JOURNAL OF AVIATION

e-ISSN: 2587-1676 **J Aviat 2021; 5(2): 230-240**

Research Article **DOI :** 10.30518/jav.1006313

Bibliometric Analysis of Air Cargo Transportation for Two Decades

Ramazan YILDIZ[1], *Murat TAŞDEMİR*[2*]

[1] Çanakkale Onsekiz Mart University, Yenice Vocational School, Department of Management and Organization
[2*] DHMİ (State Airports Authority), Aeronautical Information Management Expert

Abstract

This study examines the scientific studies on Air Cargo via bibliometric analysis for two decades. The aim of study is determining the intellectual structure of the air cargo focused studies, reveal its evolutionary development in the area and identify the research gaps or topics for further studies may be needed. Dimensions database was used to obtain bibliometric data. "Air Cargo" OR "Air Freight" AND "Supply Chain Management" keyword combination was selected to define the primary focused area. "Commerce, Management and Tourism" or "Transportation and Freight Services" or "Business and Management" sub-categories defined as research content. 492 journal articles were analysed with bibliometric techniques and WosViewer software used for visualization. Analysis indicates that most of citied and majority of published articles had found place on interdisciplinary researches. Studies which are linked to production, management and international supply chain operations got more attention compared to focused solely on air cargo ones. Besides, USA, UK and China were determined as most productive countries and Cranfield University was ranked first among institutions. According to another result, two main clusters were also observed in collaborations between universities/institutions as Eastern and Western settled. International Journal of Physical Distribution and Logistics Management was determined the leader of journals. Only journal which focused solely aviation research is Journal of Air Transport Management. With rising trend and new developments in both aviation and supply chain management are foreseen that researches in the area will sustain its rising trend in the future. Especially environmental, e-trade, labour and other interdisciplinary issues will need to be examined deeply.

Keywords: Bibliometric Analysis, Air Cargo, Supply Chain Management, Logistics, Civil Aviation

1. Introduction

Bibliometric analysis (BA) is an important tool for literature review of previous studies in certain fields. With the analysis, it can be determined how many scientific studies have been published before, which studies have been given weight via citations and where the evolutionary stages of the studies have gone [1]. Also trends in a specific area and collaboration between institutions, countries, the intellectual structure of the subject can be observed. Within the scientific databases (WoS, Scopus, Dimensions etc.) and data visualization tools (VosWiever, CiteSpace, CiteNetExplorer etc.) BA researches good potential
not only with ability to count with wide data but also bonds, trends, common view angles between institutions, countries or authors.

Corresponding Author/Sorumlu Yazar: Murat Taşdemir murat.tasdemir@dhmi.gov.tr
Citation/Alıntı: Yıldız R., Taşdemir M. (2021). Bibliometric Analysis of Air Cargo Transportation for Two Decades, J. Aviat. 5 (2), 230-240.
ORCID: [1] https://orcid.org/0000-0001-8437-8171; [2] https://orcid.org/0000-0001-5131-1085
DOI: https://doi.org/10.30518/jav.1006313
Received: 8 October 2021 **Accepted:** 10 December 2021 **Published (Online):** 20 December 2021

In terms of the evolutionary developmental perspective; statistical bibliography technique firstly announced by Wyndham Hume in 1992. Hume aimed to analyze how scientific processes work with quantitative way, described with a quote "*Enlighten the scientific and technological processes via counting published documents in the area*" [2]. Current *Bibliometry* term, which is a combination of *biblion* refers book and *metricus* as measuring in Latin and Greek terms; offered by Alan Pritchard in 1969. Pritchard defined the term similar to Hume: *"Aiming to determine the trend of development in a particular field with counting and analyzing various publications in written communication and nature of a disciplinary area"* to obtain clear view. Pitchards term bibliography was accepted and spread initially in North America and then the rest of the world for analyzing an existing literature on focused determined areas. Nowadays *librametry, webometrics, altmetrics* and *scientometrics* terms can be used to refer to the original term Bibliometrics and used to substitute it [3, 4]. After developments emerged in digital indexing ensures to reach to information digitally (and relatively simple), bibliometric analysis became a popular method to define orientation of researches and measuring productivity. Within the scientific databases (WoS, Scopus, Dimensions etc.) and analyze and visualization tools (VosWiever, CiteSpace, CiteNetExplorer etc.) BA researches has got potential not only wide data also bonds, trends, common view angles between institutions, countries or authors.

Air cargo transportation has a great importance for businesses and society. From the point of view for businesses, it ensures that urgent and perishable products that will ensure customer satisfaction are delivered to the desired location on time. In case of high inventory costs, it helps to increase the profitability and efficiency of the processes. From the point of view of society, air cargo transportation has a vital role for delivery of the products (medicine, food, etc.) which are needed immediately to the desired place on time.

Importance of air cargo has been increasing gradually since the modern aviation activities begun in the global context. According to the data published in 2017, approximately 35% of the product trade in the world is carried out by air cargo transportation. It became one of the most important parts of the supply chain network due to reasons such as being a fast transportation type and meeting urgent needs on time [5]. Some of the reasons why air cargo transportation has grown dramatically over the last 20 years include: There is an increase in the transportation of products with light weight but high value (except for emergencies). Air cargo transportation is preferred due to the short life span of some products. Due to the speed of air cargo transportation, inventory and waiting costs are also reduced. In recent years, the potential of air cargo transportation in the supply chain has been increasing due to many reasons such as the design of wide-body aircraft, the creation of cargo sections at the bottom of passenger aircraft, and the rapid conversion of passenger terminals to cargo aircraft [6].

Covid19 outbreak once again proves air cargo operations' necessity. It provides an uniqe, unrivalled advantage about transporting urgent needs in supply chain from source to end point swiftly [7]. Due to the epidemic; urgently needed food, medicine, vaccine, PPE, medical stuff etc. products were provided by air cargo transportation [5]. Although air carriers per kg price are 12 times more expensive than shipping, high value products and *time mattered* goods were transported via aircrafts because of the fast delivery advantage. Hi-tech products, medical equipment and fresh food can be given as an example for this group. As pandemic hits the whole transportation sector, especially both the aviation and shipping industry; airlines and freight carriers kept some measures to ensure cash flow to continue their operations. One of these measures is to transform/modify aircrafts with the intention of using these valuable assets as cargo carriers. Lack of the international passenger flights, cargo operations used as a tool to compensate for the financial loss partially. Hence air cargo prices fell gradually and finally in May 2021 air carriers per kg price got competitive ratio; 6 times more expensive than sea transport [8].

Although a considerable amount of BA studies found place in the literature about aviation, there is a relatively small body of literature concerned with air cargo transportation, supply chain and logistics. Raza et al. [1] conducted a bibliographic study on revenue management in the airline industry. It has

been determined in which fields and countries the studies on the subject are more common. In their comprehensive analysis, Cavaignac and Petiot [9] investigated 491 articles on transport industry and sample group consists of airports and ports. Qaiser, et al. [10], highlight current status of studies about desicion supporting systems for sustainable logistics in 2017. Dixit and Jakhar [11] performed BA anlysis in the context of airport capacity management. Authors identified *airport capacity*, *congestion* and *ground handling problems* are important keywords and closely related to ACM in the literature. Faura and Martínez [12] evaluated 20 years of data on airport efficiency, determined the journals with the most cited articles and publications. They stated that airports' efficiency measurements were studied by universities frepuently in the period. Article determines the status of scientific studies on air cargo and authors aimed to draw a direction for further studies.

Paper begins with the general information for BA and its importance. Specifies air cargo activities' inevitable rise in supply chain processes and published bibliometric studies which aimed to determine air cargo & supply chain focused essays in the literature. The rest of paper structured as follows; describing air cargo activities' business nature and principals, recent developments and situation in the area due to the Covid 19 pandemic outbreak; followed by methods used to perform the analyze, results and discussion.

1.1. Business nature of Air Cargo and recent developments

Firms need to perform SCM requirements successfully in order to survive as a consequence of current intense competition in business environment. It is crucial to accomplish the transport activities of valuable products on global scale. Firms therefore require to manage air cargo operations prosperously. Air cargo activities have to be carried out with coordination with each step of SC members in order to take advantage of the fast delivery opportunity [13].

Air cargo transportation also has a strategic importance for states and businesses. When evaluated from the point of view of the states, it is ensured that the products that the countries urgent needs (medicine, defence equipment, etc.) are obtainable in a short time by air cargo transportation [6]. In addition to strategic importance varying customer needs, requests and satisfaction in a limited time magnitudes its position and share.

As air cargo offers benefits in supply chain management, also has important effects on the economic development and welfare of countries. Air cargo transportation creates new jobs and its growth rate has bonds with countries' GDP ratios. Even there is a difference in numbers between cargo and passenger flight activities, air cargo has significant impartonce for the airports' fiscal developments. Yuan et al. [6] mentioned that air cargo activities are affected economically from performances of logistics sub-processes and cargo traffic intensity of regions.

Timing is an important factor in aviation acitivities and easily can cause extra costs for firms as a result of insufficient operations. Hence firms' miscoordination and faults in whole chain can result in significant losses if compared to other types of transportation [14].

Air freight operations have some distinctive meacsures such as packaging of goods, loading procedures, air cargo facility security practical applications etc. which are consist of strict rules and in accordance with international law. These loads also includes curicial technical issues such as center of gravity, optimization of load efficiency and timing. In order to increase the efficiency of aircraft, containers and pallets are divided into sections and optimized with a mixed linear programming models. In this respect, in cargo plans; 4 factors should be considered in terms of the characteristics of the aircraft construction, construction planning, packaging of products and load balance [15].

Cargo handling activities also plays critical role in air cargo operations and that may be divided into several groups:

- Making a reservation for the cargo shipment.
- After the cargo is brought to the airport, it is taken to the warehouse. In the warehouse, the products are distinguished according to their general or special cargo conditions and their packaging is checked.
- By being tagged, the information and addresses of the sender and receiver are included. The

shipping label is used to mark the packaging. A fee is charged for shipping and other services that will occur.

- Necessary documents such as products, airline invoice and sender's certificate are examined. The products are loaded into the trunk of the aircraft by creating a unit load (ULD) [16].

Covid 19 outbreak and its reflections to the service is maybe the most important issue needed to advert for air cargo sector almost for last two years. The outbreak has supreme effects on the whole supply chain steps and innately on air cargo transportation activities. In particular, the appearance of flight restrictions has a profound effect on air cargo transportation. To get a clear view of the deepest crisis in aviation history, comparisons have to be made between pre-crisis and current status. Sharp decline is observed notably in the passenger side as a result of flight restrictions and decreasing demand. Compared to the pre-crisis year 2019, During the crisis, airlines' net cash lost was reported as 126.6B $ in 2020 and was forecasted 47.7B for 2021. Drop in number of passengers is also remarkable; 60.2% in 2020 and 46.6% (expected) in 2021 [17].

Figure 1 shows the air cargo and container transport rates per kg from May 2017 to March 2021.

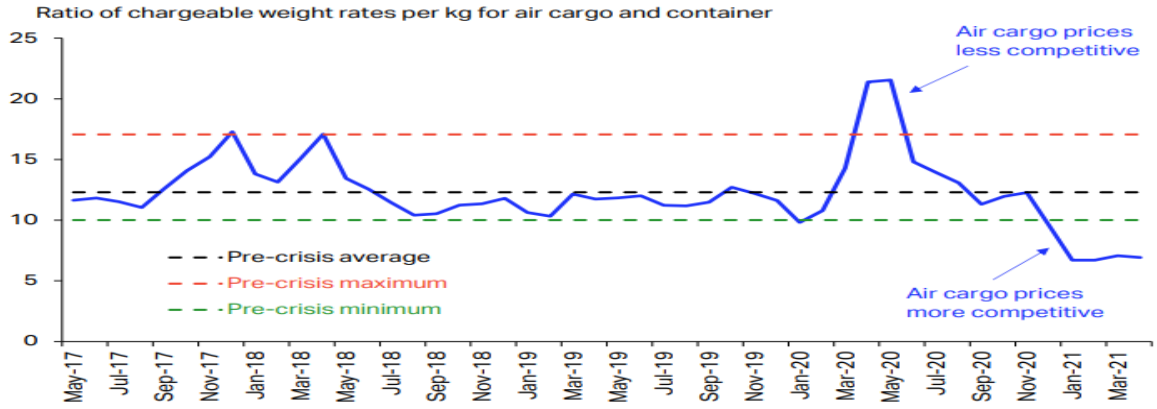

Figure 1. Ratio of chargeable weight rates per kg for air cargo and container [17].

Compared to other aviation transport activities, the cargo side seems to successfully cope with the crisis implementation of successful strategies. With the aim of preventing the collapse or bankrupt of airlines, due to the cash flow based monetary issues, some strategies have been implemented by both airlines and solely cargo carriers. Lack of the passenger flights especially inter-country stage, some airlines converted passenger aircrafts to air freights with modifications or carried cargo in passenger seats with minor arrangements [18]. International Civil Aviation Authority (ICAO) and Federal Aviation Administration (FAA) published the documents to ensure of secure cargo carrying and modification terms for passenger aircrafts. Manufacturers like Airbus and Boeing determined the guidelines for this specific and partly uncommon operations [19, 20]. Also, cargo prices rearranged naturally with supply demand principals. Hence, air cargo caught competitive prices against other transportation branches first time in its history. Figure 1 demonstrates ratio of the air cargo and container chargeable rates for per kg of goods. As seen on the figure the outbreak could be considered as a *milestone* for air cargo. Despite to the all adversities, both customers and cargo carriers took advantage of new *competitive* prices mutually.

Almost all regions of the world made progress after first shock wave of outbreak. With the international perspective, only Latin America region has negatively affected compared to 2019. Africa, Asia Pacific, Europe, Middle East and North America had growth for CTK (Cargo Tonne-Kilometres). The most growth is observed in North America, with a ratio 25.5%, followed by Africa 24.5%, Middle East 14.1%, Europe 5.7% and Asia Pacific 5.3%. As mentioned, Latin America experienced a loss of -14.0%. With another sight view, when compared the world share to CTK is represented on table 1.

Table 1. Regions World Share / CTK Ratios.

Region	Total Market (World Share / CTK)	International Market (World Share / CTK)
Africa	0,087	0,082
Asia Pacific	12,074	5,491
Europe	3,667	3,842
Latin America	-0,168	-0,143
Middle East	0,935	0,922
North America	1,287	0,686

Table 1 means as the calculated numbers closest to zero, there is a balance between world cargo share and CTK. Due to the calculation Asia Pasifics' CTK is only 2.7% of the total market, which has 32.6% of the total cargo market. Also, Europe, Africa and with the negative comparison result whilst Latin Americas' CTKs can not meet the demand.

2. Methodology

The data was compiled from dimensions.ai web site for analysis. After the long years of WoS databases' monopoly in the scientific indexing area, initially Scopus database became active in 2004 and afterwards Dimensions enabled the BA data for researchers in 2018. Despite to it covers less than two other databases its first years in service, with developments to collecting data such as Crossref, Pubmed and other open resource databases it became an option for scientific data. Visser et al, (2017) collected and compared large data sets for all three databases. Results of research stressed out dimensions content is at 25% larger than Scopus [21]. The purpose for determining co-author, institution collaborations and citation analysis Google Scholar and dimensions got higher ranks with 46% while WoS got only 28% [22]. Because of WoS databases' indexing restrictions, Scopus databases' institution-based membership policy, slow download, filtering etc. reasons; Dimensions selected to obtain the RAW data to execute bibliometric analysis.

To establish the study design keywords and research areas were selected/filtered as follows;

Key Words: "Air Cargo" **OR** "Air Freight" **AND** "Supply Chain Management"

Fields of Research (with Dimensions category codes): 15 Commerce, Management, Tourism and services **OR** 1507 Transportation and Freight Services **OR** 1503 Business and Management;

Publication Type: Article.

Primary results consisted of 508 results. After initial download of database (RAW Data) extraction of duplicated and irrelevant studies executed for data cleaning. Eventually 492 articles were obtained for analysis.

VOS Viewer version 1.6.16 was used for bibliometric analysis and visualization for the data. With the aim of analyzing common words, key words text and semantic based similarities etc. Lexos tool was used [23].

3. Results

Figure 2 reveals that there has been a gradual rise in the number of publications for the selected period. Especially soon after the beginning of the global economic crisis in 2007, research interest in the determined area had been accelerated over the years. Also, COVID-19 global pandemics did not reversely affect the interest trend. The present study raises the possibility that due to the developments, adjusted pricing policy, global supply chain problems and shifting technology in the area such as Unmanned Aircraft Systems (UAS) or drones, new research topics will be needed for the air cargo distribution. Hence, next years we can expect to observe rise of studies in the area as a consequence of new improvements.

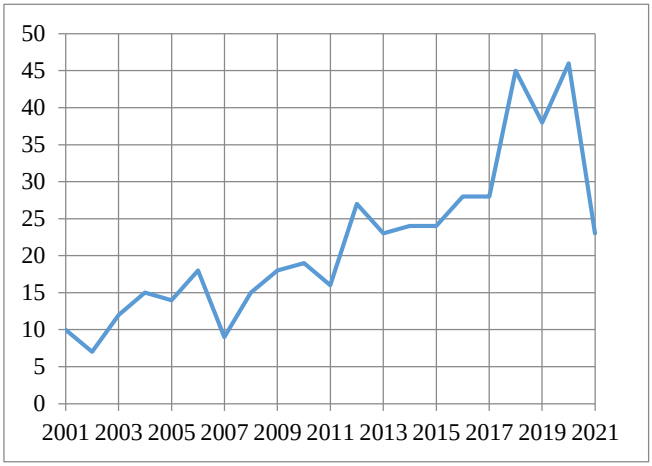

Figure 2. Number of publications by years

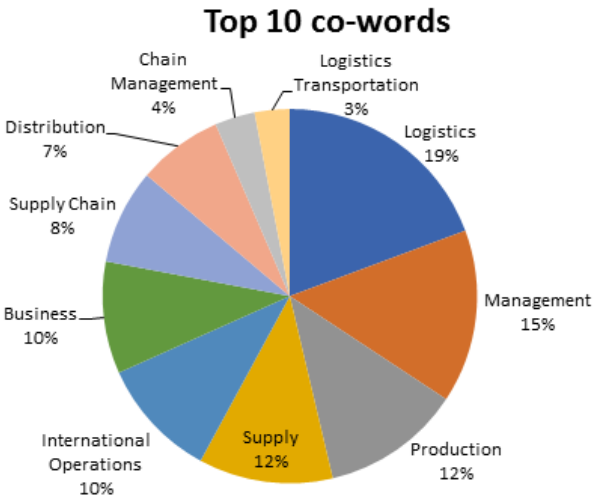

Figure 3. Top 10 co-words by percentage.

Co-word analysis executed via *Lexos* semantic and text analyzer in the defined data base. Analysis contains title, keywords and abstract of each publication. As seen on Figure 3; Logistics, Management, Production, Supply, International Operations and Business terms are the most commonly used. Thus, as the nature of air freight operations which highly depends on international trade of goods and has bonds with production and supply steps, keywords represent management and production areas have also found a place with high ratio.

Due to the high number of publications and authors, top cited publications and authors are restricted to ensure simplification. For the purpose, both publications and authors were selected with at least 100 citations and above. Table 2 provides the results which are obtained from the database to represent most cited studies with the name of first author. Also figure 4 shows visulated diagram for top cited authors.

Table 2. Top cited documents.

Author	Year	Citations	Essay
Manuj	2008b	537	Global supply chain risk management strategies
Manuj	2008a	429	Global supply chain risk management
Pettit	2010	410	Ensuring supply chain resilience: Development of a conceptual framework
Christopher	2004	399	Creating agile supply chains in the fashion management
Chen	2004	330	Understanding supply chain management: Critical research and a theoretical framework
Bontekoning	2004	252	Is a new applied transportation research field emerging?
Svensson	2000	244	A conceptual framework for the analysis of vulnerability in supply chains
Barnes	2006	214	Fast fashioning the supply chain: Shaping the research agenda
Bottani	2006	200	A fuzzy TOPSIS methodology to support outsourcing of logistics services
La Londe	1994	186	Emerging logistics strategies
Johnson	2001	157	Learning from toys: Lessons in managing supply chain risk from the toy industry
Speier	2011	156	Global supply chain design considerations: Mitigating product safety and security risks
Ballou	2007	152	The evolution and future of logistics and supply chain management
Gupta	2016	145	Identifying enablers of technological innovation for Indian MSMEs using best-worst multi criteria decision making method.
Pettit	2005	137	Emergency relief logistics: An evaluation of military, non-military and composite response models

As table 2 shows, its apparent that the studies which are focused primarily aviation activities could not get attention compared to whole chain management-oriented ones. This result may be explained by the fact that, the studies with "narrow focused" only have capacity to enlighten one step for all SCM issues. However, as mentioned before in the study, SCM operations need consideration as a whole process due to its complexion. If we now turn to co-words analysis which represented on Fig 3, its possible to obtain supportive results for this statement. Studies, which cover whole SCM procedures or investigate the problems of main steps' relations with others, got more attention within the context.

Most cited articles' scope, aims and findings were investigated and summarized below;

Starting from the list for most cited articles; Manuj and Mentzer [24] examined a qualitative study on risk management strategies in the global supply chain. Risks in the global supply chain; It takes place in 3 main topics: supply, demand and operation. Research lists 6 risk management strategies which are determined for managers. These are: Postponement, speculation, hedging, control-sharing-transfer, security and avoidance. Air cargo activities found place about the integration with other areas via usage of RFID and GPS technology. Another article published by same authors with the aim of implications for stakeholders and future researchers to ensure an insight for global supply chain risk management. In order to purpose this, authors intended to integrate literature from several disciplines including logistics, supply chain management, operations management, strategy, and international business [25].

To identify and improve SC's flexibility, Pettit et al. [26] analysed SCM resilience levels. They highlighted 14 capabilities for the topic. Air cargo operations discussed about its competency for the demand for LCD monitors. Christopher at al. [27] worked on agile SCM in the fashion industry. In the study, they identified three critical times (time to market, time to service, and time to respond) related to timely delivery of products. The last-minute use and costs of air cargo transportation in delays in the supply chain are discussed.

Another literature-based study was published by Chen et al, [28]. In the study, 400 articles analysed with the intention of to develop a research framework within the context of SCM. Dispersed body of frame described and diverse disciplines such as purchasing, logistics and transportation, strategic management, operations management literature investigated thoroughly. Bontekoning et al, [29] have reviewed 92 articles to identify the characteristics of the intermodal studies. Air transportation focused handbooks, reference texts and essays cited and examined in the intermodal logistics frame.

Svensson, [30] analysed vulnerability in supply chain. Study explores the concept of vulnerability form the point of view an inductive approach and continues with a case study of a car manufacturer in the automotive industry. Barnes and Lea-Greenwoood [31] focused to the fashion business strategy and its nature for obtain new fashion products to stores in limited time. Paper provides the fast fashion studies reviews within the context of supply chain. Air Cargo described in *Changing Logistics* section to refer its shorter shipping times, where and when became necessary for retailers.

A study presents a multi-attribute approach for selection and ranking of third party (3PL) service providers by Bottani and Rizzi [32]. Selection methodology settled up on the TOPSIS technique and fuzzy set theory. All cargo categories and their assigned weights, explained and finally a practical implication discussed in conjunction with real case application. La Londe and Masters [33] proposed that supply chain management is a combination of all suppliers with divergent roles and areas. Even the supply chain oriented the level of firm, co-operation to produce value during the steps of delivery to customer have to be accepted as a whole process. Johnson, [34] focused to the toy industry and its characteristics about time and supply related issues. Because of the distance between manufacturing and main markets, paper stressed out long transit times and information lags were caused. Air freight described as an expensive way for industry and only used for late replenishments of toys.

Speier et al. [35], studied the global supply chain and reducing the safety and security-related risks of products. They talked about the use of air cargo transportation to reduce the delivery times of products. The study addresses process management, information sharing, management of the SC partner, and service providers related to SC safety and security. In order to prevent these risks, the design of the SC must be done very well. In addition, all stakeholders within the SC need to act in a mutually relationship and dependent manner.

Baloou, [36] approaches SRM as an advantageous appliance when coupled with demand generation. In the international context especially for multinational companies, investing motivation to target countries will achieve revenue enhancement. Improvements in information technology and the just-in-time philosophy can be the major value drivers to realize the potential of area. Air Cargo

found a place in the essay because of its nomic advantages, big contribution to just-in-time and ease of transportation for distant markets. Gupta and Barua, used literature review and expert judgement to identify the enablers of technological innovation and its affects for progressing development of MSMEs (Micro-small and Medium Enterprises). Essay citied within the context of aviation; MCDM, SERVQUAL, VIKOR and BWM method-based studies [37]. With the aim of to determine the best methods for distributing food in the terms of speed for emergency situations and security Pettit and Beresford, described advantages and disadvantages of transportation modes which includes air transport activities [38].

In addition to listed studies, its will be fair to add some other articles which are also got citations.

Rezae et al., [39] used BWM and SERVQUAL models for the quality assessment of the air cargo baggage handling system. In the study, the perceived service quality in the baggage handling system was evaluated. In the evaluations, it is understood that there are differences between the perceptions and expectations of the customers. Choi et al., conducted research on air logistics and SCM risk analysis, taking into account Blockchain technology [40]. In the research, reduction of delivery times in air cargo transportation, demand management techniques, supply situations and the values of Blockchain are discussed. In their cross-sectional study, Dobrovnik, et al., [41] investigated the Blockchain applications in logistics. Study contains in-depth analysis for the effects of Blockchain applications with existing potential on organizations. They stress out the possibility to minimize deviation for air cargo containers with the boundary 0.1 percent, in order to using these applications based on blockchain technology. Ballou [42] studied the past and future of SC management and logistics. In the study, air cargo was defined as a significant factor for reducing the inventory costs in the SC. Also, study addresses the current challenges for better planning and operational management issues in the context. In their critique of new product development and SRM risks, Tang et al. [43] mentioned air cargo with its vital role for preventing delays. Study investigates Boeing 787s delivery and flight operation delays within the SRM perspective. They described delay related in 6 areas, which are: Technological, operational, supply, employee, managemental and demand sub-categories.

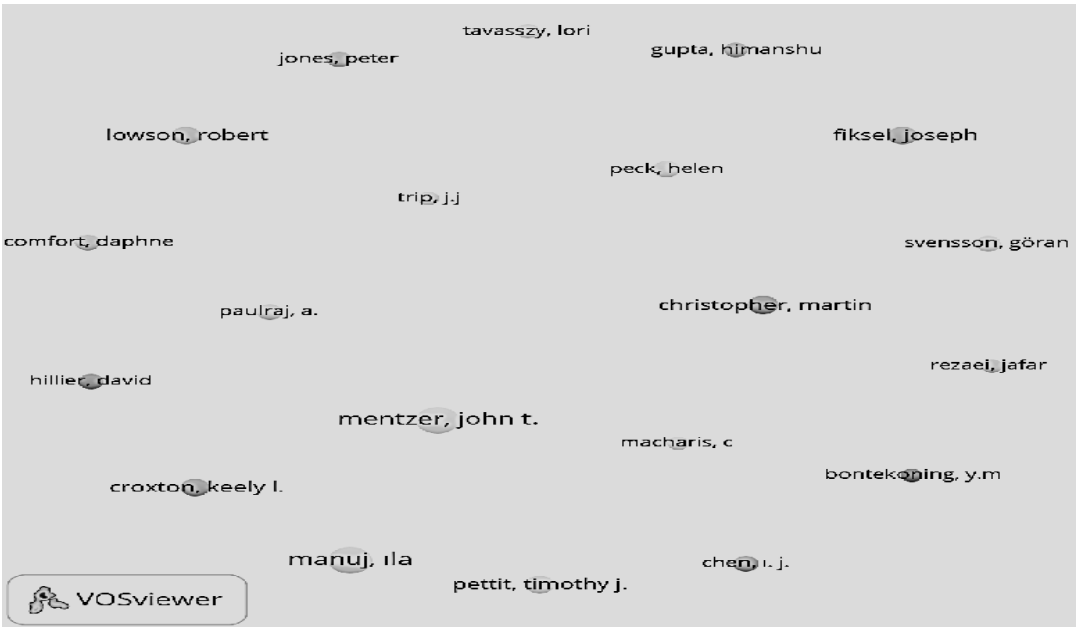

Figure 4. Top cited authors (more than 100 citations)

There is a difference observed between top documents and authors list. Some of the most cited documents' authors also found place in top cited authors. Vast majority of essays published with more than one author created the difference. Because of that, nearly half of authors, whose paper

was determined as *most cited*, couldn't place *top cited authors* within the criteria 100 citations or above. Authors who found place both two listings aligned as fallows with surname; Manuj, Pettit, Gupta, Christopher, Svensson, Bontekoning and Chen. Most cited author was determined as Ila Manuj and John Thomas Mentzer with their two publications; Global Supply Chain Risk Management [24] with 429 citations and Global supply chain risk management strategies [25] with 537 citations.

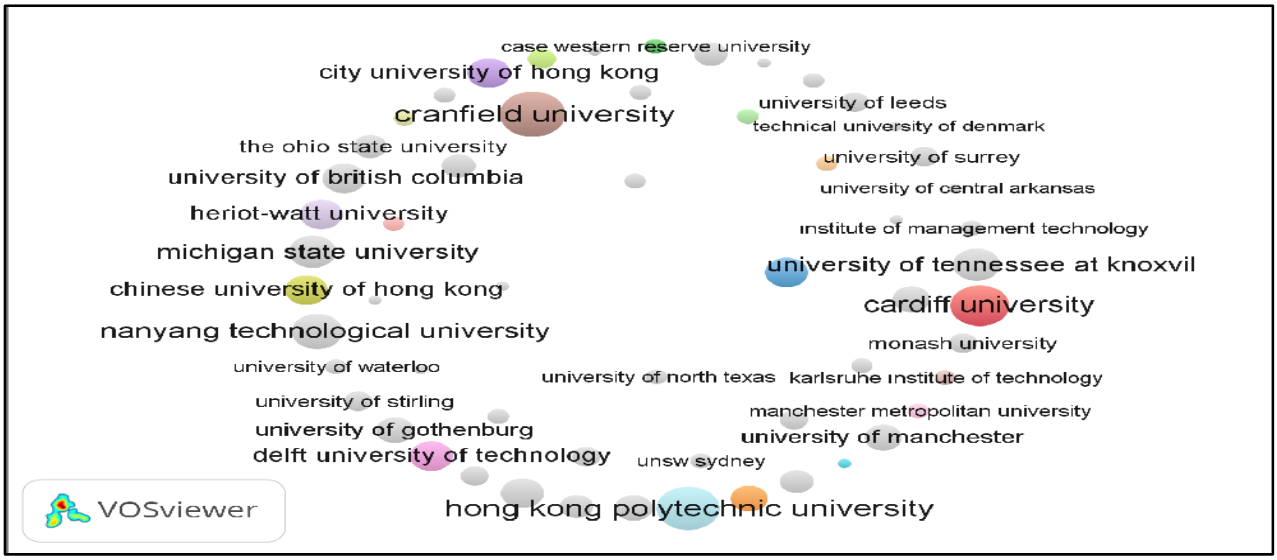

Figure 5. Top cited institutions

As seen in figure 5; Cranfield University, Hong Kong Polytechnic University and Cardiff University share the top 3 stages between all institutions. In general view UK, North American and Asian universities have more publications compared to others and followed by Canadian and Dutch universities. The counries which published most articles demonstrated in figure 6, furthermore collaboration between institutions and bond figuration can be seen on figure 7.

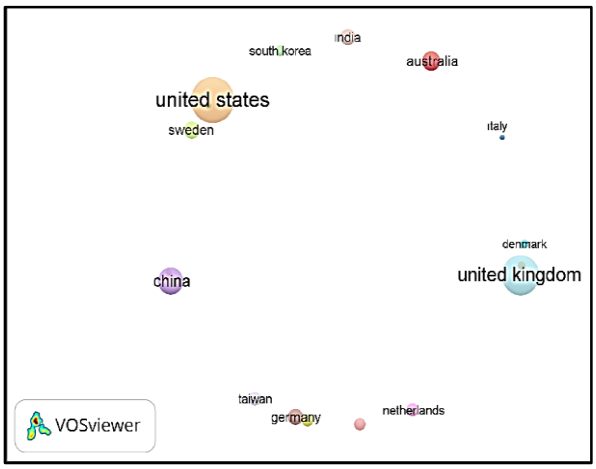

Figure 6. Most article published countries.

Published articles in the selected database sorted with numbers as; USA 110, UK 86, China 46, Australia 27, India 20, Germany 20, Sweden 22, Taiwan 16, Netherlands 15, Canada and Singapore 14. Results shows, there was a positive correlation between number of published articles and with countries' logistics sector size in addition to density of importing&exporting activities among the world. Contrary to countries with intense marine shipping activity such as Netherlands, Sweden and Singapore; countries which has a developed aviation sector such as USA and UK, have more publications. These results also represent whole aviation activities such as general aviation, passenger transportation etc. creates a common knowledge and triggers productivity of scientific work in this particular area besides countries' logistic share in air cargo.

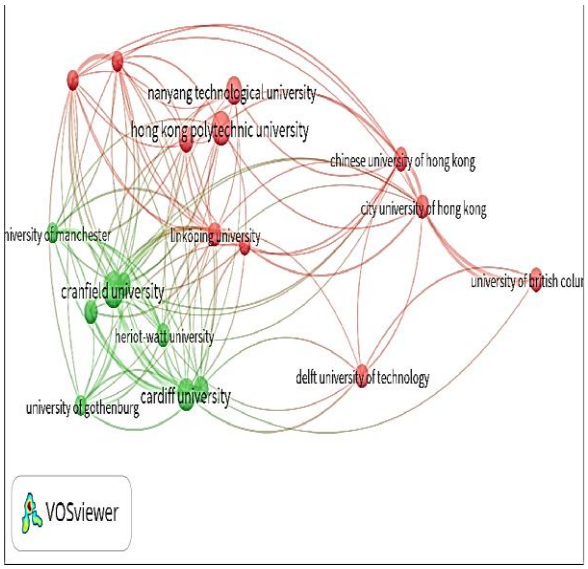

Figure 7. Collaboration between institutions and bonds.

As seen on figure 7 there are 2 main clusters detected for institutional collaborations. The first cluster (green) consists of solely Western universities; however, the second one (red) consists of both Eastern and Western universities with Eastern majority. Especially Chinese and some other Asian foundated universities have strong bonds both internal and external network with clusters. Bond strength of top three universities in the Top 20 list detected as follows: Cranfield University (264), Chalmers University of Technology (206), Chinese University of Hong Kong (187).

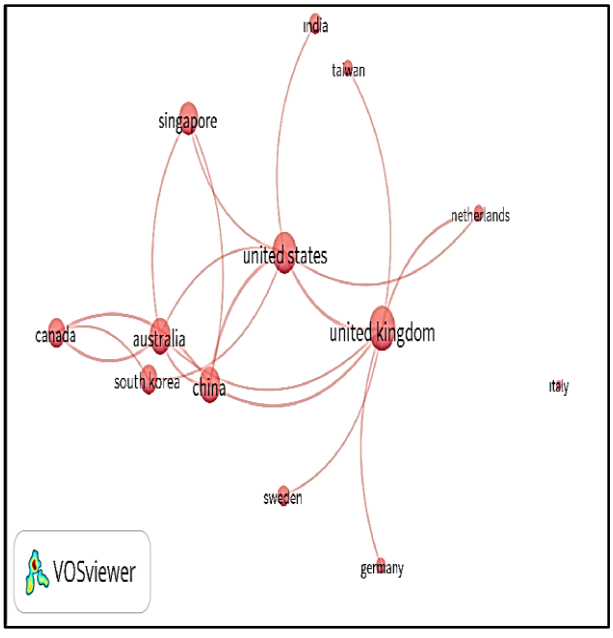

Figure 8. Co-authorship of countries.

Due to the analysis of co-authorship of countries' authors, as seen in figure 8, collaboration somehow depends on political relationships between countries. For instance; even in geographically close countries such as China and South Korea there is no co-work or research was observed. Link strength which demonstrates the collaboration density between countries observed as follows; USA and UK 27, China 25 and Australia 18.

Another criterion has to be examined is major journals for the area. Journals with the number of articles, total link strength and 2 years impact factor (IF) can be compared in table 3.

Table 3. Major journals of area.

Journal	Documents	Total Link Strength	IF (2020, 2 yrs)
International J. of Physical Distribution & Logistics Management	43	658	6.045
International J. of Logistics Research and Applications	24	444	4.104
Transportation Research Part E	18	259	6.875
Journal of Business Logistics	17	162	6.677
The International J. of Logistics Management	16	171	5.661
Journal of Air Transport Management	15	72	4.134
Journal of Supply Chain Management	14	248	8.647
International J. of Production Economics	14	304	7.885
Production Planning & Control	12	353	6.791

Although the research area of this study primarily focused on an aviation branch which is Air Cargo services, the vast majority of journals are determined in logistics, production and supply chain research based. The only journal was kept place in the list focused purely on aviation actions is Journal of Air Transport Management (JATM). If the Total Link Strength parameter is examined, which demonstrates the interaction with others, JATM has got relatively low score. As a result, logistic research orientated journals got more published essays and link strength than specially focused on aeronautical fields. Co-citation analysis occurred in 3 clusters that journals; cited and got cited, grouped

at the same cluster. Figure 9 demonstrates the cluster structure of journals.

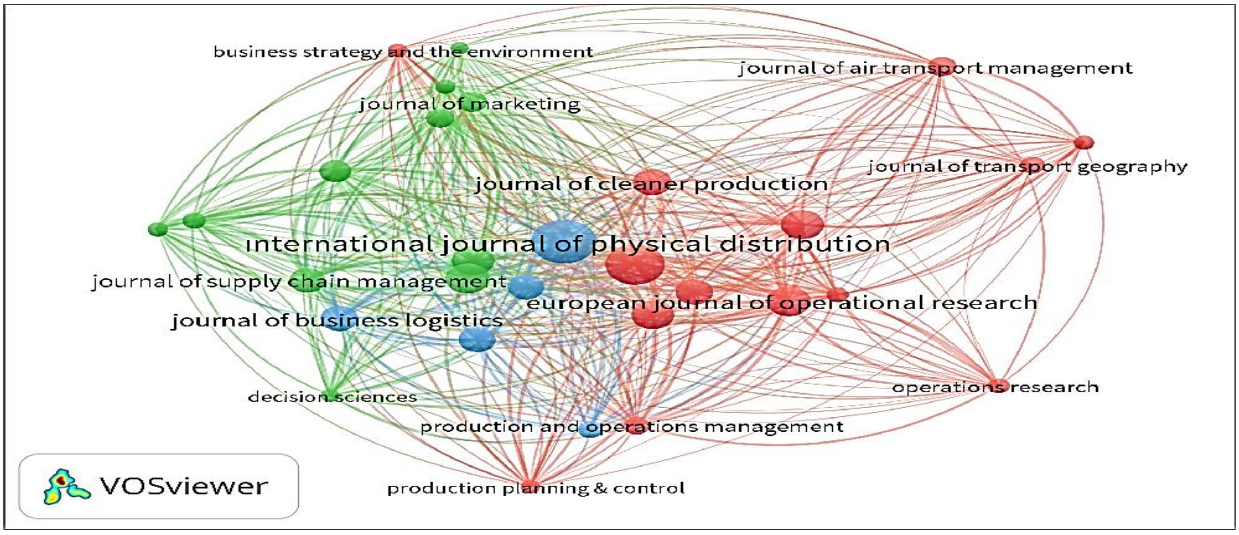

Figure 9. Cluster structure and bonds of journals.

4. Conclusion

Due to the increasing values for global commerce, transport activities of goods need more complicated processes in order to ensure perfection both organizational, operational and financial dimensions. Thus, scientific research on the area follows a similar trend with logistic activities acceleration. As a result, universities/instutitions publish new essays with an increasing tendency for the area. As mentioned in the study before; pricing, operational and managerial shifting on air transport activities also creates its *research demand* with serious advantages for manufacturers, suppliers etc.

Together with the rising interest to the topic; universal knowledge, shared *"know how"* experience and new perspectives put forward to the community. However, with close inspection of published materials for logistic based studies, a *paper hurricane* can be also observed. Hence determining the milestones and qualified studies carry importance for new researchers and people who want to get informed about topics. Bibliographic analysis is a proven way to determine qualified studies with various stages. Also, research trends, collaborations, regional scientific activity data can be obtained through analysis.

Study primary focused *Air Cargo* oriented studies to obtain in-depth information on the literature. Bibliographic analysis methods used to perform the analysis with selected criterias and co-word analysis, author, journal, most cited documents are also determined. In addition, networking and collaboration between institutions, countries were examined.

Result of the study findings shows; vast majority of studies not only focused to air cargo but also production, management and international operation issues besides that. Observation of these fields together means; logistics researches oriented to area generally did not focus in a specific area, conduct bonds between aeronautical activities and relevant other main fields of logistics management. Inspection of journals that pressed most of the articles and got most cited essays supports this view. Logistics, supply chain, planning&control-oriented journals indexed as had most "total link strength" parameter and published document in numbers. The only journal which focused for solely on aviation is Journal of Air Transport Management (JATM). As seen on figure 9, there are dense interrelations between most cited journals. Impact factor of these journals which have larger intrest area, relatively got higher scores compared to narrow area focused ones. Both research and publishing source statistics reflects the result that Inter/multi-disciplinary researches have been attracting more attention for last decades. Co-word analysis results for selected publications, supporting evidence could be seen about this claim. Instead of aeronautical activity

keywords solely; logistics, management, production words occur more frequently. As a result, vast majority of air cargo researches' performed under/with other disciplinary branches together.

Some countries have more air cargo activities compared to the rest, because of its location, production values, developed aviation industry and logistics investment to became *hub*. Scientific production rates also reflect and partially supports density of air cargo activity movements. USA, UK and China are the most article published countries in the area among the countries. Trade capacity, amount of import/exported goods globally and project focused institutions, working groups make positive effect for efficient production for scientific publishing. Top 3 countries followed by India, Germany, Sweden, Taiwan and Netherlands which are also strong logistic activities and trade volumes consistent with results.

Collaboration between institutions and countries also shows similarity with air cargo distribution network, flight trajectories. USA and UK placed at the center of the collaboration network; European countries generally bonded with the UK as a proxy for other continents. Asian countries grouped closely with relationships except despite the close distance; South Korea and China, Taiwan and China. This demonstrates beside the logistic activities; politic affairs play a crucial role for collaboration to scientific studies. Similar to production rate of publications, USA, UK, China and Australia have more collaborated studies than others.

As the industry evolves with production and supply demands, air cargo transportation will continue its rising trend in the future. Carbon emissions, fuel prices, aircraft and staff shortage etc. problems now and in the future will be the main key difficulties that have to be solved. Despite to short time delivery and "new" competitive pricing advantages, it could be said that; we will see more freighters in the sky soon. Especially intercontinental trade, which doesn't need production lines and the customers have to be close, e-commerce and raw material demands for mass production in the post-pandemic era, air cargo operations can catch capacity had never been.

Analysis of literature also shows the existance of research interest and trends for new studies. Paper can provide to find "research gaps" for interdisciplinary topics in the context.

Further investigations which focus on the interdisciplinary modes, have an option to compare aviation activities with both disciplines separately. This can ensure a clear view, if the bond strength of the aviation and other related areas are sufficient or not.

Also with growing production, trade rates of Eastern especially for the last decades, the shift on published articles and major journals, institutions, collaboration networks' can be observed. It's foreseen that this dynamic industry will get more attention from researchers in the future.

Ethical Approval
Not applicable

References

[1] S. A. Raza, R. Ashrafi, and A. Akgunduz, "A bibliometric analysis of revenue management in airline industry," Journal of Revenue and Pricing Management, vol. 19, no. 6, pp. 436–465, 2020.

[2] İ. Şimşir, "Bibliyometri ve Bibliyometrik Analize İlişkin Kavramsal Çerçeve" in Bir Literatür İncelemesi Aracı Olarak Bibliyometrik Analiz, O. Öztürk and G. Gürler Ed., Ankara, Turkey, Nobel Bilimsel Eserler, sec. 1, pp. 7-31, 2021.

[3] R. N. Broadus, "Toward a definition of "bibliometrics," Scientometrics, 12(5-6), 373-379, 1987.

[4] A. Martín-Martín, E. Orduña-Malea, J. M. Ayllón and E. D. Lopez-Cozar, "The counting house: Measuring those who count. Presence of bibliometrics, scientometrics, informetrics, webometrics and altmetrics in the Google Scholar citations, Researcherid, ResearchGate, Mendeley & Twitter," arXiv preprint arXiv:1602.02412, 2016.

[5] G. Baxter, "A strategic analysis of Cargolux airlines international position in the global air cargo supply chain using Porter's five forces model," Infrastructures, vol. 4, no. 1, 2019.

[6] X. M. Yuan, J. M. W. Low, and L. Ching Tang, "Roles of the airport and logistics services on the economic outcomes of an air cargo supply

chain," International Journal of Production Economics, vol. 127, no. 2, pp. 215–225, 2010.

[7] S. J. Pettit and A. K. Beresford, "Emergency relief logistics: an evaluation of military, non-military and composite response models," International Journal of Logistics: research and applications, 8(4), 313-331, 2005.

[8] IATA, "Air Cargo Market Analysis," May, 2021 Report, IATA, Quebec, 2021.

[9] L. Cavaignac and R. Petiot, "A quarter century of Data Envelopment Analysis applied to the transport sector: A bibliometric analysis," Socio-Economic Planning Sciences, vol. 57, pp. 84–96, 2017.

[10] F. H. Qaiser, K. Ahmed, M. Sykora, A. Choudhary, and M. Simpson, "Decision support systems for sustainable logistics: A review & bibliometric analysis," Industrial Management and Data Systems, vol. 117, no. 7, pp. 1376–1388, 2017.

[11] A. Dixit and S. K. Jakhar, "Airport capacity management: A review and bibliometric analysis," Journal of Air Transport Management, vol. 91, no. February 2020, p. 102010, 2021.

[12] J. Cifuentes-Faura and U. Faura-Martínez, "Twenty Years of Airport Efficiency – A Bibliometric Analysis," Promet - Traffic&Transportation, vol. 33, no. 4, pp. 479–490, 2021.

[13] G. Baxter and P. Srisaeng, "Cooperating to compete in the global air cargo industry: The case of the DHL Express and Lufthansa cargo A.G. Joint venture airline 'Aerologic'," Infrastructures, vol. 3, no. 1, 2018.

[14] T. W. Chung, W. C. Ahn, S. M. Jeon, and V. Van Thai, "A benchmarking of operational efficiency in Asia Pacific international cargo airports," Asian Journal of Shipping and Logistics, vol. 31, no. 1, pp. 85–108, 2015.

[15] E. Y. C. Wong, D. Y. Mo, and S. So, "Closed-loop digital twin system for air cargo load planning operations," International Journal of Computer Integrated Manufacturing, vol. 34, no. 7–8, pp. 801–813, 2021.

[16] S. Budiarto, H. P. Putro, P. Pradono, and G. Yudoko, "Revenue management of air cargo service in theory and practice," IOP Conference Series: Earth and Environmental Science, vol. 158, no. 1, 2018.

[17] IATA, "Outlook for the global airline industry" April 2021 Report, IATA, Quebec, 2021.

[18] S. Albers and V. Rundshagen, "European airlines′ strategic responses to the COVID-19 pandemic (January-May, 2020)," Journal of Air Transport Management, 87, 101863, 2020.

[19] ICAO, "Repurposing aircraft passenger cabins for transport of Cargo," ICAO Safety. https://www.icao.int/safety/OPS/OPS-Normal/Pages/Airworthiness%20TCPC.aspx (accessed 13 Sep, 2021).

[20] FAA, "FAA Amends Cargo Exemptions," Regulatory updates due to Coronavirus – FAA. https://www.faa.gov/coronavirus/regulatory_updates/ (accessed 16 Sep, 2021).

[21] M. Visser, N. J. van Eck, and L. Waltman, "Large-scale comparison of bibliographic data sources: Scopus, Web of Science, Dimensions, Crossref, and Microsoft Academic," Quantitative Science Studies, 2(1), 20-41, 2021.

[22] A. W. Harzing, "Two new kids on the block: How do Crossref and Dimensions compare with Google Scholar, Microsoft Academic, Scopus and the Web of Science?," Scientometrics, 120(1), 341-349, 2019.

[23] Zhang, C., Feng, W., Steffens, E., de Landaluce, A., Kleinman, S., & LeBlanc, M. D. "Lexos 2017: Building reliable software in Python," Journal of Computing Sciences in Colleges, 33(6), 124-134, 2018.

[24] I. Manuj and J. T. Mentzer, "Global supply chain risk management strategies," International Journal of Physical Distribution and Logistics Management, vol. 38, no. 3, pp. 192–223, 2008b.

[25] I. Manuj and J. T. Mentzer, "Global supply chain risk management," International Journal of Physical Distribution & Logistics Management, 2008a

[26] T. J. Pettit, J. Fiksel, and K. L. Croxton, "Ensuring Supply Chain Resilience: Development of a Conceptual Framework," Journal of Business Logistics, vol. 31, no. 1, pp. 1–21, 2010.

[27] M. Christopher, R. Lowson, and H. Peck, "Creating agile supply chains in the fashion industry," International Journal of Retail & Distribution Management, vol. 32, no. 8, pp. 367–376, 2004.

[28] I. J. Chen and A. Paulraj, "Understanding supply chain management: critical research and a theoretical framework," International Journal of Production Research, 42(1), 131-163, 2004.

[29] Y. M. Bontekoning, C. Macharis and J. J. Trip, "Is a new applied transportation research field emerging? A review of intermodal rail–truck freight transport literature," Transportation Research Part A: Policy and Practice, 38(1), 1-34, 2004.

[30] G. Svensson, "A conceptual framework for the analysis of vulnerability in supply chains," International Journal of Physical Distribution & Logistics Management, 2000.

[31] L. Barnes, and G. Lea-Greenwood, "Fast fashioning the supply chain: shaping the research agenda," Journal of Fashion Marketing and Management: An International Journal, 2006.

[32] E. Bottani and A. Rizzi, "A fuzzy TOPSIS methodology to support outsourcing of logistics services," Supply Chain Management: An International Journal, 2006.

[33] B. J. La Londe and J. M. Masters, "Emerging logistics strategies: blueprints for the next century," International Journal of Physical Distribution & Logistics Management, 1994.

[34] M. E. Johnson, "Learning from toys: Lessons in managing supply chain risk from the toy industry," California Management Review, 43(3), 106-124, 2001.

[35] C. Speier, J. M. Whipple, D. J. Closs, and M. D. Voss, "Global supply chain design considerations: Mitigating product safety and security risks," Journal of Operations Management, vol. 29, no. 7–8, pp. 721–736, 2011.

[36] R. H. Ballou, "The evolution and future of logistics and supply chain management," European Business Review, 2007.

[37] H. Gupta, H and M.K. Barua, "Identifying enablers of technological innovation for Indian MSMEs using best–worst multi criteria decision making method," Technological Forecasting and Social Change, 107, 69-79, 2016.

[38] S.J. Pettit and A.K. Beresford, "Emergency relief logistics: an evaluation of military, non-military and composite response models," International Journal of Logistics: Research and Applications, 8(4), 313-331, 2005.

[39] J. Rezaei, O. Kothadiya, L. Tavasszy, and M. Kroesen, "Quality assessment of airline baggage handling systems using SERVQUAL and BWM," Tourism Management, vol. 66, pp. 85–93, 2018.

[40] T. M. Choi, X. Wen, X. Sun, and S. H. Chung, "The mean-variance approach for global supply chain risk analysis with air logistics in the blockchain technology era," Transportation Research Part E: Logistics and Transportation Review, vol. 127, no. March, pp. 178–191, 2019.

[41] M. Dobrovnik, D. Herold, E. Fürst, and S. Kummer, "Blockchain for and in Logistics: What to Adopt and Where to Start," Logistics, vol. 2, no. 3, p. 18, 2018.

[42] R. H. Ballou, "The evolution and future of logistics and supply chain management," European Business Review, vol. 19, no. 4, pp. 332–348, 2007.

[43] C. S. Tang, J. D. Zimmerman, and J. I. Nelson, "Managing New Product Development and Supply Chain Risks: The Boeing 787 Case," Supply Chain Forum: An International Journal, vol. 10, no. 2, pp. 74–86, 2009.