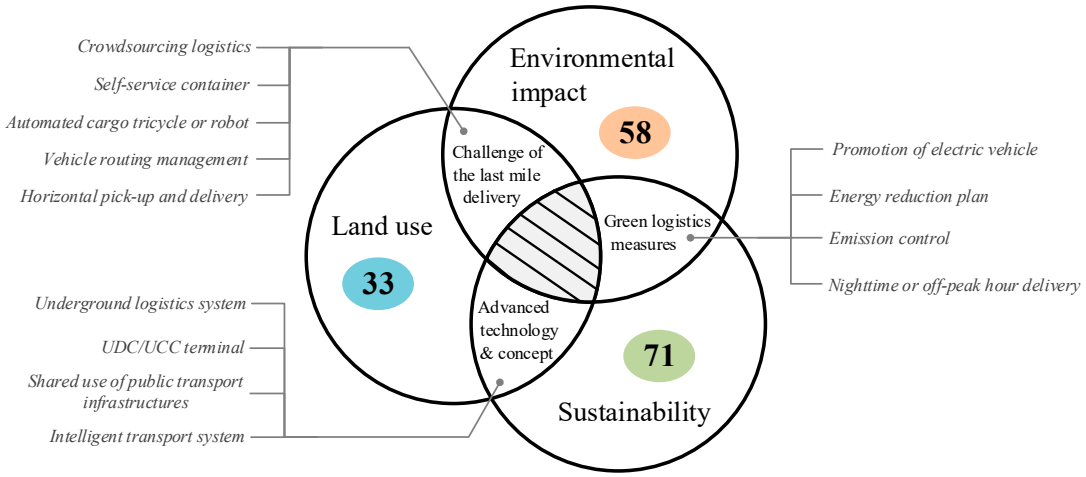

Figure 10. Research emphasis of sustainable urban freight transport.

The low efficiency of CL is the source of energy consumption and air pollution [71]. Coulombel et al. [72] developed a modeling chain combining demand process, multi-level traffic assignment and emission scheme to investigate the pollution of urban road freight in Paris. They found that lorries accounted for 8 percent of total urban mileage but generated 36 percent of additional social cost (up to 2.1 billion € per year). Restrictive freight access and load limitation policies were also considered to be major factors in increasing CL emissions [73].

Another emerging trend is the use of a variety of simulation-based modeling and evaluation methods to study the G2 topic, such as *system dynamic* [74], *agent-based modeling* [75], *impact predicting model* [2], *traffic microsimulation* [76], *multi-criteria group decision-making* [77,78], *fuzzy analytic hierarchy process* [79], etc.

In order to map an integrated knowledge structure for sustainable urban freight transport, the theoretical emphasis and research topic of G2 documents were further explored. As depicted in Figure 10, three salient subjects, "green logistics measures", "challenge of the last mile delivery" and "advanced technology and concept" are identified by the overlapping areas. The secondary titles are also attached to reflect the detailed research emphasis of each subject.

5.2.1. Green Logistics Measures

Achieving green logistics goal usually relies on two dominant measures: one is to promote the application of environmental-friendly energy (e.g., electric vehicle, EV), and the other is to improve logistics efficiency by policy-level incentives (e.g., nighttime or off-peak hour delivery), so as to reduce the negative effect of CL [80,81]. EV system in CL, seen as a possible alternative to the fuel-based logistics mode, has been widely discussed in recent years for its operation and management, such as benefit estimation [82], economic feasibility [83], policy support [84], competitiveness [85], investment risk [86], diffusion dynamic [87], business mode [88] and implementation barrier [89]. Meanwhile, the off-peak hour delivery has been proven to achieve better transport sustainability in terms of driving time, delivery reliability and energy efficiency [90,91].

5.2.2. The Last Mile Delivery Challenge

With the rapid development of e-commerce and just-in-time demand, challenges from last-mile delivery, such as time-efficiency and synchronization have become one of the bottlenecks in CL operations management [5]. The cost of last mile delivery occupied at most 75% of the total cost of the supply chain [92]. In recent years, the crowdsourcing mode (CSM) is considered as one of the most promising solution to cope with the gaps, which can be interpreted as a concept of outsourcing the end-service to an indirectly related community, such as neighbor or friend [93]. Several surveys of

logistics companies and public have indicated that CSM has gained high recognition in the logistics process by reducing pollution emissions and can generate huge cost benefits [94].

Improving the capability of equipment and infrastructure is another way to solve the last mile delivery problem. Initiatives in this area have focused on modular freight unit [95], self-collection cabinet [96], mobile depot [97], light goods tricycle [98], autonomous robot [99], etc.

5.2.3. Advanced Technology and Concept

The development of advanced infrastructure, such as urban distribution center (UDC) and urban consolidation center (UCC), is regarded as a sustainable and innovative solution to meet the freight demand in future urbanization [12]. Especially, UCC as an intelligent transportation system is gradually mature in practice, its implementation of the success factors and barriers are being hotly discussed [55,100].

Furthermore, collaborative strategies, such as the shared use of tram [101], rail transit [102], and metro network [103] for mixed passenger and freight movement, have been positively implemented in some urban delivery projects, e.g., Zurich [104], Vienna [104], Dresden [105] and Paris [106]. The optimization of passenger-freight time window [107] and operational schedule [108] is currently being hotly discussed.

Another ambitious concept is the urban underground freight pipeline and logistics system (ULS), which aims to alleviate traffic congestion and vehicle emissions by shifting the goods movement from urban road to a group of dedicated underground tunnels/pipelines [109,110]. The relevant research of ULS, such as underground transportation technology [111], feasibility [112] and system design [113], has actually experienced long-term study. Its practice has been supported by some national and local governments [114], but has not been implemented on a large scale. In recent years, with the prominent contradiction of urban transportation, ULS has ushered in a new round of development peak. According to Dong et al. [115], several UDC-based modern ULS projects have already stepped into the construction phase and been expected to operate within the next decade.

5.3. Logistics Network Design and Operational Research (G3)

In CL system planning, the mathematical modeling and optimization methods represented by operational research (OR) play an important role in deepening complex knowledge of urban freight transport into mathematical models with specific goals and constraints and designing accurate or heuristic algorithms for computational optimization. Over the past decade, a large amount of evidence has shown that the application of OR has not only attracted increasing research attention, but also made a great contribution in reducing the actual logistics cost and improving the robustness of decision-making in real-world cases [101,116]. Typical CL planning issues solved by OR are summarized as follows, mainly including *facility location problem* (FLP), *service network design problem* (SNDP), *vehicle routing problem* (VRP), *freight scheduling problem* (FSP), *location-routing problem* (LRP) and their variants. However, the theoretical results obtained by relevant literature on these five issues are not outstanding in practical sense, or are not directly related to the urban freight problem, which cannot be summarized as existing research results of CL to some extent. As synthesized in Table 9, a total of 28 representative documents from G3 were classified according to six domains recommended by Nagy and Salhi [117]: basic OR attribute, constraint, model type, application area, solution method and experimental size.

Table 9. The list of documents addressing the focused topic of G3.

Literature Source	Basic or Attribute	Constraint			Model type				Aim and Objective	Solution Method	Experimental Size (*City/State Name*)
		TW	Uncertainty	Capacitated	MIP	Hierarchial	Robust	Dynamic			
Oppenheim [118]	VRP		√		√				Mixed passenger and freight	Frank-Wolfe alg.	NA
Taniguchi and Shimamoto [29]	VRP	√	√		√			√	Intelligent transport system	Genetic alg.	25 depots & 80 links
Hu et al. [119]	VRP	√			√	√			Common urban distribution	Depth-first search alg.	106 depots (***Beijing***)
Crainic et al. [22]	SNDP	√		√	√	√			Common urban distribution	Decomposition	NA
Qureshi et al. [120]	VRP-FSP	√		√	√	√		√	Common urban distribution	Branch and price alg.	100 depots (***Tokyo***)
Zhong and Moodie [121]	FLP					√			Retail supply chain	Genetic alg.	240 km^2 area (***Dalian***)
Ehmke et al. [122]	VRP								Last mile delivery	Hybrid heuristic	50 depots (***Stuttgart***)
Hemmelmayr et al. [28]	VRP-LRP			√		√			Common urban distribution	Adaptive neighborhood search alg.	200 clients & 10 depots
Motraghi and Marinov [123]	FSP	√		√				√	Moving freight by metro	Discrete event simulation	Single metro line (***Newcastle***)
Smirlis et al. [124]	VRP	√							Third party logistics firm	Data envelopment analysis	300 clients (***Athens***)
Jiang and Mahmassani [125]	VRP	√		√	√			√	Freight distribution manage	Nearest neighbor heuristic	500 clients (***Chicago***)
Qureshi et al. [126]	VRP	√			√				Common urban distribution	Dantzig–Wolfe decomposition	225 nodes, 789 links (***Osaka***)
Fatnassi et al. [108]	SNDP-FSP	√	√	√	√	√	√	√	Mixed passenger and freight	Exact alg.	500 vehicles (***Northampton***)
Roca-Riu et al. [127]	FSP	√			√				Parking slot assignment	CPLEX	8 parking nodes (***Barcelona***)
Yang et al. [128]	FSP			√	√			√	Vehicle lease planning	Lagrangian relaxation alg.	50 nodes & 12 time periods
Ahani et al. [86]	FSP		√	√	√				EV replacement	MATLAB solver	64km daily use
Archetti et al. [129]	VRP-FSP			√	√			√	Last-mile delivery	Tabu search alg.	25 vehicles & 100 OD pairs
Crainic et al. [130]	SNDP-VRP	√	√	√	√	√		√	Adjust demand strategies	Monte Carlo simulation	3 satellites & 25 client zones
Ghilas et al. [131]	SNDP-FSP	√	√	√	√	√			Common urban distribution	Adaptive neighborhood search alg.	40 pickup & delivery orders
Park et al. [132]	LRP			√	√	√			Express service collaboration	Two-phase heuristic	20 k households (***Seoul***)
You et al. [133]	VRP	√		√	√				Truck assignment	Hybrid exact alg.	7 depots (***California***)
Behnke and Kirschstein [134]	VRP			√	√				Green logistics chain	Shortest path alg.	1,000 nodes (***Berlin***)
Behiri et al. [102]	FSP	√		√	√			√	Urban rail freight transport	Discrete event simulation	Single rail line (***Paris***)
Boysen et al. [99]	FSP	√		√	√		√		Robots for last mile delivery	Multi-start local search alg.	16 depots & 40 clients
Dong et al. [135]	SNDP-FLP			√	√	√			Moving freight by metro	Artificial immune alg.	2 metro lines (***Nanjing***)
Marinelli et al. [136]	SNDP		√	√	√	√			EV network configuration	Fuzzy C-Means Clustering	50 clients & 4 satellites
Ozturk and Patrick [106]	FSP	√		√	√	√		√	Urban rail freight transport	2-approximation alg. & dynamic program alg.	60 demands & single rail line with 30 stations (***Paris***)
Zhou et al. [137]	VRP			√	√	√			Last mile delivery	Hybrid genetic alg.	164 clients (***Chongqing***)

TW: time window; MIP: mixed integer programming; alg.: algorithm; NA: not available.

5.4. Research Gaps and Agenda

The comprehensive trend and theoretic core of CL literature have been clarified and discussed based on the scientometrics analysis and thematic review of the clustering results of CL literature. Although considerable efforts have been made by researchers and practitioners in urban freight planning and management, there are still some gaps that can be explored. Figure 11 builds an interactive framework by incorporating major topics, methodology, measures, and objectives of CL based on prior literature. Therein, knowledge advancement (method and theory), logistics innovation (technology push), and urgency of demand (scenario pull) are generally recognized as the three main driving forces for promoting sustainable urban freight transport [13,63]. For real-world practices, the inconformity between CL planning strategies and the satisfaction of stakeholders is widely recognized as a dominant obstacle to CL development. So far, the logistics activities have seldom been integrated into urban planning agenda [53]. Therefore, the success factors and the policy implication for city logistics cases should be highlighted as priorities for future research. In terms of knowledge, prior studies applied a series of theories to discuss some key CL topics and show good effects, such as freight regulation [63], ex-post evaluation [60], dynamic impact of different CL measures [42], and CL planning method [81]. The application of these theories needs to be further enriched in the future. In addition, a great deal of attention is paid to explore the potential improvement measures to improve the sustainability and efficiency performance of city logistics, including operational patterns, supply chain optimization, role playing of stakeholder, and multimodal transportation. However, by reviewing the literature in these fields, we find that the current knowledge system is far from being able to serve as a decision support tool for the promoting such measures. The dotted links in Figure 11 denote the finding gaps in current research, which along with the corresponding research agenda, are summarized as the following three aspects.

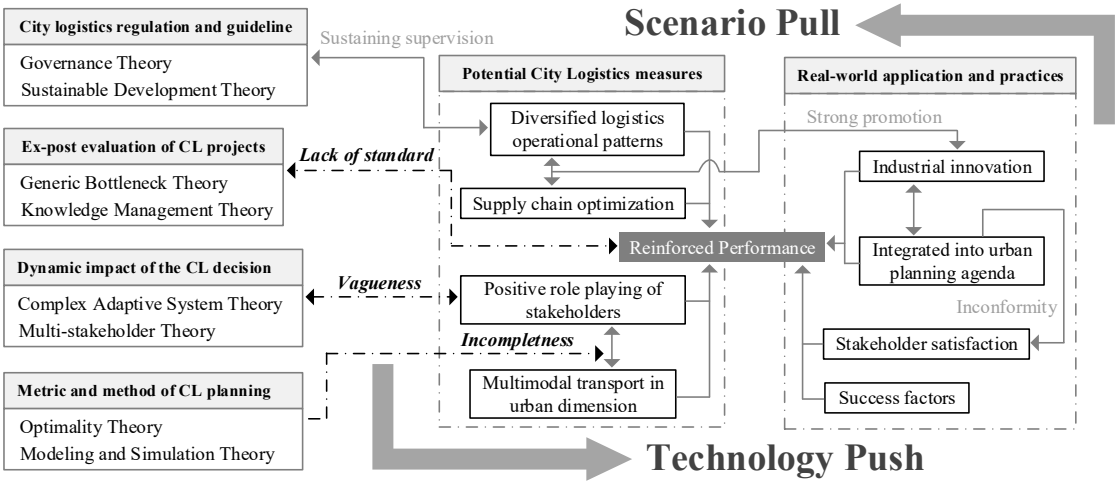

Figure 11. Research gaps framework of CL studies.

5.4.1. Fragmented Knowledge of the Performance Evaluating Guideline

A number of indicators systems have been adopted to assess the benefits, social-environmental externalities and performance of CL policies and activities [26,138]. However, the evaluation criterion of multi-dimensional scenario analysis, dynamic and universally applicable urban freight performance and impact has not yet been formed. In particular, the discrete calculation of indicators often leads to the inconsistent conclusion of the multi-dimensional coupling between the factors affecting the performance of CL.

To fill this gap, one possible approach is extract and accumulate knowledge from a series of cases to develop a more comprehensive performance measurement model or criteria to suit categories of situations. Semi-quantitative methods based on text mining and expert evaluation may be more

effective than mathematical models in some cases. Moreover, the construction of a scenario-based platform for specific cities or regions may contribute to the systemization and synthesis of CL multi-level evaluation and further promote information sharing and interaction in CL management.

5.4.2. Vagueness of Decision-Making Interaction among Stakeholders of CL from a Global Perspective

The operation and decision-making of CL involve many stakeholders, such as local authorities, manufactures, logistics service providers (LSP), carriers, customers, and even the sharers of transportation resources. Therefore, the stakeholder theory and complex adaptive system theory are helpful to analyze the decision-making mechanism and interaction influence of multiple participants. At present, the application of these theories is limited to analyze local [139,140] or static relationships [141]. However, in the future, logistics planning will be an important part of urban planning, and local governments will not only be the regulators, but also play multiple roles in logistics activities [35]. From a global and dynamic perspective, the stakeholder behavior analysis and interactive influence of urban logistics decision-making chain based on multi-level goals will become an important research direction.

5.4.3. Incomplete CL Planning Method

Limited to the development concept of CL lags behind, the rail/road/shipping freight network design or transportation scheduling methods from the LSP perspective are hard to be applied to the logistics planning in the urban dimension. Table 9 reflects that the current exploration on CL planning method is relatively narrow, and the model type is relatively simple. Key modeling features, such as robustness [142] and uncertainty [143], which have been widely solved and applied in other transportation fields, are rarely seen in the CL research. Considering the characteristics of urban freight transport (e.g., complex stakeholders, urban ecology, and existing road-network infrastructure), the task of CL planning with the requirements of urban sustainable development goals is extremely challenging.

In addition, emerging concepts and complementary solutions, such as crowd-sourcing, consolidation strategy, collaborative passenger and freight movement and ULS, have not been closely combined with urban characteristics to effectively solve the problems of urban planning so far. The academic endeavor upon the feasibility and reliability of such the modal shift in CL planning, construction, operation and overall management are still in the early age. The comparison and analysis of various predictable innovations to improve urban freight practices can bring more possibilities and opportunities for the sustainable development of CL in the future.

6. Conclusions

CL supports urban economy and sustainable development, but its negative externalities also continue to deteriorate with the growth of demand. At present, the initiative of incorporating urban logistics planning into the scope of urban planning is gradually recognized and valued by practitioners. This paper systematically reviewed the status quo, trends and gaps of CL research and deeply analyzed the prominent topics. Of 3210 records retrieved from five popular online databases, a total of 513 eligible documents were screened. Then, based on the scientometrics experiment, this paper made a statistical analysis of the publication year profile, journal allocation and research methods of the included literature, and constructed four kinds of visualized bibliographic information timeline maps for the authorship network, international collaboration network, keywords co-occurrence network and research topic clustering. The main findings are as follows:

- Since 2008, the annual number of papers published in CL domain has increased dramatically. There were 10 times as many in 2018 (82 titles) as there were in 2008 (8 titles). Nearly half of the CL literature (1993–2018) has been published within the past three years.

- Journals with major contributions and influence in the field of CL include *Transport Policy*, *Transportation Research Part E: Logistics and Transportation Review*, and *Transportation Research Part A: Policy and Practice*.
- Modelling and simulation are the most popular method, followed by qualitative analysis and conceptual research.
- Co-author network chart shows that Antonio Comi, Michael Browne, and Eiichi Taniguchi are the most prolific authors, while the result of author co-citation analysis presents that Eiichi Taniguchi, Laetitia Dablanc, and Hans Quak receives the most co-citations.
- The geographical distribution of CL literature indicates that a there is a wide, robust and high-intensity collaboration among global countries/organizations in the field of CL.
- Keywords such as "sustainability", "transportation policy", "urban area", "traffic congestion", "air quality", "last mile delivery", and "supply chain management" are frequently tracked, which is consistent with the main research topics obtained by cluster analysis.
- Using data mining to cluster index keywords, 22 categories with timeline features were generated automatically and further summarized into three themes, including decision support from a sustainable perspective for logistics strategies, policies and management (G1), the impact of CL on urban sustainable development and the real-world initiatives (G2), and logistics network design and operational research (G3).

Afterwards, a series of topics, including sustainability, land use and environmental assessment, green logistics measures, supply chain management, policy implications, crowdsourcing for the last mile delivery challenge, advanced technologies and concepts, and logistics planning methods, were proposed to explore the knowledge structure of CL. Finally, a framework was constructed to analyze the gaps in current studies and propose the corresponding research agenda. The research findings provide an intuitionistic demonstration for the bibliographic information of CL literature, and put forward new ideas and requirements for the development of CL. It will contribute to the evaluation of the current situation of CL and the grasp of the future direction by academics and practitioners.

Inevitably, this work has limitations in specimen integrity. First, to avoid excessive invalid records, the search field was limited to the "Title" field rather than the "Title/Abstract/Keywords" or "Database terms". This retrieval strategy will undoubtedly result in the loss of some literature related to CL topics. Second, the shortlisted samples were all in English and only two conference-oriented journals were reserved, while other proceedings, books, reports and manuscripts in other languages were excluded. These limitations may affect the statistical results of the study, but have little impact on the concentration of the research trends and the discussion of topics.

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Appendix A

The digital bibliographical information (Endnote format) of all literature retrieved in this work is available at https://figshare.com/s/9c30a3627abdf9b3fa36.

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