Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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What can we learn from the JATM literature for the future of aviation post Covid-19? - A bibliometric and visualization analysis☆

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ABSTRACT

This paper aims to draw lessons from retrospectively evaluating the evolution of the air transport discipline right up to the COVID-19 outbreak through the *Journal of Air Transport Management* (JATM), the main scholarly air transportation journal globally. As such, this study deploys a comprehensive bibliometric analysis and graphical mapping of the JATM knowledge body through CiteSpace visualization of 1483 JATM papers from 2001 to 2019. Our results suggest that while the industry has experienced pandemics and economic crises in the past, both were not dominant in influencing JATM literature neither in frequency nor in impact. That said, recovery, crisis and disruption are important key words in JATM papers not just in regard to safety and economic crisis management but increasingly also related to health concerns with recent key papers published in the pandemic and recovery management context which may have helped the industry dealing with the current crisis as well as current JATM papers on this topic assisting with preparing for a transitioning out of COVID-19 world.

1. Introduction

Since the US Airline Deregulation Act in 1978, the global air transport industry has experienced a remarkable growth and transformation process. Ever increasing demand but also changing ecosystems have led to the emergence of new business models such as low-cost airlines (Ko, 2016) resulting in the average airline becoming more diversified with many full service carriers having low-cost carriers as part of their holding or corporate portfolio (Pearson and Merkert, 2014). While the aviation industry has since its inception been exposed to endogenous risks and volatilities of both demand and costs (i.e. fuel costs; Merkert and Swidan, 2019) it has always been able to restructure, show resilience and bounce back sharply even from crises and disasters such as the Oil Crisis, the Gulf War, the Global Financial Crisis, the 9/11 terrorist attacks, the Severe Acute Respiratory Syndrome (SARS), Swine Flu (H1N1) and Middle East respiratory syndrome (MERS) (Chung, 2015; ICAO, 2020). As such, the industry kept growing and operated as many as 38 million scheduled commercial flights and carried 4.3 billion passengers in 2018 (Industry High Level Group, 2019), supporting 65.5 million jobs globally, including 10.5 million airport and airline staff, and $2.7 trillion in world economic activity in 2019 (ACI and IATA, 2020). However, since early 2020, the aviation industry is facing its perhaps greatest challenge ever as it is struggling with the COVID-19 pandemic (IATA, 2020a), which resulted in closed borders and many airlines not only coming to a standstill, with hibernating of up to 95% of their fleets, but some even going into voluntary administration (e.g. Virgin Australia or Avianca) and most asking for unprecedented government support, including all of the large US carriers.

Similar to SARS, COVID-19 is an airborne disease that can be transmitted rapidly among people (Yang et al., 2020). As of July 30, 2020, the number of reported cases has exceeded 18 million with approximately 694,715 deaths announced (Johns Hopkins University, 2020). The experience with previous outbreaks tells us, that they usually have direct and serious negative effects on both human health and national economies (Black et al., 2017; Liang et al., 2018) with the air transport industry at the center of the storm (e.g. Suau-Sanchez et al., 2020), as it derives from human and freight mobility, thus not only depending on such but potentially also causing the disease to spread regionally including to remote areas (Yang et al., 2020). It is hence no surprise that the early evidence suggests significant impact of COVID-19

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on the aviation sector, with EUROCONTROL (2020) reporting that the number of flights decreased by 87% in April compared to the same period of the previous year and our own analysis of OAG and CAPA data showing that some large airports and routes have come to a near standstill in May 2020. On that basis, IATA (2020b) predicts that the global air transport industry could lose $ 314 billion in passenger income in 2020 pointing to the impact of COVID-19 being much more severe than the SARS epidemic that caused an 8% annual decrease in Revenue Passenger Kilometers (RPKs) (ICAO, 2020). Before that background, in this paper we aim to review the extant literature to see what lessons have been learned from previous pandemics and crises as we argue that the industry will need any advice it can to survive the impact of COVID-19 however long it may last.

Significant events such as COVID-19 has been used in the past for special issues and bibliometric review analysis in the tourism context (Mulet-Forteza et al., 2018) but not for aviation. In this paper we aim to retrospectively evaluate the evolution of the air transport discipline right up to the COVID-19 outbreak through the *Journal of Air Transport Management* (JATM), the main scholarly air transportation journal globally. The main motivation behind performing this bibliometric analysis on JATM is to understand the evolution of the journal, its importance in the field of air transport management, any lessons that can be learned from its papers in terms of strategies for handling pandemics in the aviation context and finally any guidance based on history on who might likely be the institutions and authors that we will look for in terms of reference to strategies for the post-COVID-19 era. As bibliometric review analysis has not yet been widely published and generally accepted in JATM, COVID-19 as a great motivation and theme for finally reviewing the JATM literature in such an innovative manner. Koc and Boz (2014) state that scholarly journals contain clues to reflect the development of a field or industry. In this sense, we regard JATM as an important scholarly resource that reflects the development of the air transport industry. When we did a quick search with the keyword "Air Transport" in the Web of Science (WOS) database we found that most of the results were originated from and associated with JATM which provides additional support for this notion. Considering this, our study seeks an answer to the following research question: What can we in a systematic manner learn from the extant JATM literature in terms of the future of aviation management transitioning out of and post-COVID-19 or perhaps for preparing and managing potential future pandemics (e.g. COVID-21)?

In light of this question, the following sub-questions are also being inquired in this study:

(a) Based on bibliometric evidence what were the powerhouses/authors etc. Until COVID-19 occurred?
(b) Was there anything in the JATM literature on management of aviation during and after pandemics?

To answer these questions, the entirety of JATM literature pre COVID-19 is analyzed covering the 2001–2019 period. Using several metrics, we present a comprehensive picture of the JATM literature to readers, and we also develop a graphical mapping of the journal to provide additional insights. The remainder of this paper is organized as follows. Section 2 presents the research methodology including previous studies and bibliographic material. In Section 3, the publication and citation structure of JATM, the most cited publications, and the main results of leading authors, institutions and countries are analyzed. Then, the knowledge body of the JATM is mapped using the CiteSpace visualization software in Section 4. Section 5 summarizes our main findings including limitations of the study and offers in addition to our conclusions some future research avenues.

2. Bibliometric method and data

2.1. Bibliometric analysis and related works

Bibliometric analysis refers to the quantitative analysis of bibliometric material related to a research area, a journal or a specific topic (Merigó et al., 2017; Mulet-Forteza et al., 2018). In this way, not only retrospective evaluation of the related area, discipline or journal can be made, but it is also possible to identify future trends (Merigó et al., 2015a). Similar to such bibliometric analysis, structured literature reviews have traditionally also allowed retrospective evaluations, but those reviews suffered from being limited to a relatively small number of studies included in the analysis. Compared to straightforward literature reviews, bibliometric analyzes provide deeper insights (Derudder et al., 2019) and offer more objective results in terms of trend and performance (Guzeller and Celiker, 2019; Wang et al., 2020) as they not only offer a macro perspective but also more diversity as they cover a much larger part of the population (of potentially relevant studies).

In the past, while the collection and processing of bibliometric materials were very troublesome, advancements in technology have made this a much easier exercise (Cancino et al., 2017). The extant literature includes bibliometric studies in many areas including management (Podsakoff et al., 2008), finance (Chung et al., 2001), tourism and leisure (Mulet-Forteza et al., 2019), marketing (Samiee and Chabowski, 2012), and sustainability (Olawumi and Chan, 2018). In terms of academic journals, many studies have focused on an important period of a journal or the entire publication process, addressing past and current trends and the development of the journal. Some of these analyzes go back almost 30 years, as with Heck and Bremser's (1986) exemplary paper analyzing *The Accounting Review* or Merigó et al.'s (2015b) review of 40 years of the *Journal of Business Research*. In the transportation space, Derudder et al. (2019) examined the entire period of the *Journal of Transport Geography* while Zhou et al. (2019) analyzed *Transport* between 2017 and 2019 and discussed emerging trends. Mulet-Forteza et al. (2018) analyzed the 25-years development of the *Journal of Travel & Tourism Marketing*, covering the period 1992–2017. Donthu et al. (2020) comprehensively analyzed 45 years of publication performance of the Journal of Business Research. Guzeller and Celiker (2019) bibliometrically analyzed the *Asia Pacific Journal of Tourism Research*'s publications between 2009 and 2017. More recently, Wang et al. (2020) celebrated the 40th anniversary of *Omega* by publishing a bibliometric study.

There are also many bibliometric analysis studies in the extant literature that have focused on a specific topic including socially responsible funding (Fabregat-Aibar et al., 2019), sustainable transport (Zhao et al., 2020) and more recently also a scientometric analysis (which is often used synonymously with bibliometric analyses) on safety issues related to COVID-19 (Haghani et al., 2020). Some bibliometric studies have further focused on the relationships between different areas such as air transport and tourism (Spasojevic et al., 2016) and psychology and tourism (Barrios et al., 2008). Lastly, some of these studies have deployed just one of the bibliometric analysis tools such as the most influential journals (García-Lillo et al., 2016; Park et al., 2011) in that literature; prolific researchers (McKercher, 2008); the top contributor institutions (Jogaratnam et al., 2005); journal clusters (Modak et al., 2019); co-authorship networks (Sun and Rahwan, 2017); cross-institutional networks (Ye et al., 2012) and country-based evaluations (Aldemir and Sengur, 2017; Köseoglu et al., 2015).

In the transportation literature, bibliometric analysis has also been conducted on topics such as data envelopment analysis (Cavaignac and Petiot, 2017), carbon emission research (Tian et al., 2018), sustainable transport (Zhao et al., 2020) and urban smart mobility (Tomaszewska and Florea, 2018). More recently, Chen and Liu (2020) carried out a bibliometric analysis on high-speed railway research using a wide range of keywords. In terms of academic transport journals, Derudder et al. (2019) bibliometrically analyzed the *Journal of Transport Geography*.

Zhou et al. (2019) focused on the *Transport Journal* and Modak et al. (2019) examined *Transportation Research* journals more broadly. Although there are many studies on different modes of transportation, air transport studies are sparse and the few that do exist are incomprehensive (Aldemir and Sengur, 2017; Bergiante et al., 2015; Loos et al., 2016) such as Ginieis et al. (2012). As, no retrospective study has so far specifically examined the JATM literature. Therefore, it can be concluded that although JATM is the major scholarly "air transport management" journal, its current position and contribution in literature has not been understood sufficiently, let alone in association with strategic responses to pandemics such as COVID-19.

There is no general acceptance in the literature about which bibliometric methods and tool sets are better (Cancino et al., 2017; Merigó et al., 2019). Therefore, various metrics from the extant literature are used in this study. Among these, the number of studies, the number of citations, average citation per study, *h*-index are the primary metrics deployed in our analysis. In this context, the number of studies denotes productivity while the number of citations indicates the journal's influence (Donthu et al., 2020). Besides, per-citation and *h*-index are important indicators of influence. The *h*-index, which is considered to be a robust influence metric, shows the number of *h* studies in a journal that exceeds *h* citations (Merigó et al., 2019). Also, the publication development of JATM is analyzed using citation thresholds (Cancino et al., 2017). Apart from these, the most cited studies, basic statistics about leading institutions, authors and countries, and frequently used keywords are also preferred (Modak et al., 2019) and hence deployed in this paper.

2.2. Graphical mapping analysis

Retrospective evaluations are usually based on the integration of two approaches: evaluative and relational techniques. While evaluative techniques focus on productivity and influence metrics described in the previous section, relational techniques visualize existing relationships and provide information about past and present trends (Guzeller and Celiker, 2019). Graphical mapping called relational techniques aims to provide deeper insight into the intellectual structure of a particular field or journal (Zhao et al., 2020). In this study, graphical mapping is developed using CiteSpace. CiteSpace, developed by Chen (2006), is a software that allows visualization of knowledge areas, defining past and present trends, and categorizing the information in narrower clusters (Zheng et al., 2017). Although there are many other software packages (i.e. VOSviewer, BibExcel, HistCite, etc.), CiteSpace is preferred in this study because it allows extra analysis such as burst detection (Li et al., 2017).

Graphical mapping analysis includes co-citation (authors, documents, and journals co-citation), co-author analysis (authors/countries/institutions co-occurrence) and co-word analysis (keyword occurrence). Co-citation occurs when two publications cite to the same third publication. The co-authorship indicator illustrates collaboration networks, in other words, the extent to which the units are connected (Mulet-Forteza et al., 2018). Co-word analysis is also used to identify and measure the most frequent keywords in publications. By doing so, the intellectual structure of the relevant literature can be explained and trends can be identified (Donthu et al., 2020; Guzeller and Celiker, 2019). Also, we deploy burst detection and cluster analysis in this study. Burst detection shows the presence of specific keywords, authors, and institutions that exceed the predefined thresholds in a certain period. It can be concluded that the items with strong bursts have great domination in a certain period or have become an important (past/current) trend (Guzeller and Celiker, 2019; Zhou et al., 2019). Finally, the cluster analysis provided through CiteSpace analysis helps to identify similar research topics according to the related keywords. In this analysis, each cluster represents the basic research topics that make up the knowledge body in the journal. By doing so, the goodness-of-fit value is measured by the silhouette score ranging between −1 and +1 (Li et al., 2017). Accordingly, higher silhouette scores show the homogeneity between the items. The cluster labels formed as a result of the analysis depend on the keywords. In this context, the log-likelihood ratio (LLR) value compares the probability of having a keyword in one cluster compared to the probability of having the same keyword in another cluster and evaluates the goodness-of-fit of each cluster in this way. Thus, the homogeneity of the labels is met (Zhao et al., 2020). Finally, the modularity Q value, ranging between 0 and 1, indicates that the relationship increases between clusters as it approaches 1. Generally speaking, Modularity Q values between 0.4 and 0.8 are acceptable (Li et al., 2017).

2.3. The bibliometric data collection process

In this study, the evolution of the air transport management field using JATM literature until COVID-19 (by end of 2019) is presented with a comprehensive bibliometric analysis. The JATM is a scholarly journal that publishes original articles in areas such as economics, management and policy related to the air transport industry. JATM was first published in 1994 by Butterworth-Heinemann. While the journal's first editor was Rigas Doganis, Sveinn Vidar Gudmundsson and Rico Merkert currently lead the journal as Editors-in-Chief. JATM offers its readers access to independent, original and double blind peer-reviewed studies in major areas such as policy/regulation/law, strategy, operations, marketing, economics and finance and sustainability. It is abstracted and indexed in databases such as TRID, RePEc, Scopus and the Social Sciences Citation Index of the WoS Core Collection. The impact factor, it received for the first time in 2001, is currently 2.412 as established by the Journal Citation Report 2018 edition. Moreover, the 2018 edition of the Scimago Journal Rank (SJR) reported that the CiteScore of JATM is 3.27, and JATM ranked 27th in the "Transportation" category. While this rank does not seem high, it is worth noting that JATM is a niche market journal with its focus on one mode of transport that is aviation only. What is more, over the last five years the Citescore has gone up from 1.31 in 2014 to a predicted score of 3.60 in 2019, which evidences a strong trajectory of JATM in gaining in importance and impact in the wider academic literature.

The bibliometric material used in our study was retrieved from the WoS database. Although there are many different databases such as Scopus and Google Scholar, WoS was taken into account because it indexes the most influential and important journals in the scientific world (Modak et al., 2019; Zhao et al., 2020) and is the most frequently used database in bibliometric analyzes (e.g. Derudder et al., 2019; Mulet-Forteza et al., 2018). The data collection process was carried out in March 2020 with the keyword "Publication name = Journal of Air Transport Management" on the WoS search page. The data retrieved from the database covers the period of 2001–2019. There are two main reasons for choosing this research period: a) The journal started to be indexed in Web of Science in 2001, b) Since the evolution until COVID-19 was examined, it was terminated at the end of 2019. After uploading the data, the time slice for analysis was determined as 1 year. Documents, authors, keywords, institutions, and countries are included in the analysis separately as an analysis unit. Also, the threshold level is set to (2, 2, 20), (4, 3, 20) and (4, 3, 20) with Top N per slice = 50 (Zheng et al., 2017). The general flow chart adopted in the study is given in Fig. 1.

3. Research results

For this section, where basic statistics around JATM are provided, 1483 documents retrieved from the WoS database were analyzed. Having examined the journal, seven different document types were found. As can be seen in Table 1, the documents are mostly composed of articles (n = 1401, 94.4%). This percentage also includes proceedings papers. Other bibliographic material are editorials (n = 49, 3.3%), book reviews (n = 25, 1.7%), reviews (n = 4, 0.3%), biographical items (n = 2, 0.1%) and corrections (n = 2, 0.1%).

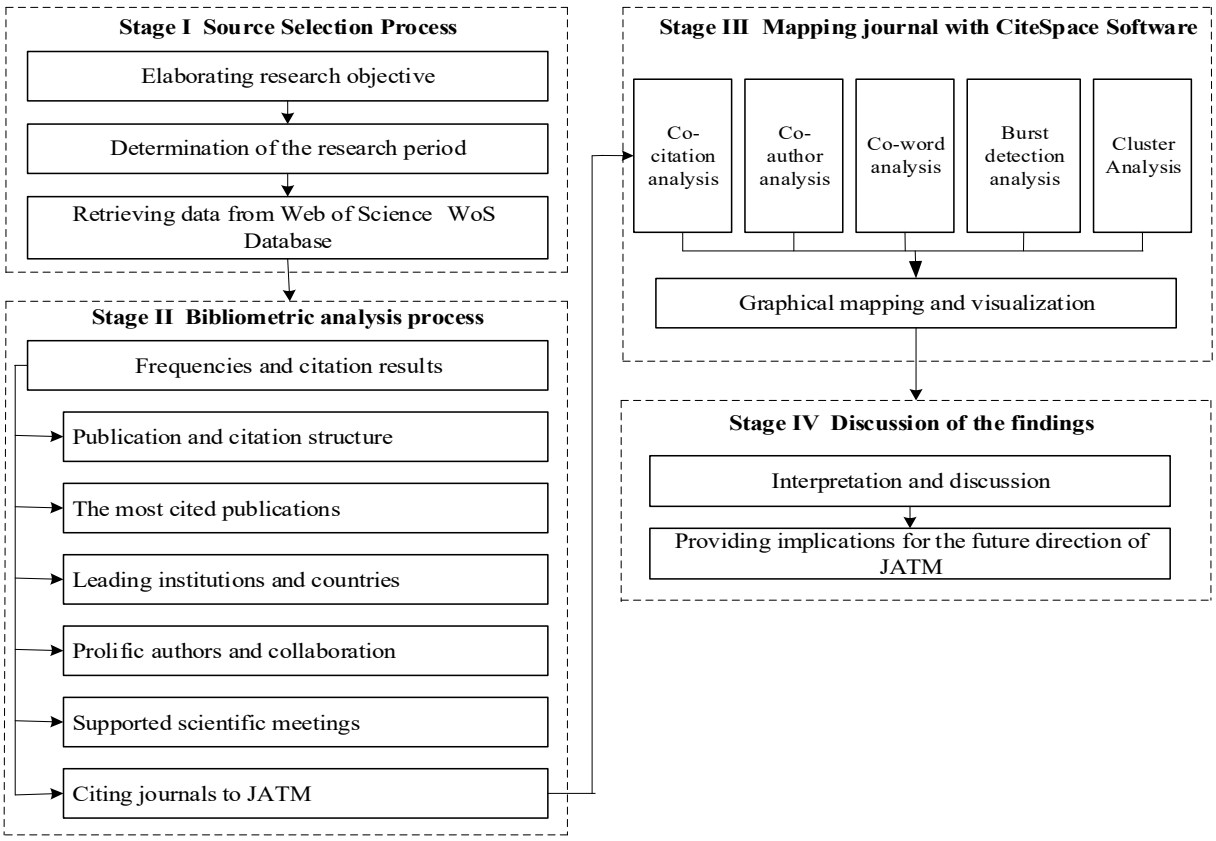

Fig. 1. The general flow chart of the proposed model.

Table 1
Distribution of document types.

Document Type	Frequency (n)	Percent (%)
Article	1401	94.4
Proceedings Paper	227	15.3
Editorial Material	49	3.3
Book Review	25	1.7
Review	4	0.3
Biographical Item	2	0.1
Correction	2	0.1

Fig. 2 visualizes the WoS categories found in association with JATM. Considering all the studies published in JATM, the majority of the documents in JATM are related to transportation (n = 1663, 17%) and economics (n = 1613, 17%) categories. These categories are followed by transportation science technology (n = 1143, 12%), management (n = 1079, 11%) and operations research management science (n = 945, 10%). Apart from these categories, there are results for different categories such as hospitality leisure sport tourism, environmental studies, and business. Note that a study can be covered by more than one category.

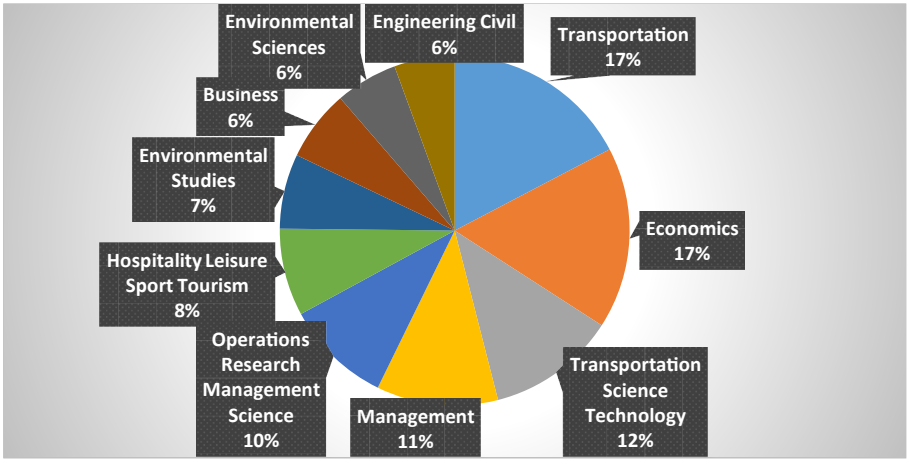

Fig. 2. Top 10 WoS categories in JATM (without self citations).

3.1. Publication and citation structure in JATM

In this section, JATM's publication and citation structure is explained. Regarding publication frequency, it is somewhat erratic, but the number of studies has increased gradually except for 2019. As Fig. 3 depicts, the number of studies in JATM exceeded 100 for the first time in 2012 and peaked in 2016 with 140 studies. Considering the general picture, the increase in the number of studies can be associated with the increase in the number of submissions received by journals, and developments in computer technologies and scientific software (Valenzuela et al., 2017). Average citations by each study also increased regularly. Moreover, there is a significant increase in average citations received each year, which is an indication for the increased quality and impact of papers published in JATM and indeed a result of improved quality assurance by the editors as the number of submissions has reached with 540 its highest level in 2019 (based on data provided by Elsevier). The increase in the number of scientific journals and subsequent academic studies around the world may, of course, also have contributed to the increase in the number of citations.

Table 2 presents the general publication and citation structure of JATM using citation thresholds. Accordingly, the number of publications is partially erratic but tends to increase in general. The number of citations has increased rapidly over the years, with minor exceptions. JATM exceeded the citation threshold of 100 for the first time in 2005. In 2011, the number of citations reached a serious level and exceeded 1000 citations. The most significant increase in the number of citations was in 2016 with 904 new citations (52.8% growth), and by 2019, the number of citations received in one year was recorded as 3523. Table 2 also reveals that studies with more than 100 citations account for only 1.21% of all studies, and more than half of the studies received at least 5 citations. When we examine the cited studies, it is evident that 88.8% of the publications received at least one citation, which shows that JATM generally hosts publications that are consulted and cited in the field and that increasingly so. As such, while considering the citation thresholds, it should be noted that the studies published in recent years have not yet reached potential citation levels. Finally, both the average number of citations per study (AC/ES) and the annual average number of citations (AC/EY) have increased substantially over time. Regarding the journal's impact factor (IF), it was observed that the impact factor is generally increasing except for minor fluctuations. The most obvious increase was realized in the jump from 1.084 to 2.038 in 2016. Today, the impact factor of the JATM is at its highest level with 2.412.

3.2. An overview of the most cited studies

Another aspect worth examining in regard to JATM is the most cited papers. Table 3 presents the 20 most cited papers in JATM with the most cited paper being "Airline safety measurement using a hybrid model" with 244 citations by Liou et al. (2007). The papers entitled "Passengers' perceptions of low-cost airlines and full-service carriers: A case study involving Ryanair, Aer Lingus, Air Asia and Malaysia airlines" by O'Connell and Williams (2005) and "The effect of airline service quality on passengers' behavioral intentions: a Korean case study" by Park et al. (2004) are the second and third, respectively. Considering the average number of citations per year, there are four studies with 10 and more citations. Among them, Liou et al., 2007 have the highest rate of average citation per year, followed by "Building an effective safety management system for airlines" by Liou et al. (2008) and Olawumi and Chan (2018). Although there are studies on various topics such as competition, performance, and passenger demand, it is evident that safety and service quality issues stand out as the most influential topics within the air transport management area. Particularly the focus on safety is interesting to a COVID-19 context where safety and particular health concerns has become even more paramount. That said, the fact that the most recent study in the top 20 was published in 2011 which indicates that time is needed for the contribution of more recent publications to become visible.

3.3. Leading institutions and countries of JATM

Valuable perspective can also be obtained from the analysis of the most productive institutions and countries in JATM, as summarized in Table 4. Cranfield University ranks first in terms of the total number of studies and total citations, followed by University of British Columbia and Loughborough University. Considering the average number of citations per study, there are notable differences in the ranking as the University of California System is ranked first with an average of 25.32 citations, followed by National Cheng Kung University with 20.50 citations and the University of Westminster with 19.10 citations. Generally speaking, leading institutions in terms of institutional ranking are located in Anglophone countries. Besides, the most productive countries are the US, England and Taiwan. Countries such as Germany, Australia and China are also well represented in these rankings. Considering the average number of citations per study, which is an indicator of influence, it is evident that the Netherlands is first with 18.30 citations, followed by Portugal with 16.88 and England with 16.28 cites per paper,

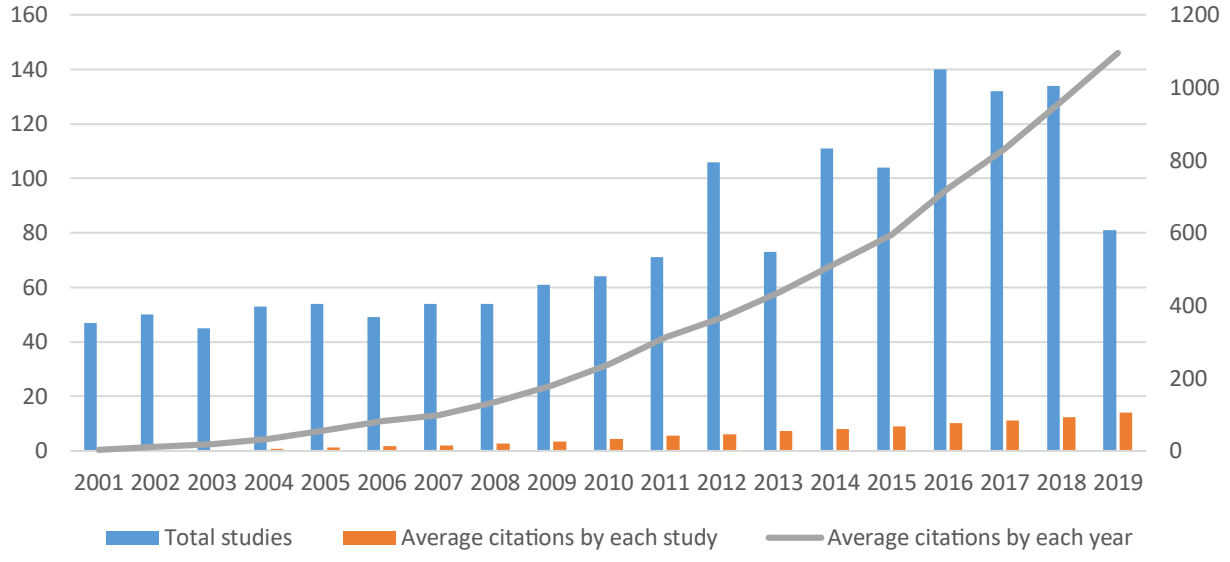

Fig. 3. Number of publications and citations per year in JATM.

Table 2
General citation structure of JATM between 2001 and 2019.

	Publications with citations									
Year	≥100	≥50	≥20	≥5	≥1	TS	TC	AC/ES	AC/EY	IF
2001	1	9	16	27	41	47	3	0.06	3.00	–
2002	1	6	19	39	42	50	18	0.22	10.50	–
2003	0	9	20	34	39	45	37	0.41	19.33	0.438
2004	4	7	20	39	51	53	75	0.68	33.25	0.487
2005	3	5	29	44	51	54	152	1.14	57.00	0.541
2006	2	7	22	44	48	49	212	1.67	82.83	0.577
2007	5	10	23	43	48	54	195	1.97	98.86	0.453
2008	1	9	23	43	49	54	388	2.66	135.00	0.773
2009	0	5	25	46	52	61	544	3.48	180.44	0.828
2010	0	3	21	52	61	64	758	4.49	238.20	0.829
2011	1	3	12	54	67	71	1052	5.70	312.18	0.907
2012	0	2	23	76	102	106	966	6.21	366.67	0.800
2013	0	1	13	50	70	73	1256	7.24	435.08	0.849
2014	0	1	25	85	107	111	1559	8.09	515.36	0.931
2015	0	3	17	70	103	104	1711	8.96	595.07	1.084
2016	0	0	12	78	130	140	2615	10.16	721.31	2.357
2017	0	0	7	61	120	132	2587	11.14	831.06	2.038
2018	0	1	3	35	108	134	3162	12.33	960.56	2.412
2019	0	0	0	1	28	81	3523	14.03	1095.16	N/A
Total	18	81	330	921	1317	1483	20,813			
Percent	1.21%	5.46%	22.25%	62.10%	88.81%	100%				

Notes. ≥100, ≥50, ≥20, ≥5, ≥1 denotes the number of studies with equal or more than 100, 50, 20, 5 and 1 citation. Other abbreviations: TS = Total Studies, TC = Total Citations, AC/ES = Average citations per study, AC/EY = Average citations per each year, IF=Impact Factor.
Source: Compiled by the authors based on WoS data.

respectively.

Table 4 presents collaboration frequency (Collab.) and total studies per population (TS/Pop). Collaboration frequency refers to how many of the total studies are published as a result of collaboration, while total studies per population normalizes the number of publications by proportioning the population of the countries. Considering the population of the countries, the most productive countries are Taiwan, Portugal and the Netherlands. Regarding collaboration, the studies of Cranfield University, University of British Columbia and National Taiwan Ocean University are mostly involved in the collaboration. Based on countries, the collaboration ranking is in line with the order of total studies and total citations.

In addition to Table 4, Fig. 4 shows country-based publication production over two-year periods. Notably, China's impact and contribution to JATM has greatly increased over the last few years parallel which is in line with the global trend of China's contribution to world science (Derudder et al., 2019).

3.4. Author productivity and collaboration issue

Another important issue in a bibliometric analysis is author productivity. Table 5 lists the productive authors in JATM with Niemeier HM ranking first in terms of the total number of papers (22) followed by Oum TH (21) and Zhang AM (16). Considering influence as measured by the total number of citations and average citations per study, Table 5 reveals again a much different ranking. As such, Barros CP is the top ranked influential author with 9 studies and an average number of 34.22 citations per study. The second is Burghouwt G, with 10 studies and an average number of 29 citations per study. Noteworthy, nine of top 15 productive authors are on the JATM editorial board, which suggests that the editorial board is an important resource that contributes to JATM. When the *h*-indexes of the authors are examined, the most influential author is Forsyth P, followed by Gillen D and Zhang AM.

Lastly, Fig. 5 provides information about the author's collaboration in JATM. Considering author collaboration, it can be observed that almost a quarter of the publications are made in sole authorship (n = 367, 24.75%). However, the rest of the publications have been produced in collaboration, mostly between two authors. Progress in an academic research discipline is dependent on the strength of network collaboration between researchers and institutions (Li et al., 2017) and our results suggest that JATM performs well in this regard.

3.5. Supported scientific meetings and their productivity

Kuhn (1970) stated that one of the preconditions for the formation of a scientific research discipline is an active scientific community that takes thought leadership. In this regard, scientific conferences are very important, which enable researchers to communicate their findings and come together. Table 6 shows the scientific conferences supported by JATM and reveals the dominance of Air Transport Research Society (ATRS) conferences in this regard. That said, the Hamburg Aviation Conference ranks first in terms of productivity with 19 studies derived from this meeting being cited on average 46.53 times. In terms of the number of citations, the most influential meeting is the Hamburg Aviation Conference with 884 citations.

3.6. Analysis of author and journals citing JATM

In this section, authors and journals citing JATM are analyzed. Table 7 presents the most cited authors and journals to JATM using various metrics, taking into account a total of 8092 journal papers citing JATM. As such, the most citing author is Tzeng GH with 66 papers, followed by Zhang AM with 59 papers and Barros CP with 42 papers. In respect to the *h*-index, the *h*-indexes of the most citing authors are ranging from 9 to 63, indicating that they are highly influential authors. In terms of journals citing JATM, *Transportation Research Part A: Policy and Practice* rank first with 223 papers (2.75%), followed by *Sustainability* with 202 studies (2.49%) and *Transportation Research Part E: Logistics and Transportation Review* with 179 studies (2.2%). Moreover, the top 15 citing journals are highly influential journals none of which has an impact factor below 0.748 ($M_{IF} = 4.174$). Furthermore, we observed that these journals are mostly in the field of transportation, and in this respect; JATM has made a significant contribution to the related literature.

4. Graphical mapping of JATM with citespace

To deepen the insights of the bibliometric results, in this section, a

Table 3
Top 20 most cited studies in JATM from 2001 to 2019.

R	Title	Author(s)	Year	TC	AC/EY
1	Airline safety measurement using a hybrid model	Liou et al.	2007	244	17.43
2	Passengers' perceptions of low-cost airlines and full-service carriers: A case study involving Ryanair, Aer Lingus, Air Asia and Malaysia airlines	O'Connell and Williams	2005	167	10.44
3	The effect of airline service quality on passengers' behavioral intentions: a Korean case study	Park et al.	2004	161	9.47
4	Building an effective safety management system for airlines	Liou et al.	2008	142	10.92
5	An application of DEA to measure the efficiency of Spanish airports before privatization	Martin and Roman	2001	142	7.1
6	Price elasticities of demand for passenger air travel: a meta-analysis	Brons et al.	2002	141	7.42
7	Privatization, corporatization, ownership forms and their effects on the performance of the world's major airports	Oum et al.	2006	122	8.13
8	Examining airline service quality from a process perspective	Chen and Chang	2005	116	7.25
9	Competition between network carriers and low-cost carriers - retreat battle or breakthrough to a new level of efficiency?	Franke	2004	115	6.76
10	Air transport and tourism - Perspectives and challenges for destinations, airlines and governments	Bieger and Wittmer	2006	114	7.6
11	Expectations and perceptions in airline services: An analysis using weighted SERVQUAL scores	Pakdil and Aydin	2007	113	8.07
12	Performance evaluation of Italian airports: A data envelopment analysis	Barros and Dieke	2007	110	7.86
13	How do the demands for airport services differ between full-service carriers and low-cost carriers?	Barrett	2004	109	6.41
14	Competitive advantage of low-cost carriers: some implications for airports	Gillen and Lall	2004	107	6.29
15	Mixed logit modeling of airport choice in multi-airport regions	Hess and Polak	2005	106	6.63
16	Competition of high-speed train with air transport: The case of Madrid-Barcelona	Roman et al.	2007	102	7.29
17	Gravity models for airline passenger volume estimation	Grosche et al.	2007	101	7.21
18	A modified VIKOR multiple-criteria decision method for improving domestic airlines service quality	Liou et al.	2011	100	10
19	Size versus efficiency: a case study of US commercial airports	Bazargan and Vasigh	2003	98	5.44
20	A comparative analysis of productivity performance of the world's major airports: summary report of the ATRS global airport benchmarking research report - 2002	Oum et al.	2003	97	5.39

Notes: TC = Total Citations, and AC/EY = Average citations per each year.

graphical mapping of the publications in JATM is developed. In doing so, we first examine the document co-citation network.

4.1. Document co-citation analysis

As defined earlier, co-citation occurs when two publications receive a citation by the third publication from JATM. Based on our CiteSpace analysis, the co-citation network of 1483 publications is illustrated in Fig. 6 suggesting that many different types of studies are cited in JATM publications. In this regard, the most cited study in JATM is "The impact of strategic management and fleet planning on airline efficiency-A random-effects Tobit model based on DEA efficiency scores" (n = 20) published by Merkert and Hensher (2011). This is followed by "A non-parametric efficiency measure incorporating perceived airline service levels and profitability" (n = 19) by Merkert and Pearson (2015) and "The growth limits of the low-cost carrier model" (n = 19) by de Wit and Zuidberg (2012). In addition to the co-citation analysis, Fig. 6 also presents clusters of the knowledge body based on the cited documents. Note that the colorings in stripes on top of the map reflect the citation dates of the studies. According to Fig. 6, a wide range of clusters are identified, from low-cost carriers (#0) to small regional airport sustainability (#2) and airline service quality (#3).

Table 8, moreover, details seven major clusters using cluster labels and mean silhouette values. Considering that the prominent clusters give clues about trend topics, it can be concluded that the hottest topics in JATM are low-cost carrier and airline service quality, the former going to be hit hardest by COVID-19 and both likely to be heavily researched in that context. Finally, the modularity Q value of the figure is 0.7727, indicating that there is a high relationship between clusters. The mean silhouette value is also 0.4542, indicating medium level homogeneity.

4.2. Author collaboration network

This section examines author collaboration networks in JATM as visualized in Fig. 7. Note that the size of the circles indicates the frequency of the collaborations, and the size of the labels shows the leading authors in terms of collaboration. As such, Oum TH, Gillen D and Park J appear to be leading in terms of collaboration.

Interestingly, through burst detection analysis (a unique feature of CiteSpace) we noted that broader collaboration networks do not exist as only five authors in JATM have burst values. The last column of Table 9 shows the burst density and suggests that Oum TH (Burst strength = 5.8673, 2001–2006) and Gillen D (Burst strength = 5.4768, 2002–2005) stand out in terms of strength of citation burst. This indicates that the authors received a considerable number of citations in the marked years but both seem to have this success in the early days of JATM and hence an expectation of them being most likely to contribute to the COVID-19 discussion in the aviation management literature in a similar fashion may be unjustified.

4.3. Institution and country collaboration networks

Fig. 8 visualizes networks of collaboration based on institutions. As mentioned earlier, the size of the circles and the labels show the lead in terms of those metrics. Accordingly, Cranfield University and the University of British Columbia, which are also prominent in terms of productivity, are also leading in interinstitutional collaboration. In terms of countries, the USA ranks first and it can be inferred that many collaborations from different continents are established.

Table 10 and Table 11 provide more detailed institution and country-based citation burst results. 14 bursts were detected for both categories. Considering the strength of the citation bursts, the leading institution and country are Wilfrid Laurier University (Burst strength = 5.7759, 2002–2005) and Canada (Burst strength = 10.5395, 2001–2007). In other words, the citations of these two units in JATM increased significantly in the marked years and hence quite a while ago. Korea Aerospace University and Embry Riddle Aeronautical University have in contrast reached very strong positions in recent years and it is hence more likely to see them being active players in the COVID-19 discussion.

In terms of countries, China and some developing countries such as Turkey and Iran have achieved great success in recent years, as shown in

Table 4
The most productive and collaborator institutions and countries contributing to JATM.

R	University	TS	TC	TC/TS	Collab.	Country	TS	TC	TC/TS	Collab.	*Pop*	*TS/Pop*
1	Cranfield University	55	971	17.65	51	USA	273	3727	13.65	273	328,200	*0.832*
2	University of British Columbia	43	799	18.58	41	England	188	3061	16.28	187	55,980	*3.358*
3	Loughborough University	37	574	15.51	21	Taiwan	161	2485	15.43	160	23,780	*6.770*
4	National Taiwan Ocean University	30	208	6.93	25	Germany	112	1273	11.37	110	83,020	*1.349*
5	Embry Riddle Aeronautical University	27	281	10.41	19	Australia	105	1544	14.70	103	24,990	*4.202*
6	Helmholtz Association	23	196	8.52	3	PR China	99	997	10.07	93	1,393,000	*0.071*
7	University of New South Wales Sydney	23	396	17.22	2	Canada	97	1559	16.07	96	37,590	*2.580*
8	Bremen University of Applied Sciences	22	132	6.00	2	Spain	85	1227	14.44	82	46,940	*1.811*
9	National Cheng Kung University	22	451	20.50	15	Italy	71	989	13.93	68	60,360	*1.176*
10	University of California System	22	557	25.32	12	Netherlands	66	1208	18.30	61	17,280	*3.819*
11	German Aerospace Center DLR	21	189	9.00	7	South Korea	52	468	9.00	46	51,640	*1.007*
12	Universidade de Lisboa	21	389	18.52	4	Turkey	47	576	12.26	42	82,000	*0.573*
13	University of Westminster	20	382	19.10	11	Brazil	41	332	8.10	36	209,500	*0.196*
14	George Mason University	19	319	16.79	14	Portugal	40	675	16.88	36	10,280	*3.891*
15	Korea Aerospace University	19	131	6.89	16	France	34	280	8.24	30	66,980	*0.508*

Note. R = Ranks, TS = Total Studies; TC = Total Citations; TC/TS = Total citations per total studies; Collab.: Collaboration frequency; Pop: Population in thousands; TS/Pop = Total Studies per population.
Source: Publication data based on WOS data and population data retrieved from Worldbank.

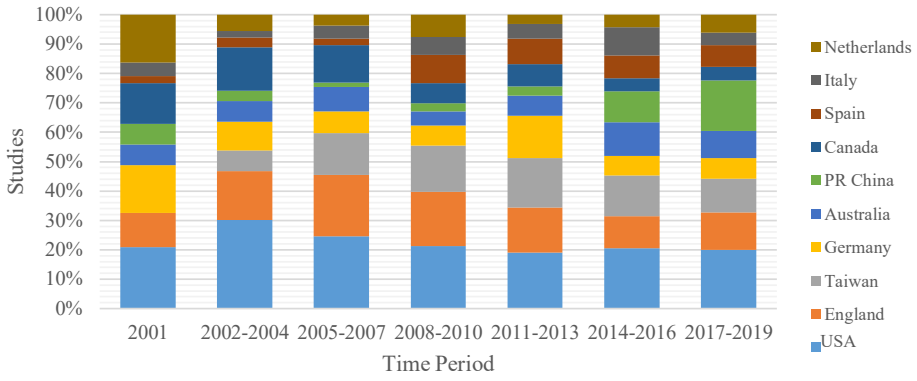

Fig. 4. Distribution of studies in JATM by top 10 countries.

Table 5
Top 15 productive authors in JATM.

R	Name	TS	TC	TC/TS	*h*-index
1	Niemeier HM *	22	103	4.68	6
2	Oum TH *	21	366	17.43	8
3	Zhang AM *	16	263	16.44	9
4	Gillen D	15	354	23.60	9
5	Forsyth P *	14	249	17.79	10
6	Park JW *	14	294	21.00	7
7	Chang YC	13	108	8.31	8
8	Gudmundsson SV *	13	55	4.23	3
9	Button K	12	181	15.08	6
10	O'Connell JF *	12	337	28.08	7
11	Chang YH	11	289	26.27	8
12	Burghouwt G *	10	290	29.00	8
13	Barros CP	9	308	34.22	7
14	Graham A *	9	181	20.11	5
15	Pitfield DE	9	103	11.44	7

Notes. TS denotes total studies. In addition, TC = Total Citations, and TC/TS = Total citations per total studies. * = Authors which are part of the editorial board of JATM.

Table 11.

4.4. Co-word analysis

The words used in a journal are worth examining in terms of reflecting the journal's profile (Merigó et al., 2017), scope and core areas of interest. In this context, the results of a co-word analysis

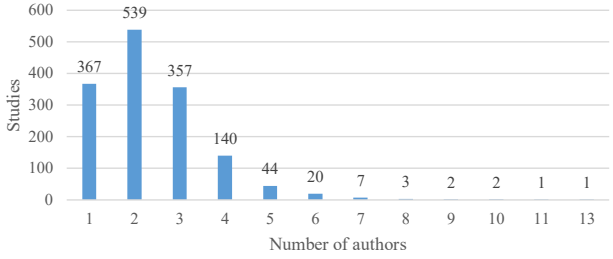

Fig. 5. Distribution of studies in JATM by number of authors.

retrieved from the abstract and keywords of studies in JATM are shown in Fig. 9 and Table 12.

As such, the first three words frequently used in the JATM papers are airport (n = 154), model (n = 152) in the context of business model and airline (n = 130). Similarly, the words with the highest centrality in the network are airport (0.13), model (0.13), efficiency (0.10) and low-cost carrier (0.10). Fig. 9 shows further that none of the key words associated with this JATM special issue (SI) frequently to an extent that they would appear in figure. As such we diverted a little from the standard bibliometric practice and ran in addition to the common procedure a search within the JATM literature in the WoS database for a subsample of the following SI words: Recovery, Crisis, Disruption, Disease, Pandemic, Influenza, Outbreak, SARS and Swine flu (H1N1). We analyzed this subset of data both separately and as a whole through the Citespace and while none of these SI words made it into the most frequently or

Table 6
Supported meetings by JATM and produced outputs.

R	Meeting Title	TS	TC	TC/TS
1	Hamburg Aviation Conference	19	884	46.53
2	19th World Conference of the Air Transport Research Society ATRS	11	28	2.55
3	15th World Conference of the Air Transport Research Society ATRS	10	142	14.20
4	20th World Conference of the Air Transport Research Society ATRS	10	14	1.40
5	18th World Conference of the Air Transport Research Society ATRS	9	42	4.67
6	5th Annual Air Transport Research Group Conference	9	179	19.89
7	Conference of the Air Transport Research Society	9	352	39.11
8	12th Conference of the Air Transport Research Society	8	144	18.00
9	14th Conference of the Air Transport Research Society ATRS	8	95	11.88
10	14th World Conference on Transport Research WCTR	8	26	3.25

Notes. TS denotes the total number of JATM publications derived from meetings. In addition, TC = Total Citations, and TC/TS = Total citations per total studies.

Table 7
Top 15 authors and journals citing JATM without self-citations.

R	Author	TS	*h*-index	Journal Name	TS	P (%)	IF (2018)
1	Tzeng GH	66	63	Transportation Research Part A: Policy and Practice	223	2.756	3.693
2	Zhang AM *	59	34	Sustainability	202	2.496	2.592
3	Barros CP	42	36	Transportation Research Part E: Logistics and Transportation Review	179	2.212	4.253
4	Wanke P	37	18	Journal of Transport Geography	156	1.928	3.560
5	Derudder B	35	32	Transport Policy	131	1.619	3.190
6	Li Y	34	9	Tourism Management	113	1.396	6.012
7	Liou JJH	32	24	Journal of Cleaner Production	103	1.273	6.395
8	Witlox F	32	39	Transportation Research Record	99	1.223	0.748
9	Han H	31	39	Expert Systems With Applications	85	1.050	4.292
10	Cui Q	30	17	Transportation Research Part D: Transport and Environment	72	0.890	4.051
11	Fu XW	30	23	Transportation Research Part C: Emerging Technologies	66	0.816	5.775
12	Redondi R *	29	13	Transportation Research Part B: Methodological	65	0.803	4.574
13	Fageda X *	29	22	Journal of Transport Economics and Policy	59	0.729	1.027
14	Hansen M	28	18	Safety Science	58	0.717	3.619
15	Button K	26	24	European Journal of Operational Research	55	0.680	3.806

Notes. TS indicates the number of times JATM has been cited by journals above. In addition, P= Percentage of the studies of journals citing JATM, and IF= Impact Factor, H-index = Performance of scientific productivity and efficiency.

centrality words, as shown in columns 1 and 2 in Table 12, it is evident that Recovery, Crisis and Disruption are of importance to the discussion in the JATM literature, as shown in column 3 of Table 12, and are in fact not far of the top ranking. As safety is at the very heart of the aviation industry, it was expected to see crisis management and recovery in relation to aircraft accidents (Chang et al., 2018) in that list. A more in-depth analysis of the relevant papers picked up by the SI words has revealed that a number of these were not only recent but also related to recovery from demand disruptions (e.g. Delgado et al., 2020) and economic crisis (Barros, 2008) and importantly also to pandemic management research. Notably Gold et al. (2019) talked about health screening strategies for international air travelers during a pandemic well before COVID-19 hit the aviation sector. Chung (2015) developed strategies of pandemic control in the airport management context and Chou and Lu (2011) evaluated influenza preventive measures for airlines from a passenger perspective in 2010, something that could not be of greater interest to the current COVID-19 discussion only ten years later.

The citation burst results shown in Table 13 help to identify past and current, but not the most recent trends. It is observed that there are 21 words with strong burst values, with the strongest burst value shown for the words airport (Burst strength = 14.2566, 2001–2010), low-cost airline (Burst strength = 6.8828, 2005–2012) and airline alliance (Burst strength = 6.5875, 2001–2006). The prominence of these words in those years provides clues about trends suggesting that low cost carriers has been the most recent hot topic. Regarding methodology deployed by papers published in JATM, data envelopment analysis was quite popular for a while (Burst strength = 3.9468, 2008–2013). In recent years, words such as economic development, passenger and behavioral attention have produced strong bursts, thus these words can be seen as emerging trends. What is missing from a COVID-19 perspective is bursts around our SI words such as pandemic or recovery and even crisis did not produce a burst in past years. There is of course any chance that the present JATM special issue will produce such a burst in the future. Content analysis showing the response of European carriers to COVID-19 ranging from innovation to exit (Albers and Rundshagen, 2020), remarks on the aeropolitics in a post-COVID-19 world (Macilree and Duval, 2020), as well as findings showing that the attitudes of ageing passengers will matter relatively more in such a world (Graham et al., 2020) which will and in many jurisdiction already has led to innovations such as self-service technology in airport. As such there appears evidence that JATM bursts will emerge around both technology and also process innovation such as innovative security control lane operations during the COVID-19 epidemic. Even before the special issue, recent JATM literature has picked up the COVID-19 theme such as Nikolaou and Dimitriou (2020) who have deployed epidemiological models to evaluate the effectiveness of European airports in controlling the emergence of epidemics and have also derived controlling measures to break the chain of infections in aviation specific use cases.

5. Conclusions

Motivated by the COVID-19 outbreak and our view that the aviation sector may have to deal and should have prepare for several waves of the virus or a COVID-21, this paper analyzed the Journal of Air Transport Management (JATM) bibliometrically and through visual mapping for any lessons it may provide to this context. It is original in its contribution as it is the first bibliometric study on JATM and air transport management more generally and of course with reference to COVID-19 in particular. Our retrospective evaluation spans over the entire lifetime of JATM from 2001 to the end of 2019 right to before COVID-19 hit the global aviation sector. Our results suggest that the journal as such has made significant progress over that period as it has grown substantially and has reached record levels in terms of impact factor, number of citations and average citations per paper at the end of the analyzed period in 2019. Today JATM can be seen as the flagship of the aviation

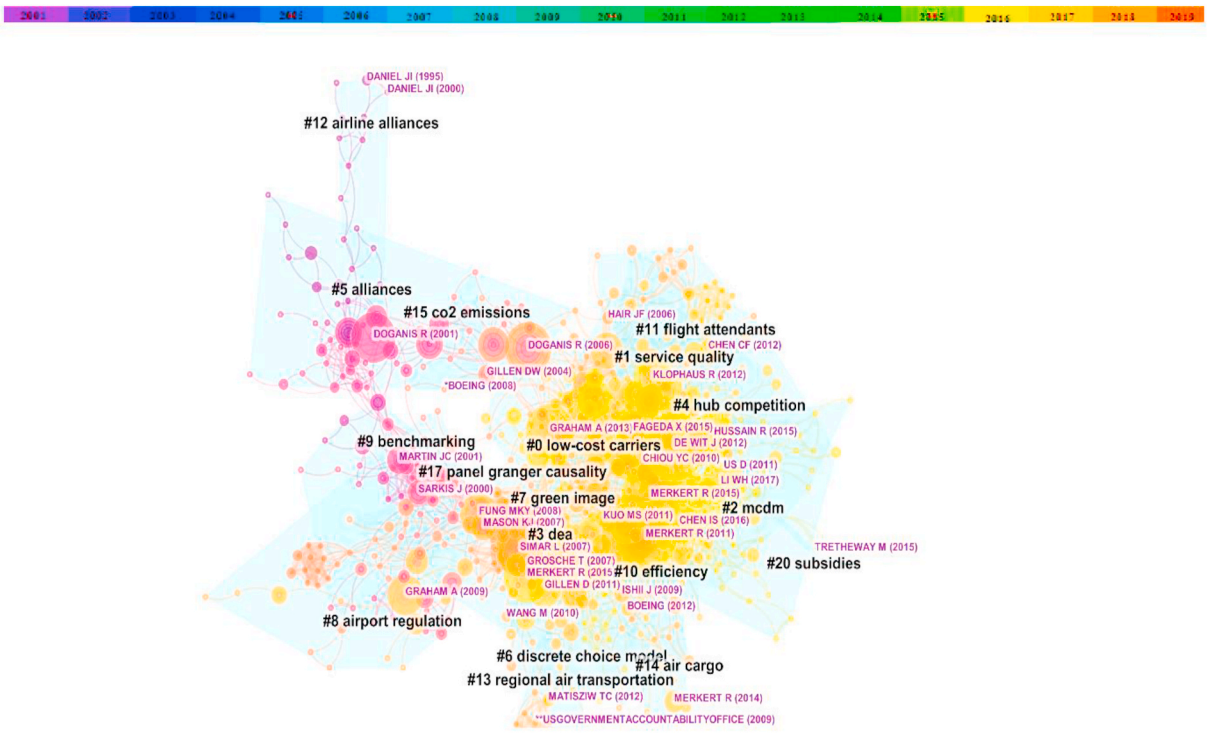

Fig. 6. Document co-citation analysis.

Table 8
Topic clusters according to cited documents.

Cluster	Size	Mean Silhouette	Label (TFIDF)	Label (LLR)	Mean (Year)
0	88	0.708	low-cost carriers	low-cost carrier (124.57, 1.0E-4)	2012
1	66	0.690	Taiwan	low-cost airline (96.56, 1.0E-4)	2012
2	65	0.836	making approach	airline service quality (108.43, 1.0E-4)	2014
3	59	0.883	efficiency	small regional airport sustainability (76.91, 1.0E-4)	2010
4	55	0.847	high-speed rail transport integration	aviation research data (72.57, 1.0E-4)	2014
5	53	0.859	evolution	strategic alliance (89.56, 1.0E-4)	2001
6	53	0.716	airports	analytic hierarchy process assessment (83.44, 1.0E-4)	2012

management literature which justifies our focus on the journal (as common in bibliometric analysis, e.g. Derudder et al., 2019).

In terms of core subject areas, our analysis has shown that JATM has been an important source for leading journals in many different areas such as safety, transport, operational research, sustainability and tourism. In regard to the journal's research productivity the U.S. is by far the leading country but China's contribution to the JATM literature has gradually increased over the analyzed period. Considering collaboration networks, we found that international and even intercontinental collaborations are common in JATM. Mainstream topics in JATM are found to be focused on the airports, airline alliances and low-cost airlines. While during the analyzed period of 2001–2019 the aviation industry witnessed various infectious diseases and crises (Chung, 2015), JATM papers focusing on these disasters were less prominent in the results of our bibliometric analysis than initially expected. Considering the most frequently used words as a piece of evidence, words associated with the topic of this special issue (i.e. COVID-19) and in particular recovery, crisis, disruption were however close to the top key words of JATM publications. What is more, we found some recent key papers on pandemic management, prevention and recovery. The latter has a long tradition in JATM, unsurprisingly related to safety and aircraft accidents but also economics crisis and recently epidemic crisis. That disease and health words were not featuring in the top 15 of frequently used words is understandable as the JATM literature is quite large and also because previous outbreaks were not as catastrophic as COVID-19 on a global scale. However, it is anticipated that this pandemic and health will attract more attention in future studies, not least through this JATM special issue, and the unprecedented impact of COVID-19 on the global air transport industry.

Although we are confident that our bibliometric analysis presents a comprehensive and rigorous evaluation, there are some limitations. First, this study covers the period of 2001–2019. While that is the entire population of JATM indexed papers in the WoS database hence impossible to include more papers, we note that recent publications continue to evolve including gray publications at conferences etc. That said, this is in our context less a problem than normally as many conferences have been cancelled due to COVID-19. Secondly, our bibliometric analysis has an inherent limitation as the full counting approach was used. If there are many authors from the same country or institution, the number of frequencies is multiplied by the number of authors which provides an advantage for multi-author publications and overestimates multi-author documents (Merigó et al., 2017; Valenzuela et al., 2017). Fractional counting, where frequencies are calculated by dividing the number of authors, could be used in future studies but we expect little difference as when used simultaneously, the two counting approaches did not cause serious deviations in previous studies (Mulet-Forteza et al., 2018; Wang et al., 2020). We also feel that some parts of the industry did not receive sufficiently large enough attention such as air cargo and specifically air freighter operators of which some have, contrary to the rest of the industry, benefited from the COVID-19 crisis due to the specific

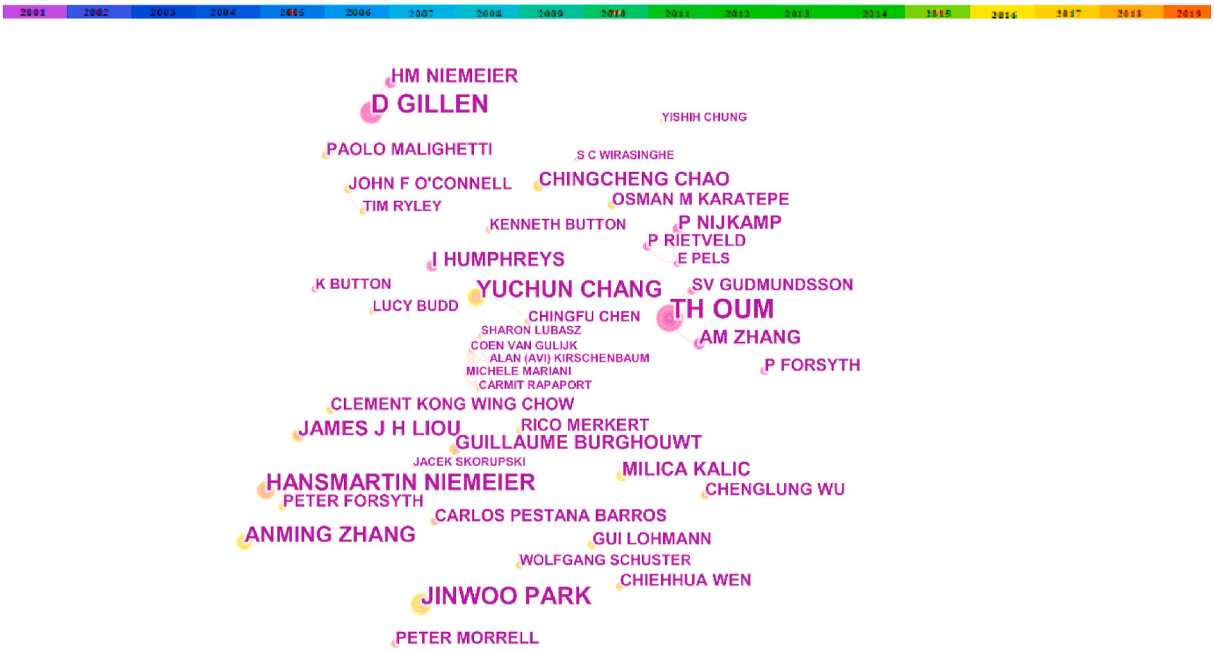

Fig. 7. Author network analysis. Modularity Q = 0.9626 Mean silhouette = 0.3656 Network density = 0.0071.

Table 9
Top 5 authors with the strongest citation bursts.

Authors	Year	Strength	Begin	End	2001–2019
Oum TH	2001	5.8673	**2001**	2006	
Nijkamp P	2001	3.0581	**2001**	2002	
Gillen D	2001	5.4768	**2002**	2005	
Niemeier HM	2001	3.0248	**2011**	2012	
Park J	2001	3.5014	**2015**	2016	

Fig. 8. Institution network analysis. Modularity Q = 0.8407 Mean silhouette = 0.1844 Network density = 0.0081.

Table 10
Top 14 institutions with the strongest citation bursts.

Institutions	Year	Strength	Begin	End	2001–2019
Vrije Universiteit Amsterdam	2001	5.1794	**2001**	2002	
University of California Berkeley	2001	4.2416	**2001**	2004	
University of British Columbia	2001	5.1431	**2001**	2007	
Wilfrid Laurier University	2001	5.7759	**2002**	2005	
George Mason University	2001	3.1988	**2003**	2006	
National Central University	2001	4.0794	**2005**	2008	
Cranfield University	2001	4.2421	**2005**	2007	
National Cheng Kung University	2001	5.6400	**2008**	2012	
Loughborough University	2001	4.2567	**2010**	2015	
U University of New South Wales Sydney	2001	4.0279	**2013**	2014	
Korea Aerospace University	2001	3.7218	**2015**	2019	
Embry Riddle Aeronautical University	2001	3.7119	**2015**	2019	
Universidade de Lisboa	2001	3.1617	**2015**	2017	
Delft University of Technology	2001	4.3091	**2017**	2019	

Table 11
Top 14 countries with the strongest citation bursts.

Countries	Year	Strength	Begin	End	2001–2019
Canada	2001	10.5395	**2001**	2007	
Ireland	2001	4.9869	**2001**	2010	
Netherlands	2001	5.7619	**2001**	2002	
USA	2001	5.7989	**2003**	2004	
England	2001	4.8649	**2005**	2006	
Spain	2001	3.105	**2010**	2012	
Germany	2001	3.876	**2011**	2013	
Israel	2001	3.4532	**2012**	2013	
Australia	2001	4.3065	**2013**	2014	
Turkey	2001	6.5791	**2014**	2019	
Portugal	2001	3.0251	**2015**	2017	
South Korea	2001	4.9695	**2015**	2016	
Iran	2001	3.5505	**2016**	2019	
PR China	2001	9.6211	**2017**	2019	

Fig. 9. Co-word network analysis. Modularity Q = 0.3724 Mean silhouette = 0.4916 Network density = 0.0387.

characteristics of that part of the industry (e.g. Merkert et al., 2017). As such, in future studies is may be worth delving further into specific topic areas of the JATM literature such as what we have done with regard to research on pandemic and crisis management.

Overall we are confident that our paper presents not only a general overview of the journal but also provides reference to COVID-19 and research related to pandemics and crisis management in the aviation context, which can offer managers key clues for possible decision-making situations in the future. In future studies, a broader perspective can be provided to readers using a wide range of bibliographic

Table 12
Co-word frequencies and centrality values.

Word	Frequency	Word	Centrality	SI word	Frequency
Airport	154	Airport	0.13	Recovery	30
Model	152	Model	0.13	Crisis	28
Airline	130	Efficiency	0.10	Disruption	20
Performance	100	Low cost carrier	0.10	Disease	5
Impact	100	Impact	0.09	Pandemic	3
Competition	90	Passenger	0.08	Influenza	2
Service quality	70	Competition	0.08	Outbreak	2
Industry	53	Airline	0.07	SARS	1
Demand	53	Network	0.07	Swine flu (H1N1)	0
Efficiency	53	System	0.07		
Air transport	47	Airline industry	0.07		
Low-cost carrier	44	Behavior	0.07		
Service	44	Industry	0.06		
Aviation	43	Service quality	0.06		
Network	38	Demand	0.06		

Table 13
Top 21 keywords with the strongest citation bursts.

Keywords	Year	Strength	Begin	End	2001–2019
Airport	2001	14.2566	**2001**	2010	
Privatization	2001	4.5742	**2001**	2008	
airline alliance	2001	6.5875	**2001**	2006	
Entry	2001	4.825	**2001**	2013	
strategic alliance	2001	4.2348	**2002**	2006	
aircraft noise	2001	3.0391	**2003**	2009	
Industry	2001	2.9967	**2004**	2011	
low-cost carrier	2001	5.2649	**2004**	2010	
Alliance	2001	4.8499	**2005**	2009	
low-cost airline	2001	6.8828	**2005**	2012	
airline competition	2001	4.9355	**2006**	2012	
airline service quality	2001	3.3888	**2007**	2012	
data envelopment analysis	2001	3.9468	**2008**	2013	
Efficiency	2001	3.034	**2008**	2013	
airport efficiency	2001	4.9141	**2011**	2013	
airport economics	2001	3.2611	**2011**	2012	
ownership form	2001	3.5555	**2013**	2015	
Level	2001	3.0252	**2015**	2016	
behavioral intention	2001	3.1885	**2015**	2016	
Passenger	2001	3.4213	**2016**	2019	
economic development	2001	3.3488	**2017**	2019	

metrics. In addition, we recommend to repeat our study in five years to illustrate to what extent air transport has been discussed as a reason for spreading outbreaks around the world but importantly also a key element of medical and essential good logistics but also repatriation flights during outbreaks. In this context, the anticipated increase of the studies focusing on COVID-19 from various perspectives will help clarify the relationship between air transport and management/recovery of/from pandemics. This will also enable future studies to reveal whether the industry has learned from the JATM in terms of preparing for a potential future pandemics or further waves of COVID-19. Thus, more valuable insights can be offered in the future using bibliometric analysis on a continued basis.

CRediT authorship contribution statement

Gökhan Tanrıverdi: Conceptualization, Methodology, Software, Formal analysis, Writing - original draft, Visualization. **Mahmut Bakır:** Conceptualization, Methodology, Formal analysis, Writing - original draft, Visualization. **Rico Merkert:** Conceptualization, Methodology, Writing - original draft, Writing - review & editing, Supervision.

Declaration of competing interest

The authors declare no conflict of interest.

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