



RESEARCH ARTICLE

An Analysis of Clustering the Decision Support Systems in Logistics for Supply Chain Management

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Abstract

Decision-making in logistics is becoming increasingly complex task for businesses such as agriculture, food production, and construction, as it requires decisions at the strategic, tactical, and operational levels, as well as consideration of the triple bottom line. Undoubtedly, decision support systems (DSS) played a crucial role in resolving the difficulties related with decision-making in sustainable logistics. The objective of this work is to investigate the status of research in the domain of DSS for logistics, taking sustainability into account. It is of the utmost importance to determine the prospective areas and significance of this research. By doing a bibliometric analysis, the purpose of this study is to illustrate the scientific research on the Decision Support System in Logistics. Using the Scopus database's VOSviewer programme and data analysis tool, the analysis was conducted. From 1985 to 2022, a total of 1091 papers on DSS and logistics connected to consumers were retrieved from the Scopus database. To show the progression of research ideas in this discipline, co-citation analysis and co-word analysis were undertaken. Transportation decision-making, decision analysis, and intelligence algorithm have been identified as the three primary study clusters relevant to the current research interest. This study's findings may assist researchers in comprehending the nature of Decision Support System research pertaining to logistics from around the world and in determining future research directions.

Keyword: Logistics, Decision Support Systems (DSS), Supply Chain, Bibliometric Analysis, Co-word Analysis

Introduction

Decision support systems (DSS) are interactive computerised systems that collect and analyse the information derived from a network of linked resources. Due to their capacity to define domain information and allow automated reasoning, they are also known as knowledge-based systems. Decision support systems offer intelligent access to pertinent knowledge and facilitate the structuring of decisions. The application of decision-making tools enables humans to make optimal decisions not just for logistics, but also for technological processes, as well as for the planning of corporate operations or investments. Such instruments are based on formal methodologies such as engineering economics, operational research, statistics, decision theory, and artificial intelligence techniques [1].

The modern supply chain enables international and domestic product flows, internationally dispersed production capacity and sourcing partners, and the delivery of connected services [2]. They are the alignment of enterprises bringing products or services to market [3] and operate as networks of organisations engaged in diverse processes and activities that create customer value in the form of products or services [4]. These companies engage in both upstream (such as supply) and downstream (distribution) interactions [5]. Typically, interacting organisations are represented by suppliers, manufacturers, wholesalers, retailers, and customers [6]; however, if a logistics context is also considered, roles such as logistic service providers (LSP), carriers, shippers, consignees, etc. are added to account for the physical cargo movements as well as the informational and financial flows accompanying the former [7].

In urban areas, where building materials account for 30–40% of total construction expenses and on-site space is extremely limited, efficient logistics are essential for construction firms. In order to address these difficulties, it is imperative that public and private decision-makers create more sustainable alternatives for the delivery of building materials in urban areas. Can decision support systems be useful in such situations, and if so, for whom and for what

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purpose? This study presents a set of decision support systems aimed at public and commercial decision-makers to improve the logistics and supply chain of the construction industry through evidence-based decision-making procedures. Specifically, these systems include a public participatory geographic information system for determining the impact of policy measures, a consolidation centre locator, a consolidation centre planner, and an innovation measures picker. The study explains how these decision assistance tools are implemented and tested by analysing trial locations in European cities and collaborating with businesses. Diverse tests conducted by our team illustrate that data-driven decision-making is valuable for stimulating ideas on urban building freight transport enhancement strategies. We conclude that extra focus should be paid to this particular industry [8].

According to [1], minicomputers, timeshare operating systems, and distributed computing made computer-based decision support systems possible. Due to economic globalisation, international trade continues to increase precipitately [9]. Globalization has not only expanded the complexity of today's supply chain networks, but also the logistical difficulties at the many nodes. This article discusses the most recent transport operations trends, innovations, and literature in container terminals, which have become crucial nodes in modern supply chains. Container commerce is the fastest-growing freight segment, with an average annual volume rise of 8.2% from 1990 to 2010 [9]. The global container port throughput slowed in 2011 compared to previous years. With an increase of 5.9 percent, though, the highest level has ever been reached. The 2011 throughput decline can be ascribed to the economic crisis, unrest in North Africa and Western Asia, and natural disasters in Japan and Thailand [10].

Over the last decade, academic literature on decision support system and logistics is a matured area of research where it started from 1985 with upward trending until July 2022. Based on scopus analyser, the subject area related to decision support system and logistics mainly dominated by computer science (39%), Engineering (18%), followed by Mathematics (10%), Decision Sciences (8%), Business, Management and Accounting (6%), Social Sciences (5%), Medicine (2%) and others. However, little attempts have been made to systematically review and map the research domain on decision support system and logistics related issues. The challenge is to map and visualise the research literature in a subject so that the gaps may be identified. As a solution to this challenge, bibliometric analysis has been proposed. The purpose of bibliometric analysis is to analyse the structure of a subject of study and find various trends in the literature. In addition, it could provide quantitative insights into the development of literature by analysing database-extracted information such as citations, authors, keywords, and the number of journals accessed [11][12]. Based on the aforementioned concerns, the purpose of this study is to close the research gap by integrating co-citation analysis and co-word analysis to show the evolution of this research field.

The paper consists of five sections. The introductory section begins the first segment. The following part provides a literature review on logistics-related decision support systems and bibliometric methodology. The Methodology section describes the search technique, the acquisition of bibliometric data, and the analysis. The fourth section, entitled Results and Discussion, contains several visualisations with their respective interpretations. Lastly, the Conclusion section provides a summary of the work and proposes areas for future investigation.

Overview of Decision Support Systems in Logistics

The application of Decision Support system in supply Chains are complex and dynamic networks, consisting of entities such as suppliers and customers, in which material and information exchanges take place, driven by demand and supply interactions. Multiple activities, including as manufacturing, warehousing, and transportation, take place in these networks, with the ultimate objective of fulfilling client orders at the lowest possible cost while enhancing overall competitiveness [13][14]. Supply Chain Management (SCM) is the vast variety of actions, methodologies, systems, and others that try to manage the flow of commodities in a supply chain to achieve the desired competitiveness improvement [13].

In addition, the highly stochastic nature of supply chain generates risks that are created by unpredictable occurrences and the variability of business processes, which in turn can trigger SC disruptions that impact the performance of the participating organisations [14]. Typically, these occurrences emanate from the client or supplier end of the SC. Variability in customer demand may lead to situations in which output is insufficient, resulting in unfulfilled orders, or overstock situations in which supplies are no longer required by customers, resulting in high stock expenses. Additionally, uncommon incidents with major negative consequences may occur. These events may be of a short-term (e.g., a transportation delay) or long-term nature (e.g., an earthquake that affects a supplier's production) and may jeopardise crucial SC activities, such as production, which in turn may lead to unfulfilled customer orders, thereby negatively impacting the entire SC. It should be mentioned at this juncture that, due to the intrinsic qualities of a SC, a disruption in a particular supplier, for example, could have substantial implications throughout the chain, and even in its multi-tiered aspects. Thus, solutions that enable businesses to take preventative rather than reactive action are essential [15].

To address the aforementioned issues, Supply Chain Risk Management (SCRM) is developed is a relatively new discipline that was [16][17]. SCRM is a management field that attempts to equip SCs to deal with risks, which may entail monitoring risks, attempting to mitigate their effects by contemplating various measures, and attempting to foresee them, among other objectives [15]. However, the first thing to note about SCRM is that there is no consensus in the academic literature regarding its definition [15][18]. Existing solutions to manage these risks are limited, and, according to several other authors [19][20][21][22], simulation models can be viewed as Decision Support Systems (DSSs) that can integrate real industrial data generated by the relevant SC processes that make up the system being analysed. Consequently, simulation models can capture the detail of the real system by integrating industrial data from relevant sources and centralising the data in an integrated repository [23][24][25][26], which can be used to perform simulations that enable additional value to be extracted from the raw data. In fact, the primary aims of SCRM can be achieved by simulation, as they encompass the typical uses of simulation, such as simulating the real system, testing alternative scenarios, making predictions, or just visualising logistical flows [27].

[28] discuss logistics operations pertaining to the trends and developments for transport operations at container terminals, describe and classify the scientific literature, and challenge the current operational paradigm for transport operations by proposing novel ideas that could be implemented in the future. Diverse types of vehicles that can be utilised in the transportation process and common industry trends. In addition to automation, the report highlights the importance of addressing double cycling operations and dual load capabilities of vehicles. The paper examined Twin-load vehicles, automated lifting vehicles, and straddle carriers that perform both transport and stacking operations and presented a new classification scheme to differentiate between the following decision problems: (1) comparing vehicle types; (2) determining the number of vehicles; (3) routing; (4) dispatching; and (5) collision and deadlock avoidance.

The agriculture industry has organisational obstacles, social challenges, and technological challenges, among others [29]. Next, Social Challenges including Demonstrate the value of innovations relative to their costs, to motivate businesses and individuals to collect and exchange data, Exploring the ethical aspects of Big Data in food and agriculture, and Availability of qualified personnel for big data analysis. Next, Technological Challenges, such as Improving the capability of dealing with 5V's, which are Volume (data exponentially increased, posing a challenge to the storage capacity of devices), Variety (sustainable integrate and combine data from different sources: sensors, Internet of things (IoT), mobile devices, online social networks, in structured, semi-structured, and unstructured formats), Velocity (real-time data processing), and Veracity (ensure quality and reliability) (support of connectivity in data).

Methodology

A. Data Search Strategy

The bibliographic data were extracted from Scopus, the most extensive global abstracts and citation database, using the keywords decision support system or DSS and logistics OR transportation in the titles, abstracts and keyword fields or TITLE-ABS-KEY (("decision support system" OR "DSS") AND ("logistics OR "transportation")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (SUBJAREA, "COMP")). The publishing period analysed was collected without regard to year. Initial research returned 1139 articles. The titles and abstracts of each article were then scrutinised for their relevance to decision support system or DSS and logistics OR transportation research. 46 document categories were rejected because they were written in a language other than English. Thus, 1091 articles were retained for additional examination. The abstract, the author's affiliation and the name of the institution, the year of publication, the names of the sources, and the number of citations were collected from each information source. The descriptive analysis was evaluated using Scopus Analyzer. The data was then transferred to an Excel spreadsheet for data cleansing, and VOSviewer was used for co-citation and co-word analysis.

B. Units

Excel spread sheet and Scopus Analyzer were utilised to determine the most productive journals, publication trend, contributing institutions, contributing nations, and contributing authors based on the quantity of published information sources and most cited articles. The SCImago Journal and Country Rank website was consulted for journal ranking and H-index verification. The acquired CSV text files were exported to VOSviewer for network construction and visualisation. Co-citations and co-word networks were visualised to investigate research tendencies and clusters in the subject of study (Van Eck & Waltman, 2014) [].

Results and Discussions

After Figure 1 shows the distribution of documents published per year. It shows an upward trend manifesting the increasing interest in research area of DSS and logistics researches. During the first ten years, the publication was low. The interest in DSS related to logistics research started to grow mainly from 1985 and consistently showing upward overall trend until mid-year (July) of 2022. The growing interest in the research showing more papers were published.

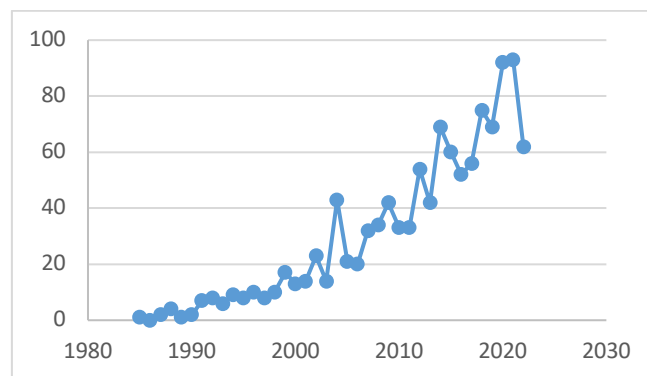


Fig. 1. Number of articles per year (from 1985 until middle 2022)

The decision support system and logistics articles were written by authors from thirty different nations. The most prolific producers of DSS and logistics products were the United States, China, the United Kingdom, Italy, and Germany. These nations produced more than 45 percent of the decision support system and logistics-related publications. Based on the Scopus database, ten journals were determined to be the most prolific publishers of articles in decision support system and logistics research between 1985 and July 2022.

According to Table 1, the most prolific journals were European Journal of Operational Research (76 publications) and Expert Systems With Applications (69 publications). Both journals were published in the Netherlands and the United Kingdom, with respective SCImago Journal Ranks of 2.35 and 2.07. One journal, Jiaotong Yunshu Xitong Gongcheng Yu Xinxin Journal of Transportation Systems Engineering And Information Technology, was published in China. The majority of the top 15 prolific journals originated in the United Kingdom, followed by the Netherlands and the United States. The European Journal of Operational Research has the highest H-index among the top 10 productive journals, with a value of 274. It is interesting to note that 14 out of 15 prolific journals that published articles on decision support system and logistics research are from Quartile 1 (Q1), including Expert Systems With Applications (SJR- 2.07), Computers And Industrial Engineering (SJR- 1.78), and IEEE Access (SJR -0.93).

TABLE I. TOP 10 PRODUCTIVE JOURNALS PUBLISHING THE MOST ARTICLES IN DECISION SUPPORT SYSTEM AND LOGISTIC

<i>Journal</i>	<i>1985-2022</i>	<i>SJR</i>	<i>H</i>	<i>Country of Origin</i>	<i>Rank</i>
European Journal of Operational Research	76	2.35	274	Netherlands	Q1
Expert Systems with Applications	69	2.07	225	United Kingdom	Q1
Transportation Research Part C Emerging Technologies	64	3.21	147	United Kingdom	Q1
European Journal of Operational Research	76	2.35	274	Netherlands	Q1
Computers and Industrial Engineering	35	1.78	136	United Kingdom	Q1
IEEE Access	23	0.93	158	United States	Q1
Jiaotong Yunshu Xitong Gongcheng Yu Xinxin Journal of Transportation Systems Engineering and Information Technology	22	0.22	29	China	Q4
Computers and Electronics in Agriculture	19	1.6	133	Netherlands	Q1
Computers and Operations Research	18	1.86	160	United Kingdom	Q1
Industrial Management and Data Systems	17	1.01	109	United Kingdom	Q1
Computers in Industry	16	2.43	108	Netherlands	Q1

Table 2 displays the 10 most frequently cited publications on decision support system and logistics, as determined by Scopus Analyzer. For each article, the first author, publication year, journal title, and total number of citations are supplied. European Journal of Operational Research published the most influential work in decision support system and logistics studies, which was mentioned 994 times by several writers. The 10 most-cited articles received a total of 3,348 citations. In addition, the most cited article was "PROMETHEE: A Comprehensive Literature Review on Methodologies and Applications" by Behzadian, M., Kazemzadeh, R.B., Albadvi, A., and Aghdasi, M. (2010), which received a total of 994 citations, which is 29.7 percent of the total citation among the ten prominent authors in Scopus up to July 2022.

TABLE II. TOP 10 PRODUCTIVE JOURNALS PUBLISHING THE MOST ARTICLES IN DECISION SUPPORT SYSTEM AND LOGISTICS

<i>Title</i>	<i>Author(s)</i>	<i>Year</i>	<i>Journal</i>	<i>Total citation</i>
PROMETHEE: A comprehensive literature review on methodologies and applications	Behzadian, M., Kazemzadeh, R.B., Albadvi, A., Aghdasi, M.	2010	European Journal of Operational Research	994
Integrated sustainable life cycle design: A Review	Ramani, K., Ramanujan, D., Bernstein, W.Z., (...), Kim, H., Thurston, D.	2010	Journal of Mechanical Design, Transactions of the ASME	337
Wireless sensor networks for condition monitoring in the railway industry: A survey	Hodge, V.J., O'Keefe, S., Weeks, M., Moulds, A.	2015	IEEE Transactions on Intelligent Transportation Systems	321
Speed models for energy-efficient maritime transportation: A taxonomy and survey	Psaraftis, H.N., Kontovas, C.A.	2013	Transportation Research Part C: Emerging Technologies	317
The application of discrete event simulation and system dynamics in the logistics and supply chain context	Tako, A.A., Robinson, S.	2012	Decision Support Systems	270
Forecasting freeway link travel	Park, D., Rilett, L.R.	1999	Computer-Aided Civil and	269

<i>Title</i>	<i>Author(s)</i>	<i>Year</i>	<i>Journal</i>	<i>Total citation</i>
times with a multilayer feedforward neural network			Infrastructure Engineering	
Integration of AHP-TOPSIS method for prioritizing the solutions of reverse logistics adoption to overcome its barriers under fuzzy environment	Prakash, C., Barua, M.K.	2015	Journal of Manufacturing Systems	241
Drive: Dynamic routing of independent vehicles	Savelsbergh, M., Sol, M.	1998	Operations Research	224
A time-space network based exact optimization model for multi-depot bus scheduling	Kliewer, N., Mellouli, T., Suhl, L.	2006	European Journal of Operational Research	191
A multi-criteria optimization model for humanitarian aid distribution	Vitoriano, B., Ortuño, M.T., Tirado, G., Montero, J.	2011	Journal of Global Optimization	184

According to Scopus Analyser, the majority of highly referenced works in the field of decision support system and logistics research were produced by researchers from Beijing Jiaotong University (26), Delft University of Technology (16), and Massachusetts Institute of Technology (16). Figure 2 depicts the top ten institutions that published research publications on decision support systems and logistics.

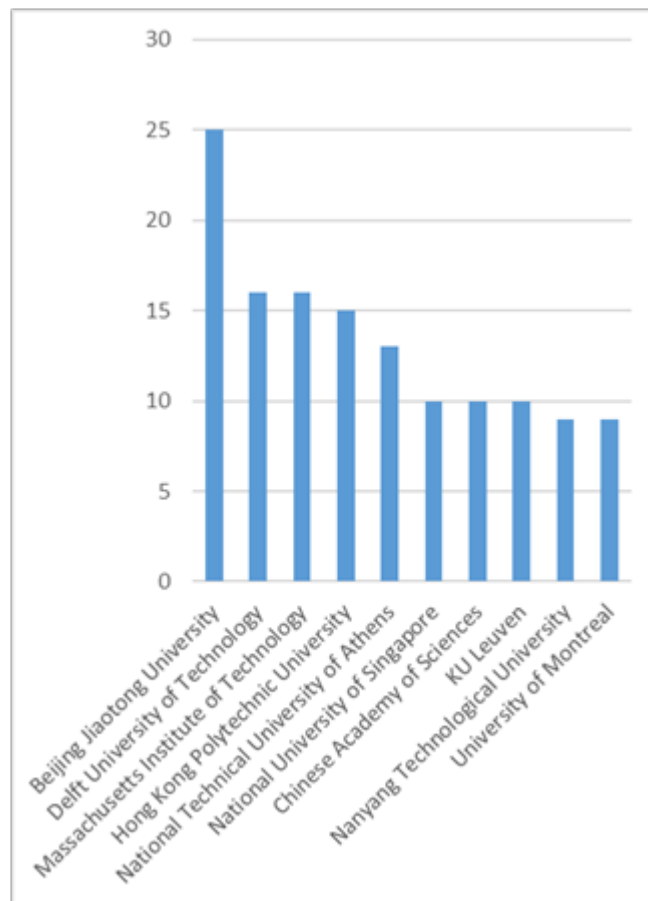


Fig. 2. Ten productive institution in publishing researches in DSS and logistics articles

A. Total Link Strength of Prominent Authors in Decision Support System and Logistics Research

Table 3 lists the 10 most significant researchers in the field of halal supply chain. These data were generated using the bibliometric software VOSviewer. In co-citation analysis, researchers or writers serve as the unit of analysis. According to co-citation analysis, the relatedness of writers is established by the frequency with which they are quoted in the same publication; the greater the frequency with which two authors are cited in the same publication, the stronger their relatedness (PerianesRodriguez, A., Waltman, L., van Eck, 2016; Van Eck & Waltman, 2014). If the study sample had a considerable number of citations for each author, it is recommended that the cut-off point be determined. Thus, only the

it was linked to the largest group of keywords. The most popular keywords (top three highest weight occurrences) within this cluster were decision support systems (occurrences=899; total link strength=5269), artificial intelligence (occurrences=287; total link strength=2449), decision support system (occurrences=283; total link strength=2424) and decision making (occurrences=259; total link strength=1703), with highest occurrences and total link strength.

Table 4 reveals the categorization of keywords in the field of decision support system and logistics research. The keywords were grouped into several clusters based on their frequent co-occurrence in Scopus-indexed papers. As noted previously, three significant clusters and their most prevalent keywords were identified. Based on the terms found inside each cluster, themes were formed. The first cluster includes the keywords of air traffic control, air transportation, airports, automation, behavioral research, benchmarking, big data, bus transportation, commerce, competition, complex networks, computer software, containers, cost benefit analysis. Thus, this cluster is more associated transportation decision-making. The second cluster consists the keywords of Bayes theorem, Classification, Classification (of information), Clinical decision support, Data mining, Decision support systems, Decision tree, Decision trees. Diagnosis, Diagnostic accuracy, Diseases, Feature extraction, Forecasting, Learning algorithms. Hence, this cluster is more associated to the decision analysis. The third cluster contains the keywords of Algorithm, algorithms, artificial intelligence, artificial neural network, automated pattern recognition and this revolves around the issue of intelligent algorithm. Ultimately, the three themes were developed based on the keywords co-occurrences.

TABLE IV. CLUSTER IDENTIFIED FROM DECISION SUPPORT SYSTEMS AND LOGISTICS RESEARCH

<i>Cluster</i>	<i>Themes</i>	<i>Keywords (Weight Occurrences)</i>
1	Transportation decision-making	air traffic control, air transportation, airports, automation, behavioral research, benchmarking, big data, bus transportation, commerce, competition, complex networks, computer software, containers, cost benefit analysis, cost effectiveness, costs, decision making, decision support, decision support model, decision support system, decision support systems, decision support tools, decision supports, decision theory, discrete event simulation, economic and social, economics, efficiency, electronic commerce, environmental impact, fleet operations, freight transportation, genetic algorithms, geographic information, gis, heuristic algorithms, heuristic methods, heuristics, hierarchical systems, information management, information systems, information technology, integer programming, intelligent systems, intelligent transportation, inventory control, investments, linear programming, location, logistics, maintenance, management, manufacture, materials handling, motor transportation, multi agent systems, multiobjective optimization, operations research, optimization, optimization modelling, planning, problem solving, quality control, railroad transportation, railroads, real time systems, resource allocation, risk management, roads and streets, sales, scheduling, sensitivity analysis, ships, simulation, stochastic systems, strategic planning, supply chain, supply chain management, supply chains, sustainability, sustainable development, tabu search, traffic congestion, traffic control, traffic management, transportation, transportation planning, transportation routes, transportation system, travel time, trucks, uncertainty analysis, urban transportation, vehicle routing, vehicle routing problem, vehicles, warehouses, waterway transportation.
2	Decision analysis	Bayes theorem, Classification, Classification (of information), Clinical decision support, Data mining, Decision support systems, Decision tree, Decision trees. Diagnosis, Diagnostic accuracy, Diseases, Feature extraction, Forecasting, Learning algorithms, Learning systems, Logistic regressions, Machine learning, Major clinical study, Prediction, Predictive analytics, Predictive value, Probability, Procedures, Random forest, Receiver operating, Regression analysis, Logistic regression, Logistic regression analysis, Logistic regression, Major clinical study, Prediction, Predictive analytics, Predictive value, probability, procedures, reproducibility of results, risk assessment, risk factors, roc curve, sensitivity and specificity, support vector machine, united states.
3	Intelligent algorithm	Algorithm, algorithms, artificial intelligence, artificial neural network, automated pattern recognition, comparative study, computer simulation, database systems, decision support system, decision support technique, evaluation, expert systems, feedback, fuzzy logic, fuzzy sets, knowledge based system, logistic models, neural networks, pattern recognition, statistical model.

Conclusions

This study was undertaken to visualise the scientific research on decision support system and logistics by utilizing bibliometric analysis. The VOSviewer software was used to analyse 1091 publications which were relevant to DSS. These articles were retrieved from Scopus database without restriction in year. The significant journals, influential institutions, impactful and trending publications were recognized. It can be determined that the were European Journal of Operational Research and Expert Systems With Applications. Both publications originated from the Netherlands and United Kingdom were the main journals, and among the most influential universities were to Beijing Jiaotong University and Delft University of Technology. Fernández a. and Ossowski s.were the most notable authors with the highest total link strength from 1985 to 2022. The most cited writers were also found and may be shown in Table 3. Finally, the decision support system work or discussion by researchers can be divided into three categories; Transportation decision-making, Decision analysis and Intelligent algorithm. The works and debate largely focused on the Transportation decision-making issue. Meanwhile, the and Intelligent algorithm were the least addressed and debated by scholars. However, more study is still needed notably in decision support system connected to logistics by undertaking bibliometric analysis. Perhaps a research can be undertaken that focuses on using other bibliographic databases such as Web of Science and other content databases, namely ProQuest, Emerald, Ebscohost and others.

The potential of connectivity between systems is being hampered by a lack of common data standards or easy-to-use ontologies. Several challenges need to be addressed such as in analytics regarding improving the performance of prescriptive analytics would strongly rely on those of descriptive and predictive analytics, combining different data analytic approaches to produce more advanced and adaptive models for DSS, lack of decision support tools, and readiness to exchange data, integration with other technologies, the openness of platforms to expedite solution creation and innovation in general but especially empower farmers in their position in supply chains.

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