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Bibliometric Analysis of Publications on City Logistics in International Scientific Literature

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Abstract

This article aims to identify the trends and dynamics of changes in city logistics on the basis of bibliometric data of international literature published in the ISI Web of Science, Scopus, Elsevier, Emerald and EBSCO host databases in recent years. The study made use of basic techniques of the bibliometric method with the support of the VOS viewer software. On the basis of a huge number of literary works, the analysis allowed for the assessment in terms of chronological development of research concerning city logistics and the identification of main authors, publications, and journals being of crucial significance to this area of research.

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Keywords: city logistics; ISO 37120; bibliometric analysis

1. Introduction

On the current level of scientific development any analysis and assessment of a given phenomenon requires that a review of literature be conducted. Scientists often use bibliometric databases. Previous publications create a bibliography of every scientific publication. Citations combine earlier works with later ones and establish a communication channel between scientists as well as perform three additional tasks: (I) formulate the theory used in the work; (II) interpret earlier results of recognized publications; (III) position the author's research within the past scientific achievement of a given discipline. Analysis of the relationships between citations constitutes a test of the network of connections existing between scientific publications. Through citing a document scientists codify knowledge, whereas being quoted in another publication contributes to the diffusion of knowledge. Bibliometric

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methods are used when the huge amount of literature within the range does not permit the analysis and identification of the main trends of development and the relationships. City logistics is one of these scholarly sub-disciplines. The author intends to choose the most groundbreaking publications, to identify the authors and journals which have the largest share in the development of urban logistics as well as to identify research clusters.

The study aims to determine trends in research on city logistics in global literature using various bibliometric analysis techniques. In addition, the author attempts to identify research gaps in the field of city logistics, which intends to deal with in future studies. The article consists of three sections. The first part includes the deliberations of scientists concerning city logistics. The next section presents the data and research methods used. The last part of the study contains results and conclusions of the examination. The analysis made use of the VOSviewer software, Microsoft Excel 2010 spreadsheet and data analysis tools available in the ISI Web of Science, Scopus, Elsevier, Emerald and EBSCO host databases.

2. Background literature

City management must deal with many issues related to the economy, spatial planning and environmental protection [14]. Furthermore, smart cities mostly require the transfer and diffusion of knowledge, innovation and technology [7]. The many tasks carried out by local governments also include those related to city logistics. In literature there is still no consensus on the definition scope of urban logistics. Taniguchi, Thomson and Yamada, creators of this concept, identify urban logistics mainly with the coordination of the flow of goods within the city [26]. This approach has been confirmed in large European city logistics projects such as Bestufs, Trailblazer, Sugar, Grass, C-liege or Enclos. Szymczak defines city logistics as the process of total optimization of transport and logistics in urban are as supported by state of the art information systems and with, consideration to economic, environment, social and safety aspects [21]. In addition, it is more and more common to see definitions of urban logistics which take into account the movement of goods and people. This approach is the result of consequences of rapidly growing individual utilizing cars [11]. Moreover, Szołtysek defines city logistics as the process of planning, implementation, coordination and control related to the movement of people, goods and information in urban areas meant to reduce costs and improve the quality of life resulting from the compromise between the needs of diverse stakeholders [22].

Taniguchi has identified three main objectives of city logistics: (I) to improve the quality of life; (II) to improve the flow of people and freight; (III) to protect the environment [26]. The realization of these objectives involves the commitment of many stakeholders who have different expectations concerning city logistics. Literature identifies several groups of stakeholders who represent different areas related to delivery of goods and people within the city: shippers (retailers, manufacturers, wholesalers), freight carriers (warehouse companies, transporters), residents (consumers), administration (national, regional, and city level). Achieving sustainable distribution is a difficult problem due to the complexity of the interactions between various stakeholders [27].

According to Brdulak the subject of the study of city logistics concerns deliberately structured and integrated flows of materials, people and information within the area of any given city. These problems include, for instance: the city's accessibility to transport, supply chains of goods, supplying the agglomeration with water and energy, waste management, removal and treatment of sewage, construction and maintenance of telecommunication networks and environment protection [2]. Szołtysek asserts that the aim of city logistics is to reduce the nuisances associated with transportation in urban areas while supporting their economic and social development. Due to increasing traffic congestion, the rationalization of the flow of people and goods in urban areas is one of the most important problems of effective city management, especially one that is in line with the principles of sustainable development.

City logistics is an increasingly important area of city management. A constantly growing number of urban residents make access to infrastructure more difficult and, consequently, reduces the quality of life. Currently 53% of the world's population resides in cities, a number that is expected to rise to 70% by 2050. Approximately 85% of the EU's GDP is generated in cities [12, 28]. Increased road traffic, transporting both passengers and freight, causes congestion and produces air pollution. European Commission forecasts show that the intensity of freight transport will increase by 40% by 2030 and by more than 80% by 2050 when compared to 2005. At the same time, it is expected that passenger transport will also increase by about 34% by 2030 and by more than 50% by 2050 in comparison to 2005 [31].On the basis of the result of a study conducted in seven major Polish cities it is estimated that in 2013 costs related to congestion will reach a level of 3.5 billion PLN (average of 2,905 per driver). Additionally, external costs

of accidents in urban areas are estimated at 80 billion euros per year, and the external costs of noise at 40 billion euros per year. Furthermore, CO2 emissions in urban areas amount to 280 million tons per year [19].

In the face of global environmental changes, rapid urbanization and ageing infrastructure, cities require a consistent methodology to prepare for these challenges. The ISO 37120:2014 Standard: Sustainable Development of Communities – Indicators for City Services and Quality of Life is the first standard of the International Organization for Standardization concerned with city metrics [12, 20]. It defines and establishes methodologies for a set of indicators which steer and measure the performance of city services and quality of life [15].The ISO 37120:2014 Standard will make the analysis and comparison of the size of urban transport and its effects possible.

One of the requirements of the European Union to Member States is the need to develop sustainable mobility strategies, including both passenger and freight transport. Unfortunately, many cities, in their plans and activities concerning the field of transport, continue to include only those tasks that apply to the movement of persons without accounting for freight. Other important strategic documents include the local spatial development plans that relate to the location of road and technical infrastructure according to spatial order [16]. On average Polish city are covered by local spatial development plans in 49.6%, while for 15.6% of areas the plans are in the design stage. When it comes to covering planning urban areas are characterized by a great diversity, for example Łódź is covered by plans in only 8.7%, while Gdańskis covered up to 64.8% [8]. According to Dablancl freight transport is marginalized by local governments because they believe that this is a problem of transport and manufacturing private companies. Hence a holistic approach to urban logistics is being promoted [6].

3. Methodology of investigations

Many aspects of city logistics solutions have been researched in the literature.The study consisted of a bibliometric analysis based on the online version of ISI Web of Science, Scopus, Elsevier, Emerald and EBSCOhost databases. This bibliometric study was constructed on June 10th of 2016 and used the standard approach consisting of finding scientific publications containing the term „city logistics" in the title, the abstract, or the one of the keyword. All data available data collected to city logistics up to the 31st of December of 2015 was obtained and such bibliometric indicators as the year of publication, document type, language of publications, country, journal, impact factor, institution, number of citations were analyzed. Data collected from ISI Web of Science, Scopus, Elsevier, Emerald and EBSCOhost was suitably formatted to be used in Microsoft Excel 2010 spreadsheet and VOSviewer software [30]. Next, the number of publications was limited so as to form ranking of most bibliometric indicators, including publications, author and journal going from the largest to the smallest. Descriptive statistics was used to determine frequency, percentage, total sum, and arithmetic average. The h-index and IF had been used to assess the quality and quantity of research output [10, 32]. The h-index was introduced in bibliometric analysis by Hirsch to illustrate the scientific achievement of a country, institution or journal [29]. That is the reason the h-index includes both productivity (number of publications) and impact (number of citations) of a given publication.

4. Results and discussion

In total 1,723 publications concerning city logistics which were published between 1975 and 2015, were identified in databases chosen for the study. The Elsevier database has the greatest number of documents numbering 553 which constituted 32.1% of all documents with the Scopus database coming in second at 23.8%. Other databases such as Web of Science, EBSCO had an approximately share of 44.11% of all published literature on the subject. The share of individual database is presented in Fig.1. Articles published in journals constituted 68.27% of all identified publications connected to city logistics. English is most common with 90.65% of all documents being published in this language.

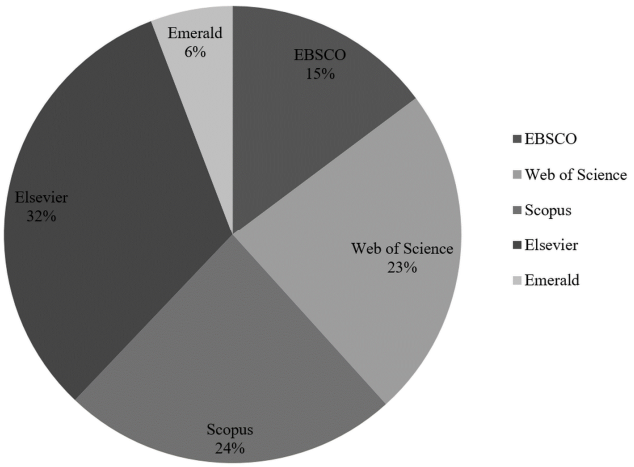

Fig. 1. The share of individual databases in publications devoted city logistics (n=1,723).

In later studies did not use the resources of the database Emerald because of lowest number of publications. Extrapolating the trend indicates the scientists growing interest in the future city logistics. Assuming that the publications trend of development identified in the years 1975-2015 in the analyzed databases will find its continuation in the following years, it is expected that 2020 will be published 270 articles on this subject, which explains 92.06% selected exponential function ($y = 1{,}1606x^{1{,}7645}$). Fig. 2 shows the trend extrapolation line for publications on urban logistics in the analyzed databases. In addition, a bar chart demonstrates the total publication per year.

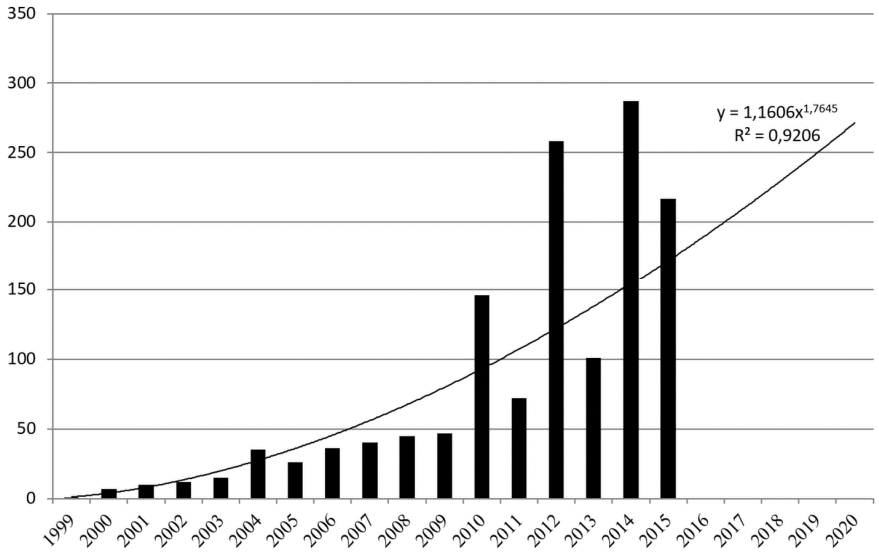

Fig. 2. The forecasted increase in publications devoted to urban logistics in the following years on the basis of Web of Science, Scopus, Elsevier and EBSCOhostdatabases – line exploration trend (n = 1,623).

The number of citations fluctuated between 101 (last place) to 199 (first place in the order). The most often quoted (199 times) in Web of Science and Scopus databases is an article published in *Transportation Research Part A-policy and Practice* by Dablancl in 2007. The other 9 publications that were the most frequently cited in the field of city logistics at global level are shown in Table 1.

Table 1. The top 10 most cited articles in Web of Science and Scopus related to city logistics (n = 815).

	Author	Title of publication	Year of publication	Source title	Total citation	Average citation per year
1	Dablancl	Good transport in large European cities: Difficult to organize, difficult to modernize	2007	Transportation Research Part A-policy and Practice	199	19.9
2	Crainic et al.	Advanced freight transportation system for congested urban area	2004	Transportation Research Part C-Emerging	189	14.54
3	Crainic et al.	Models for Evaluating and Planning City Logistics Systems	2009	Transportation Science	180	22.5
4	Munuzuri et al.	Solution applicable by local administrations for urban logistics improvement	2005	Cities	165	13.75
5	Taniguchi et al.	Intelligent transportation system based dynamic vehicle routing and scheduling with variable travel	2004	Conference: 15th International Symposium on Transportation and Traffic Theory	132	10.15
6	Crainic et al.	Intelligent freight-transportation systems: Assessment and the contribution of operation research	2009	Transportation Research Part C-Emerging Technologies	130	16.25
7	Taniguchi et al.	An evaluation methodology for city logistics	2000	Transport Reviews	118	6.94
8	Ando et al.	Travel time reliability in vehicle routing and scheduling with time windows	2006	Networks & Spatial Economics	117	10.64
9	Hemmelmayr et al.	An adaptive large neighborhood search heuristic for Two-Echelon Vehicle Routing Problems arising in city Logistics	2012	Computers & Operations Research	107	21.4
10	Perboli et al.	The Two-Echelon Capacitated Vehicle Routing Problem: Models and Math-Based Heuristics	2011	Transportation Science	101	16.83

The top 10 most productive authors in Web of Science at global level based on h-index. Taniguchi has highest h-index which is 9. His publications were cited 314 times. Crainic is most times cited author. Other 8 most productive authors in Web of Science at global level demonstrate in Table 2.

Table 2. The top 10 most productive authors in Web of Science at global level (n = 405).

	Author	h-index	Total of the times citation	Total numbers of publication	Average citation per item	Average citation per year
1	Taniguchi, E.	9	314	31	10.13	18.47
2	Crainic, T.G.	6	332	13	25.54	30.18
3	Yamada, T.	6	107	13	8.23	8.92
4	Comi, A.	6	106	15	7.07	17.67
5	Thompson, R.G.	6	65	15	4.33	5.0
6	Gonzalez-Feliu, J.	6	64	9	7.11	12.8
7	Munuzuri, J.	5	139	10	13.9	13.9
8	Cortes, P.	5	133	8	16.62	13.30
9	Nuzzolo, A.	5	45	10	5.0	11.25
10	Guadix, J.	4	53	6	8.83	8.83

Next, on the basis of their Impact Factor, the10 most globally significant Web of Science journals were identified and analyzed. The ten most significant journals published 26.04% of worldwide publications. The Impact Factor for

those 10 journals varied between 0.553 and 4.12. *Transportation Science* has attained the greatest 2015 Impact Factor value (IF = 3.295). *Transportation Research Part B-Emerging Technologies* has the greatest 5-Year Impact Factor value (IF = 4.12). Other 8 significant journals in Web of Science at global level presents in Table 3.

Table 3. The top 10 significant journals in Web of Science at global level (n = 405).

	Journal	2015 Impact Factor	5-Year Impact Factor	Frequency (%)
1	Transportation Science	3.295	3.735	4.14
2	Transportation Research Part B-Emerging Technologies	2.952	4.120	2.37
3	Transport Reviews	2.903	3.188	1.78
4	Transportation Research Part C-Emerging Technologies	2.818	3.400	2.37
5	Transportation Research Part E-Logistics and Transportation Review	2.676	3.510	2.37
6	Journal of Transport Geography	2.090	2.933	2.96
7	Transportation Research Part A-Emerging Technologies	1.994	2.998	2.37
8	Production Planning Control	1.466	0.877	2.37
9	European Journal of Operational Research	0.978	0.930	3.55
10	Transportation	0.553	0.620	1.78

The last stage of bibliometric study of publications dealing with city logistics using resources form the Scopus and ISI Web of Science databases was the analysis of co-occurrence of words which served as a basis for the grouping and evaluation of research sub-areas. Records accepted for publication analysis were selected if a given document contained the term “city logistics” in the title, the abstract, or as one of the keywords. 815 results have been found in documents published between 1989 and 2015. The extraction of the terms was carried out when the word’s repeatability within bibliographic descriptions occurred at least 10 times. In this case, while taking into account the above criteria, 7509 terms were identified, of which 191 occurred a minimum 10 times. This is accomplished in the VOSviewer software through the use of Binary Counting method. A relevance score was calculated for each of the 191 terms. On the basis of this score, most relevant terms were selected. Subsequently, 60% of the most relevant terms were selected as a default. The number of terms obtained numbered 115. Next, a set of terms unrelated to the analyzed research area was eliminated, for instance problem, focus, lack, goal, discussion, country, link, author with 85 terms. The results of the study are presented in Fig. 3.

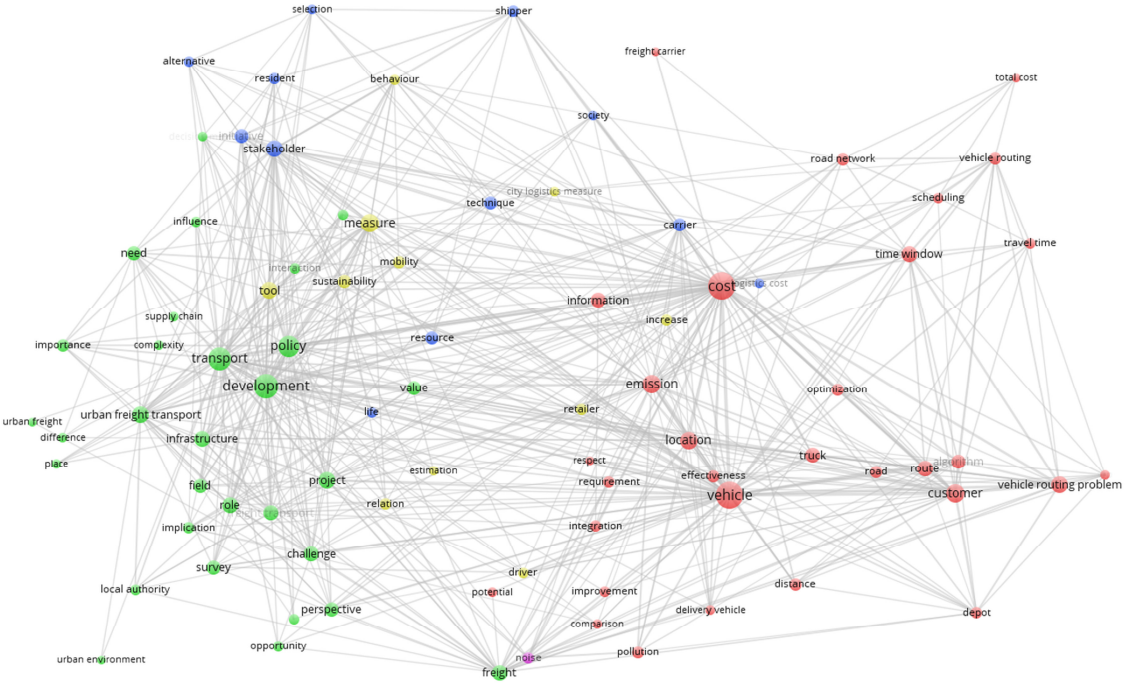

Fig. 3. Map of the intensity of the relationship between words.

Circles drawn on the map represent a given item (a term that was found more than 10 times). The bigger the circle, the higher the term's occurrence scores. Items are clustered in groups marked with one colour on the basis of their occurrence score, with colours ranging from blue (low score) to red (high score). Moreover, the closer the circles are to one another, the more often the terms occurred together and the thicker the line connecting them – the more significant the co-occurrence. It can, therefore, be seen that items such as: development, transport, policy, emission, vehicle or cost occurred in the study most frequently. Additionally, words like: depot, road, route, truck or requirement were grouped in one cluster (green colour) – which means that they appeared in close proximity one another (one paper) more often than with other terms, but have an average occurrence score.

The analysis of the co-occurrence of words and their classification into clusters resulted in the emergence of four clusters related to city logistics. The outcome consisted of following subareas: (I) financial issues (marked in red); (II) urban freight transport (marked in green); (III) environmental aspects (marked in yellow); (IV) items related to the stakeholders (marked in blue). The first research sub-area covers publications dealing with financial issues such as total costs and vehicle routing problem. The second research sub-area concerning urban freight transport focuses on publications relating to perspective freight transport and freight infrastructure projects. The third research sub-area concerns environmental aspects. The problems addressed by publications in this group mostly focus on the increase of emissions causing air pollution, sustainable development and noise. The last research sub-area is connected to stakeholders. The problems mentioned by this group of publication focused on shipper and resident.

5. Conclusion

The bibliometric analysis of the world's scientific publications concerning the field city logistics is the first study of this type. In spite of many time limitations, it made possible the reconstruction of the effects of scientific productivity in the field of city logistics. The above mentioned barriers occurred mainly due to the nature of bibliometric studies relating to city logistics referring to the title, the abstract, or to the keywords. Undoubtedly,

another limitation was that it was possible to use only five databases of scientific articles, reviews and conference publications.

The persistently high number of annual publications in the past six years for city logistics proves that it is still an interesting object of study in the world's scientific literature. Results of this study should be regarded as preliminary and require verification. They can provide important input into the discussion about the evolution of city logistics. A more in-depth, further reaching study should be conducted. A more thorough analysis of citations can be carried out from the view point of the research methodology. An analysis of the number of articles downloaded from the databases should also be conducted. This indicator is an accurate measure of the validity of a publication in a given scientific field.

Bibliometric analysis carried out in the field of city logistics helped determine the state of knowledge on the basis of which identified research gaps in the scientific topic. The author intends to deal with safe forms of city logistics development in the spatial management of medium-sized cities, which will present the recommendations to local governments.

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