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Drivers of Airport Profitability: A Bibliometric Review

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Abstract:

The current study presents a review of the airport literature, covering 222 articles published from 1985 to 2022. The review identifies the key drivers of airport performance and summarises the bibliographic information for the last 37 years. The review identifies 8 major categories: Traffic Indicators, service Quality indicators, commercial indicators, Economic indicators, environmental indicators, competitive indicators, safety and security indicators and social indicators. In addition to providing various drivers of profitability, the review provides information on publication trends, the evolution of the topic, three fields plot, profound authors and sources of publication. The review fills the gap by presenting the most important performance indicators since the previous literature focuses on the efficiency of airports.

Keywords: review, bibliometrics, drivers of airport performance, airport profitability, aviation

Introduction

The Indian aviation industry is the third-largest domestic aviation market globally and is stipulated to be the third-largest aviation market by the year 2024 overtaking the UK. Indian air passenger traffic was measured as 115 million in the last financial year i.e.2021 after facing a decline of -28.64% due to Covid-19 (IBEF, 2021). India has 153 operational airports which are postulated to rise to 190 by the year 2040. Currently 658 aircraft fulfil the air travel needs of Indians. India's aviation sector received a US$ 3.06 billion FDI inflow in the financial year 2020-21. Low-cost airliners dominate the domestic market. The government has now allowed 100% FDI in aviation. Iyer and Jain (2021) claim that the growing middle-income class of India and increasing air travel affordability are the salient determinant of growth in the Indian aviation Industry. Factors like expanding working class, policy support, aspiration to become a global MRO (maintenance, repair and overhaul) hub and increasing investment in the aviation sector are working in favour of the Indian aviation industry (IBEF, 2021). The Indian aviation sector, despite representing a minuscule of civil transport has been given due importance, especially in the last decade. The government is committed to developing the airport infrastructure throughout the country (Sun, 2021). Joint ventures with private players and state governments, owned by the central government, jointly owned with the Défense sector and state-owned are the prominent airport management models in India (AAI, 2022).

An Indian airport has various sources of revenue generation namely the ANS revenue, aeronautical and non-aeronautical revenue, security revenue, airport lease revenue and other revenues (Iyer & Jain, 2020). ANS revenue, collected by AAI depicts the terminal navigation landing charges and route navigation facility charges. The passenger service fee, housing, parking and landing charges make up the aeronautical revenue whereas non-aeronautical revenue includes ground handling, extended service hours, oil throughput charges, rent, car parking and commercial passes, and consultancy charges. Airport lease revenue is produced only in the those airports which follow the airport management model. The security revenue deals with the passenger service fee. Apart from these sources, an airport earns revenues from interest, penalty, recoveries, sale of fixed assets, training institute and others. Key expenses for an airport include operational expenses, employee-related expenses, repair and maintenance expenses, security expenses and overhead expenses. Operational expenses refer to the expenses incurred on rent, electricity, water, insurance, advertisement, meteorological services, storage, municipal taxes etc. Salary, perks, allowances, employee benefits etc. account for employee-related expenses. Repair and maintenance expenses deal with the expenses on electrical, civil, equipment, and infrastructure products. Security expenses

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are the expenses incurred towards the payments for the security. Overhead expenses deal with the expenses of regional and central headquarter (Iyer & Jain, 2020).

Airports are a public utility and therefore the sole purpose of the airport is to provide a generally acceptable level of service to the customers. However, with the rising level of expectations of the customers and the rising investments required for a modernization of airports, it has become imperative to pump in large amounts of investments into airports. This has led to the governments across the world to find innovative ways of raising money – privatizing airports, creating innovative models of PPP, concessioning elements of airport operations among others. Indian airports have not been much different than their global peers and have remained under intense pressure to generate profits and hardly a few airports have posted a profit (Shakeel, 2018). To deal with the loss-making airports, the government has adopted the privatization, lease to private parties and PPP (Public-Private Partnership) model (ENS Economic Bureau, 2021). Albalate and Fageda (2016) ascertained an association between the air connectivity and the economic growth of a country, and probably this is the reason that despite catering to low traffic, government subsidises the airports, especially the regional airports (Fageda, 2018). However, the situation of bailing out the unprofitable airport doesn't last long, especially for the airports having less demand with less advanced destination structures (Červinka,2019). This leads to huge losses as airports are not able to generate revenue from aeronautical and non-aeronautical activities. Also, high investment in the infrastructure, added with large marketing budgets and overheads put intensive pressure on airports. Swedavia (2019) claims that an airport like any other entity must be profitable, but it is often difficult to achieve because of its far-reaching social objectives as well as upliftment of an area and providing employment. Also, they expect subsidies and incentives from the government to keep them afloat despite making losses (Červinka, 2017). Hence, determining airport profitability is a complex interplay of various factors.

Based on the above discussion, this study reviews the previous literature from 1992 to 2022 to identify the interrelated areas of airport performance. Thus, the objective of this study is to provide systematic and bibliographic information on the studies related to airport profitability. The following research questions are addressed while exploring the previous literature:

a) How has the literature related to airport performance evolved since 1992?

b) What are the main performance drivers of the airports that are interrelated with each other?

Literature Review

According to the study conducted by Zuidberg (2017), where the data was collected from 125 airport in US, Canada, New Zealand and Europe from 2010 to 2016, it was claimed that

1) transfer passengers affect the profitability of the airports and
2) low-cost carriers have a limited impact on profitability.

Further, results of the study validated the quadratic relationship between the profitability and seasonality wherein the latter after a certain tipping point negatively affects the profitability. Financial variables and labour productivity exert a positive impact on airports' profitability, especially in US. Regional airports are known to be affected by the local demand spurred by economic development and population growth of the region whereas major airports' profitability was affected by the global economic development. Fernández, Coto-Millán, & Díaz-Medina (2018) in their Spain oriented study purport that there exists a positive relationship between the tourism and efficiency of the airport wherein tourism centric airports are able to achieve high efficiency than the non-tourism centric airports. Also, the study further compares the impact of low-cost carrier and charter planes on airport efficiency and contemplates low-cost carriers play a significant role in improving the efficiency of the airports in comparison to charter passengers. Low-cost airlines have been recognised as a major factor affecting the financial performance of the airports by Tavalaei & Santalo (2019) wherein referring to US airports, authors claim that low-cost airlines have transformed the competitive scenario in the airport industry and are positively impacting the profitability of the airports.

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Merkert and Webber (2018) highlight the seasonality factor in their research. They claim that airlines' profitability is affected by seasonality. Authors stress that due to the restricted capacity and volatile demand, the seasonal behaviour of the airline dealing with price and capacity management; has a significant bearing on the profitability of the airline and airport. Authors advocate that in order to be profitable airlines should pay more attention to the 'seat factor' than the "airfare' and both the factors should be kept high keeping the seasonality in mind. Both these factors not only determine the total revenues of the airlines and airports, but also the competitive standing in the marketplace. The study highlights the role of the seat factor in determining the profitability of airlines and airports along with considering the role of pricing. An, Mikhaylov and Jung (2021) also accept the role of uncertain demand affecting the profitability of the airports. Authors claim that traditionally demand has been assumed to follow a stochastic process whereas in reality demand for airlines doesn't completely follow the stochastic pattern. Addressing this problem, the authors propose a robust optimal booking limit policy that not only minimises the loss but also affects the profitability. Alderighi, Nicolini and Piga (2019) expressing the low-cost airliners' perspective claim that revenue management is a capability in low-cost airlines while referring to the resource-based view. Authors contend that even though revenue management appears simple on the surface, it is quite a sophisticated tool at its core that extracts value from different customer segments.

Grimme, Maertens and Schröpfer (2018) analysing the airport profitability comment that all areas of airports don't have economic values and small airports especially struggle hard to achieve a break-even point. Airports should identify the non-economic areas and open them for public ownership. Authors also advocate for increasing the number of air services and incentivising the airliners to improve their profitability. The recommendations seem promising but have limited applications for smaller airports. Also, launching new services need significant monetary outlay, which further puts a financial burden on the airport. Incentivizing the airports is a strategic perspective of the government and involves taxpayers' money; hence again restricting the potential of suggested measures. Another study conducted by Červinka and Matušková (2018) also analyse the sustainability of regional airports in developed economies using low-cost airliners. Authors post that despite handling the millions of passengers, regional airports struggle for positive performance measures. Authors also highlight the need for subsidizing and incentivizing the airports for improving their profitability.

Iyer and Jain (2019) presenting the Indian context of regional airports claim that despite the Indian government's impetus for promoting aviation through schemes like UDAN (Ude Desh Ka Aam Nagrik), profitability of the airports remains a pertinent issue. Double digit growth in passenger traffic since 2014 has also not been able to reverse the profitability statistics for Indian airports. Authors conducted a survey of 27 regional airports in India and claimed that all the airports were way below in achieving the break-even point. Authors contemplate small airports are not able to generate enough non-aeronautical revenue that could render them to the road to profitability. On the other hand, large international airports generate significant revenue from the non-aeronautical sources.

Review of existing literature indicates that majority of the studies focus upon improving the operational efficiency, rather than considering the area of airport profitability. However, given the hard-pressed revenues of airports across the globe, it is important to have insights about the airport profitability. Despite the exponential increase in te literature on airport productivity and performance, there is a scarcity of assimilated knowledge or review of the literature. Several factors have been discussed to understand the drivers of profitability. They range from operational capacity management (Dixit & Jakhar, 2021) to passenger service (Bezerra & Gomes, 2016); Lozano et al., 2013) and financial perspective (Humphreys & Francis, 2022; Kilkis & Kilkis, 2016). Infact the literature available is fragmented. Therefore, we believe that a thorough and an in depth analysis of the previous literature on airport performance through bibliometric methods will provide a holistic view of the various factors that affect the profitability and performance of the airports.

3. Research Methodology:

The study adopts a bibliometric methodology proposed by Donthu et al. (2021); a four-step procedure for bibliometric reviews. Specifically, we define the scope and aims for the review; second, selection of techniques based on objectives. Third, extracting the data for analysis; And finally, conducting and reporting the results. The objectives of the study are

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To explore the drivers of airport performance of Indian airports through a bibliometric review. However, the scope of the study is huge as the airport sector has been widely studied, particularly the drivers of performance but there are no reviews available that have combined all dimensions of airport performance.

3.1 Selection of Techniques – The study adopts a wide range of techniques for doing bibliometric analysis to explore the intellectual and social structure of the studies conducted with respect to the drivers of airport performance. We identify the publication trends, thematic evolution of the topic, the most prolific authors, influential sources and the content analysis of the articles extracted. The whole process allows for proposing future research directions (Ciampi et al., 2021; de Prado et al., 2016). The study also conducts the citation analysis of the documents and co-occurrence analysis of the keywords that further provides bibliographic information on the articles retrieved.

3.2 Data collection- The articles have been extracted using a web of science by employing a large number of keywords. The keywords used were; determinants, factors, predictor*, profit*, performance, productivity and airport*. The first search provided 4654 articles. The base year was kept as 1985 as the first article related to airport performance was found in the search. In the second stage, various inclusion and exclusion criteria were applied, yielding 252 papers. Finally, only articles were selected and conference proceedings, books, and communication to the editor were ignored. During the process, it is an observed fact that articles generated are prone to erroneous bibliographic information (Baker et al., 2021). This may lead to inappropriate reporting of results and interpretation (Donthu et al., 2021; Zupic & Čater, 2015). Therefore, articles were manually screened for relevance and quality. This provided us with 222 articles as shown in table 1 which were further used in analysis.

Criteria Adopted	**Articles Rejected**	**Articles Accepted**
Search engine: WOS Time period: 1985- 2022 Syntax: (((((((TS=(determinants)) OR TS=(factors)) OR TS=(predictor*))) AND TS=(profit*)) OR TS=(performance))) OR TS=(productivity)) AND TS=(airport*)		4654
Documents: Transportation, business finance, aerospace, transportation science technology, economics	3130	1524
Document type: ‘‘Articles’’, and ‘‘Reviews’’ and Language screening	28	1496
screening for the relevance of articles	1244	252
author agreement	30	222
		222

Final articles for bibliometric and content analysis
Note(s): This table provides the systematic information on how articles have been selected for the review

4.0 Results

The 222 articles under review are published between 1992 and 2022 and are written by 408 authors, published in 57 journals. Only 23 articles are single-authored, and on average, there are 0.0554 documents per author. The average number of citations per document is 23.32, while the total number of references in all articles under review is 5302.

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4.1 Publication Trend

The review shows that the studies on the factors that catalyze profitability at airports were extremely limited until the year 2009. The studies began with a single article published each in 1992 and 1993. There was hardly any significant increase in the number of publications till 2008. Since then, the articles published on the study topic grew gradually and a peak was observed in the year 2016 when 26 articles were published in a single year. Figure 1 presents a graphical representation of the publication trend over a period of three decades from the year 1992 to 2022 for the articles focused on studying the drivers of airport profitability.

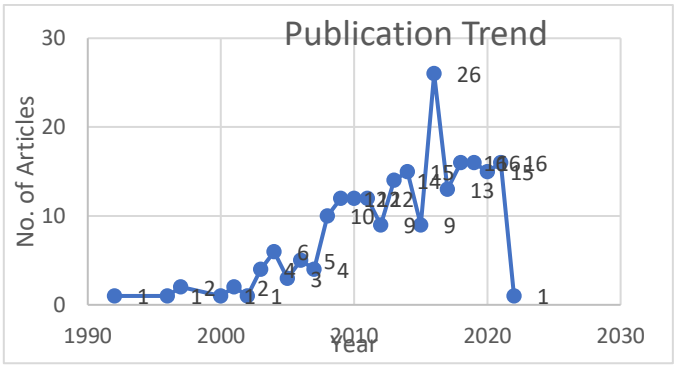

Figure 1: Distribution of published articles from 1992-2022 (Author Generated)

To further strengthen the results obtained, a word cloud was generated. According to Heimerl et al. (2014), the word cloud plays a crucial role in the delivery of a visual representation of keywords from the analyzed text, wherein the larger appearing words are more frequently used as compared to the ones smaller in size. Figure 2 presents the keywords that were prominent and were frequently appearing in the 222 articles reviewed for the research study.

Figure 2: Word cloud of the most frequently appearing words in the articles (Author Generated)

The word cloud in Figure 2 indicates that airports, airport, efficiency, airport performance and DEA are the most frequently appearing words across 222 reviewed articles.

4.2 Evolution of the Topics Related to Drivers of Airport Profitability

Further, the pre-dominant keywords are segregated into five different time zones to show how the topic has evolved over three decades. Figure 3 indicates that the segment consisting of articles from 1992 to 2009 showed the prominence of keywords' major airports', 'technical efficiency', 'privatization costs' and 'performance'. The articles published between 2010 and 2013 had 'benchmarking', 'productivity', 'inefficiency' and 'efficiency' as their focus. In the articles that were published from 2014 to 2016, the authors began analyzing 'undesirable outputs', 'impact', and 'model' in addition to the previously dominant topics like 'productivity', 'performance' and 'efficiency'. 'Efficiency',

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'productivity', 'growth', 'inefficiencies', 'model' and 'competition' turned out to be the trending topics for the articles published between 2017 and 2019. By the year 2020, the authors started focusing on more precise keywords like 'operational efficiency' in addition to 'efficiency', 'performance', 'impact', benchmarking' and 'competition'. Through all the segments it is observed that 'efficiency' and 'productivity' were common keywords, while 'competition' emerged as the new keyword in articles published between 2017 and 2022.

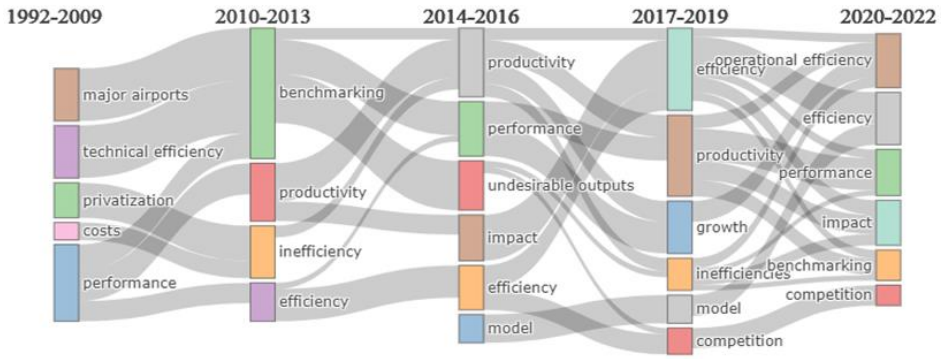

Figure 3: Trending Topics (Author Generated)

The process of studying airport profitability drivers began from 1992 and lasted until 2009. In the first stage of the research focused on airports and their profitability, the authors focused more on the study of the major airports, their technical efficiency, the process of privatization, associated costs and overall performance. Performance was the key factor studied through the first time zone indicating that it formed the basis of estimating the profitability and associated drivers.

It was in the second stage beginning in 2010 and lasting until 2013 that the authors shifted their focus on studying productivity, inefficiency, and efficiency as well as benchmarking. The research on the comparative analysis of the profits generated by different factors linked with the airports formed the basis of benchmarking in the articles published between 2010 and 2013.

The third time zone beginning in the year 2014 and continuing until 2016 exhibited revived focus of the authors on studying performance of the airport industry in addition to the model integrated by the industry to generate desirable revenues. To better understand the drivers of profitability of airports, the authors also studied the undesirable outcomes associated with its functioning.

In the fourth stage from 2017-2019, the studies conducted on the topic revolved around productivity and efficiency along with the model integrated and the growth of the industry. The focus on competition was an addition in the field of study indicating that scholars wanted to understand differences and similarities in the factors influencing airport profitability in different countries.

Finally, the articles published between 2019 and 2022 highlight that the authors shifted their focus to operational efficiency of the industry as an individual element of study along with the general overall efficiency. Some of the other areas of focus like performance, benchmarking, competition, and impact continued to be of interest from earlier time zones highlighting their indispensability.

4.3 Three Fields Plot

The bibliometric information on the articles is further strengthened by the analysis of the authors, their affiliations, and the sources of publication. Figure 4 represents a three-field plot highlighting authors, respective universities, and their countries.

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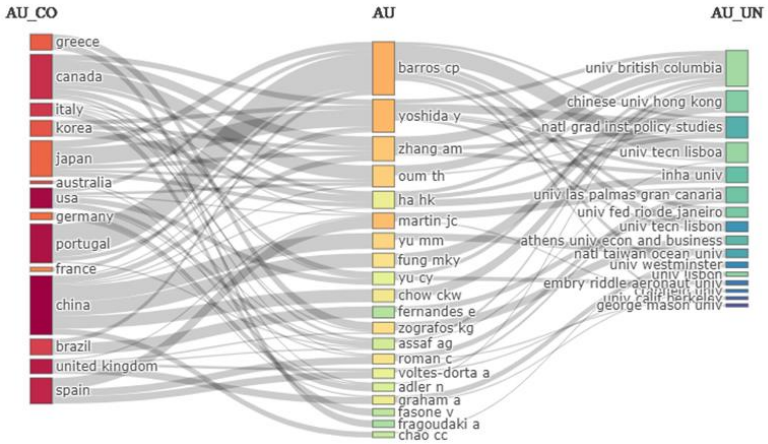

Figure 4: Three field plots: Author Country (AU_CO), Author (AU) and Author University (AU_UN) (Author Generated)

Through the graphical representation in Figure 5, it can be clearly understood that most authors who worked on the drivers of airport profitability were from the University of British Columbia, the Chinese University of Hong Kong, National Graduate Institute of Policy Studies, Inha University, and University of Las Palmas de Gran Canaria. Additionally, majority of the authors belonged to China, Canada, Japan, Portugal, Spain, USA and the UK. On the other hand, Germany, France and Australia appeared as the countries with minimum number of authors contributing to the study on drivers of airport profitability. The report published by Salas (2022) highlights that China has the largest commercial market of air travel followed by US, Japan, Spain indicating the contribution of airport industry in the economy of these countries. Therefore, more research has been focused in these countries on the factors that drive airport profitability. On the other hand, the countries like Australia, France and Germany have a comparatively much less footfall, making aviation industry a nominal contributor to country's economy. Subsequently, the interest of authors in studying profitability drivers of airports in these countries is less significant.

The further analysis of the authors based on the source from where the articles were extracted led to the observation that Journal of Air Transport Management published most articles on the topic of study. Additionally, as can be seen in Figure 5, the peer-reviewed journals like Transportation Research Part E: Logistics and Transportation Review, Transport Policy, Transportation Research Part A: Policy and Practice, and International Journal of Transport Economics were the top four journals with most articles on drivers of airport profitability.

Figure 5: Three field plot: Author Country (AU_CO), Author (AU) and Source (SO) (Author Generated)

The bibliometric review of the articles based on the most popular journals that published maximum number of articles on the study topic, led to the identification of top 10 journals as listed in Table 1. Subsequently, three zones were

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identified based on the Bradford's Law of Scattering, which indicates that zone 1 had the articles with highest number of citations, zone 2 with average number of citations and zone 3 contained articles with lowest number of citations.

Table 1

Top 10 journals based on the number of citations received by the journals (Author Generated)

Sources	**Articles**	**Rank**	**Bradford Law**	**h_index**	**g_index**	**m_index**	**TC**	**NP**	**PY_start**
Journal Of Air Transport Management	71	1	Zone 1	26	42	1.1818182	1974	69	2001
Transportation Research Part E-Logistics And Transportation Review	22	2	Zone 1	18	22	0.6923077	1424	22	1997
Transport Policy	18	3	Zone 2	9	15	0.6923077	285	15	2010
Transportation Research Part A-Policy And Practice	13	4	Zone 2	10	13	0.3225806	459	13	1992
International Journal Of Transport Economics	8	5	Zone 2	4	5	0.25	45	5	2007
Transportation Research Record	7	6	Zone 2	4	5	0.25	47	5	2007
Journal Of Transport Economics And Policy	5	7	Zone 2	2	4	0.1052632	161	4	2004
Transportation Research Part C-Emerging Technologies	5	8	Zone 2	4	5	0.2352941	104	5	2006
Research In Transportation Business And Management	4	9	Zone 2	4	4	0.5714286	39	4	2016
Transportation Planning And Technology	4	10	Zone 3	2	3	0.1538462	10	4	2010

The authors that were cited the maximum number of times in the studies related to drivers of airport profitability were also identified as given in Table 2. Barros had the maximum citations even though the article by him was published only in the year 2007. In comparison, the articles by Gillen and Lall were published in the year 1997 but their citations amounted to 106 and 96, respectively. It is indicative of the shift of authors towards more in-depth studies in the 21st century.

Table 2

Top 10 authors (Author Generated)

Author	**Local citations**	**No. of articles**	**h_index**	**g_index**	**m_index**	**TC**	**NP**	**PY_start**
BARROS CP	219	17	11	16	0.688	582	17	2007
OUM TH	116	8	6	6	0.3	344	6	2003
GILLEN D	106	7	3	3	0.115	286	3	1997
YOSHIDA Y	98	7	6	8	0.316	249	8	2004
LALL A	96	6	1	1	0.038	251	1	1997

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MARTIN JC	96	6	7	7	0.318	319	7	2001
DIEKE PUC	95	6	2	2	0.125	278	2	2007
YU CY	93	5	3	3	0.15	201	3	2003
ROMAN C	91	5	5	5	0.227	297	5	2001
YU MM	76	4	5	6	0.263	194	6	2004

4.4 Knowledge Foundations of Airport Profitability Drivers through Co-Occurrence and Co-Citation Analysis

The co-cited references were uncovered using co-citation analysis. Figure 6 gives the co-citation map of authors that were referenced at least 20 times in the reviewed articles and as many as 69 authors met the threshold. The analysis of the focus of authors led to the formation of four clusters, which can be seen in Figure 6.

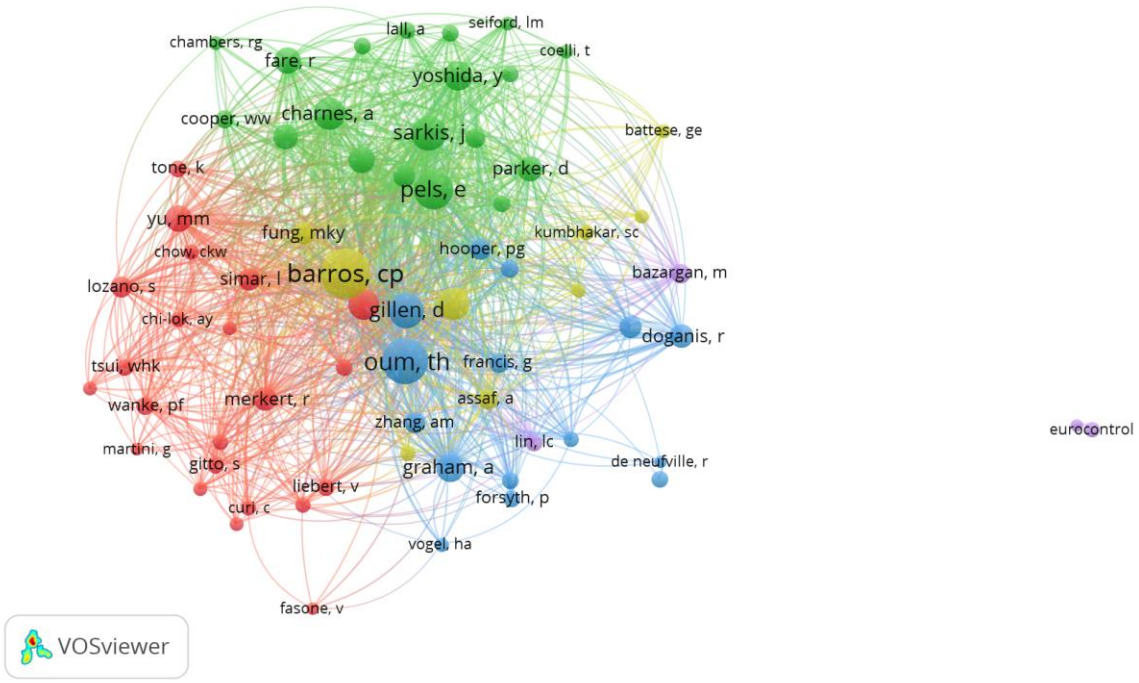

Figure 6: Co-Citation network of authors (Author Generated)

Cluster 1 encompasses the authors that focused their study on the evaluation of operational performance of the airports using DEA. The cluster 2 encompasses the authors that have studied the airport efficiency relatively to competition of ports based on their accessibility and congestion as well as the factors leading to benchmarking. In the third cluster, the authors that focused on the model adopted by the airports and their impact on efficiency and consequently profitability are grouped together. Cluster 4 represents the author focused on analyzing the studies surrounding sustainability and undesirable outputs of the airport industry.

A tabular representation of the clusters formed under co-citation network of authors can be seen in Table 3 underneath.

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Table 3

Co-citation of authors (Author Created)

label	x	y	cluster	Links	Total link strength	Documents	Citations	Norm. citations	Avg. pub. year	Avg. citations	Avg. norm. citations
barros, carlos pestana	0.7531	-0.0915	1	5	10	12	500	14.648	2009.417	41.667	1.221
dieke, peter u. c.	0.8704	0.1666	1	1	2	2	271	5.986	2007.500	135.500	2.993
marques, rui cunha	0.7428	-0.3754	1	1	1	3	58	3.112	2012.333	19.333	1.037
peypoch, nicolas	1.0469	-0.1599	1	1	1	3	23	1.193	2011.333	7.667	0.398
ha, hun-koo	-0.4215	0.4908	2	3	7	4	82	4.633	2013.500	20.500	1.158
wan, yulai	-0.1679	0.4521	2	3	4	2	36	1.602	2017.000	18.000	0.801
yoshida, yuichiro	-0.0172	0.1093	2	6	14	7	117	6.073	2010.857	16.714	0.868
zhang, anming	-0.4026	0.2157	2	4	9	7	157	7.318	2010.714	22.429	1.045
choo, yap yin	-0.9531	-0.3912	3	2	2	2	14	0.867	2016.500	7.000	0.433
oum, tae hoon	-0.8035	-0.1849	3	4	5	4	39	2.336	2010.750	9.750	0.584
yan, jia	-1.0271	-0.2191	3	2	3	2	33	1.901	2014.500	16.500	0.951
managi, shunsuke	0.3797	-0.0125	4	2	6	3	30	1.306	2010.333	10.000	0.436

5. Drivers of Airport performance

5.1 Productive Efficiency indicators

15 studies demonstrated that *ownership* has an impact on airport performance (Paraschi et al., 2020; Martin et al., 2013; Martini et al., 2013, Tsui et al., 2014; Pagliari & Graham, 2019; Marques & Barros, 2010; 9; Gutierrez & Lozano, 2016; Choo et al., 2018; Oum et al., 2003; Ha et al., 2013; Humphreys & Francis, 2000; Iyer & Jain, 2019; Adler & Liebert,

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2014; Randrianarisoa et al., 2015). It was observed that fully private airports function cost-efficiently than public airports. Under competitive conditions and *hub settings* (Paraschi et al., 2020, Tsui et al., 2014; Pavlyuk, 2016; Gutierrez & Lozano, 2016; Barros et al., 2017; Lin & Hong, 2006; Fan et al., 2014), *regulation* (Marques & Barros, 2010; See & Li, 2015; 6, Barros et al., 2017; Adler & Liebert, 2014; Assaf et al., 2014; Assaf et al., 2012) is necessary for robust pricing and operation irrespective of any ownership form (Adler & Liebert, 2014). Though the increase in corporatization enhances airports' cost controlling capacity (Martin et al., 2013), in high corruption countries, where there is no proper regulation, private majority ownership lacks optimal performance, in turn, they produce less cost efficiency compared to majority government or fully government-owned airports (Randrianarisoa et al., 2015). Also, if there is no presence of hub status, the ownership schemes act in the reverse direction (Paraschi et al., 2020). When the operation scale is small, hub operations negatively impact the efficiency scores (Barros et al., 2017). While hub status is related to operational performance, ownership form does not significantly correlate with operational performance (Lin & Hong, 2006).

Furthermore, 13 studies exhibited the impact of *cargo* (Knabe & Schultz, 2016; Scotti et al., 2014; Matulova & Rejentova, 2021; Barros et al., 2011; Chang & Yu, 2014; Guner et al., 2021; Orkcu et al., 2016; Lozano & Gutierrez, 2009; Wanke & Barros, 2017; Zhang et al., 2018; Stichhauerova & Pelloneova, 2019; Sarkis & Talluri, 2004; Shen & Chou, 2013) on airport performance. The amount of cargo handled is a distinctive output parameter (Guner et al., 2021), used in the airport's performance evaluation (Matulova & Rejentova, 2021). Besides, Shen & Chou (2013) suggested that the airports must adapt proper business strategies to obtain enough cargo and passengers. Moreover, *passenger traffic* (; Orkcu et al., 2016; Oum et al., 2003; Chakraborty et al., 2020; Knabe & Schultz, 2016; Scotti et al., 2014; Matulova & Rejentova, 2021, Barros et al., 2011; 200) is yet another most influential productive efficiency metric that shapes airports' performance. Indeed, it is the increase in passenger traffic that aids airports to overcome an economic crisis Airport efficiency in the dawn of privatization: The case of Greece. Also, the variations in airport productivity are related to the exact percentage of traffic (Orkcu et al., 2016). The total number of passengers is one of the most important evaluation criteria (Chakraborty et al., 2020) and low-cost traffic increases the ability of airports to control costs (Martin et al., 2013).

5.2 Service Quality indicators

Airport size (Paraschi et al., 2020; 9; Assaf et al., 2012; Raghavan & Yu, 2021; Fuerst & Gross, 2018; Knabe & Schultz, 2016; See & Li, 2015; Abbruzzo et al., 2016; Coto-Millan et al., 2014; Voltes-Dorta & Martín, 2016; Oum et al., 2003; Thampan et al., 2020) is a crucial driver of positive airport performance and is the most widely analysed variable in the literature. Paraschi et al. (2020) identified that an extra-large *airport size* is positively associated with airport performance, particularly, it is an essential driver of cost efficiency (Assaf et al., 2012). However, (Raghavan & Yu, 2021) found that the impact of airport size on financial productivity is inconclusive because it was observed that medium-sized airports had better leverage while the large-sized airports had better liquidity. Further, the way the complete size of the airport is utilised plays a prominent role (Fuerst & Gross, 2018). For instance, the space allocated for commercial activities and the mix of retail space specifically the food and beverage outlets denotes the quality dimension of leveraging the airport space. Because it has a positive association with scale and technical efficiency (Coto-Millan et al., 2014), larger airports achieve higher productivity The capacity analysis of the check-in unit of Antalya airport uses the fuzzy logic method (Oum et al., 2003). Additionally, it is more connected with better noise performance (Voltes-Dorta & Martín, 2016).

Next to size, *delay* (Scotti et al., 2014; Fan et al., 2014; Pathomsiri, 2007; Pathomsiri et al., 2008; Schultz et al., 2018; 1; Schultz et al., 2018; 18, Kim, 2016; Forbes & Lederman, 2010; Efthymiou et al., 2018) and *technological progress* (Barros et al., 2010; Yang & Huang, 2014; Yu, 2010; Yu & Hsu, 2012; Coto-Millan et al., 2014; Fragoudaki et al., 2016; Chi-Lok & Zhang, 2009; Fung et al., 2008); Barros, 2008; Fung et al., 2008; Chang & Yu, 2014) are major metrics of service quality that determines the airport efficiency. It is more likely that passengers in the transit will enjoy the travel if they experience a considerable *waiting time* (De Nicola et al., 2013; 19, Thampan et al., 2020; Janssen et al., 2019) for their service; rather they would get frustrated if there is too much delay. Efthymiou et al. (2018) reported delays as a measure of customer satisfaction levels. They choose to fly via airports that offered on-time service. Pathomsiri et al., (2008) had shown that even if the airport is congested, if there is no delayed flight, then the airports are found on the efficient frontier; on the other

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hand, large airports with delayed flights are found less efficient. For quicker passenger service, technological advances are necessary, with which more sophisticated processing can be done.

5.3 Safety and Security indicators

Weather conditions (Rodriguez-Sanz et al., 2019; Schultz et al., 2018; 18; Zhou & Chen, 2020; Schultz et al., 2018) are the major safety indicators of airport performance. Airports must continually assess the severity of local meteorological conditions to make a more informed flight plan (Schultz et al., 2018) and mitigating the consequences of adverse weather events enhances airport performance (Rodriguez-Sanz et al., 2019). Adopting new technologies like 'modal substitution' is mandatory to overcome the substantial challenge posed by global climate change (Zhou & Chen, 2020). This, in turn, reduces the recovery time of airline services during huge thunderstorms. Therefore, weather impact is a major factor determining airport performance (Schultz et al., 2018) and passenger safety.

Object detection and protection is an important metric of the security dimension since it is found to have a significant effect on the 'safe and smart system'. Airports must ensure optimal performance of security checkpoints to make the place safe, which is attributed to the *accuracy of a security operator* and *detection performance of illegal items* (Knol et al., 2019). Among these two, the major focus is on the security operators' accuracy because it is this person who makes use of several security devices to ensure the safety of the entire arena. For this, Skorupski & Uchronski (2018) recommended increasing the sensitivity of the detectors and the *screening devices at the hold baggage checkpoints*.

5.4 Commercial indicators

*The presence of low-cost carrier*s (LCC) (Coto-Millan et al., 2014; Martini et al., 2013; Choo et al., 2018; Pathomsiri, 2007; Tavalaei & Santalo, 2019; Ngo, T; Tsui, KWH has been highlighted as a major commercial driver of airport performance. Fragoudaki & Giokas (2020) found operations of low-cost carriers largely attributed to efficiency changes at individual airports. Because of LCCs, the competitive landscape has drastically changed. Besides, (Tavalaei & Santalo, 2019) identified low-cost oriented airports as more linked to financial performance. However, (Choo et al., 2018) argued that the airports with the presence of LLCs produced a low-profit margin. And Martini et al. (2013) found LCCs do not affect environmental/technical efficiency. Though LCCs exhibited a significant positive impact on scale efficiency, if there is a technological change, then the productivity will regress (Coto-Millan et al., 2014). Furthermore, Abrate & Erbetta (2010) reported that *outsourcing handling operations* have severe economic implications. Also, (Martin et al., 2013) pointed out that a higher level of outsourcing reduces cost flexibility. Additionally, Tovar & Martin-Cejas (2009) witnessed outsourcing having a positive contribution to airport efficiency.

5.5 Economic indicators

Price factors (Assaf et al., 2012; Choo et al., 2018; Oum et al., 2004; Lam et al., 2009; Assaf, 2011) are the predominant economic indicators of airport performance. Assaf et al. (2012) found *price cap variations* as an important determinant of the cost efficiency of airports. Compared to concession price, airport *aeronautical price* is negatively impacted by airline market concentration (Choo et al., 2018). For busy and large airports, *a dual-till price cap* is found better than a *single-till price cap*; hence, dual–till regulation complements economic efficiency better (Oum et al., 2004). Also, Assaf (2011) witnessed that *increase in oil price* is linked to efficiency measures.

5.6 Environmental indicators

Location of the airport, emission of pollutants, and the airport environment was found to be the two major categories of environmental indicators that influence airports' performance. Under the 'emission of pollutants' variable, the commonly measured metrics include *local air pollution* (Schultz et al., 2018; Scotti et al., 2014), *noise* (Schultz et al., 2018), *stochastic noises* (Yu, 2010), *pollution emitting levels* (2), *CO2 emission production of the terminal building* (Celik et al., 2021), *emission per landing* (Guner, 2021), *and airport carbon levels* (Postorino & Mantecchini, 2019). The airport environment

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dimension includes scales such as *availability of FIDs, visibility of signages and internal environment* (Thampan et al., 2020). When airports increase their intensity from low concentration to high concentration, any discrepancy or inefficiency is ruled out (Hidalgo-Gallego & Mateo-Mantecon, 2019). Moreover, with visible signages, customers get clear guidance (Manley et al., 2011) to reach their destination point in the airport (Thampan et al., 2020). Additionally, proper lighting and air conditioning make their journey a pleasant one.

5.7 Social indicators

The key social drivers of airport performance are the *functions affecting the community* (Olfat et al., 2016). During emergencies, *individuals using wheelchairs and Individuals with lower stamina* are highly in danger (Manley et al., 2011). Lee & Park (2016) found *Social responsibility, transparency and social media critically* influence airport business performance. Moreover, (Stephenson et al., 2018) found the existence of a relationship between air route development with primary and secondary *stakeholders*.

5.8 Competitiveness indicators

Competition (Ha et al., 2013; 14; Adler & Liebert, 2014; Assaf et al., 2012) among airports is an essential function of efficiency because airports with high competition perform better than their counterparts (Chi-Lok & Zhang, 2009). This, in turn, will attract more LCCs to operate from their respective airports resulting in a reduction of charges and facilitating productivity improvements in airports (Bottasso et al., 2013). Two variables, namely, technological advances or modernization (Ahn & Min, 2014; De Nicola et al., 2013) and seasonal operations (Paraschi et al., 2020; Fragoudaki & Giokas, 2020) predominantly determine the competitive capacity of any airport. Particularly, (Paraschi et al., 2020) observed that low seasonality has a positive association with airport performance. Besides, some prominent indicators of competitiveness include the number of destinations and number of airlines (Liu, 2016) or a number of flights and air links (Postorino & Mantecchini, 2019), airline dominance (Martin et al., 2013), tangibility (Ozcan, 2018), and restructuring. More the number of airlines or destinations more is the aeronautical service provided by the airport. Also, more links increase the aircraft movements, thus increasing the efficiency. In addition, market expansion (Assaf, 2011), downstream airline market structure (Choo et al., 2018; Ha et al., 2013) and airport market power (Choo et al., 2018) play an important role in driving competition.

Table 4 presents the summary of all key drivers categorised into eight major categories:

Table 4: Summary of Drivers of Airport Profitability

Economic Indicators	Commercial Indicators	Airport Traffic indicators	Service Quality Indicators	Environmental Indicators	Competitive Indicators	Safety and Security Indicators	Social Indicators
Per capita Gross Domestic Product (GDP)	Low-cost oriented airport	Air Traffic Movements	Passenger waiting time	Noise	Number of destinations	Meteorological conditions	Human development factors
Regional economic development	Freight turnover	Passenger turnover and revenues	Passenger services	Local air pollution	Number of airlines	Weight restriction procedure	Availability of wheelchairs
Operational revenue	Passenger Facility Charges (PFC)	Number of Flights	Service time	Pollutant emitting levels	Market expansion	Average queuing time at airport	Social responsibility

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Economic Indicators	**Commercial Indicators**	**Airport Traffic indicators**	**Service Quality Indicators**	**Environmental Indicators**	**Competitive Indicators**	**Safety and Security Indicators**	**Social Indicators**
						security checkpoints	
Price factors	The share of international passengers	Passenger-terminal operations	Changes in flight demand	Energy conservation	Technological advances	Screening devices at the hold baggage checkpoints	Functions affecting the community
Dual-till price cap, Single-till price cap	Passenger Facility Charge (PFC)	Cargo load or value of passengers	Arrival states of congestion	Carbon reduction	Restructuring	Object Detection & Protection	Courtesy of staff
Price cap variations	Non-aviation revenues per passenger	Airport size	Flight plan data	Actual energy consumption of the terminal building	Air links	The detection performance of illegal items	Availability of lift, aerobridges, wayfinding, etc.
Commercial aviation movement	Non-aviation revenues per square meter	Regional tourist intensity	Staffing capabilities at critical times of the day	Consumption of natural gas and electricity	Downstream airline market structure	Accuracy for a security operator	
Increase in oil price	Space allocation (Locating the stores with more concession revenue in more accessible positions)	Domestic and international departures	Technological up gradation	CO2 emission production of the terminal building	Seasonal operations of established carriers	International Country Risk Guide (ICRG) corruption index	
Airport capital investments	Concession services	Passenger/Cargo Ratio	Communications & Integration	Stochastic noises	Airport market power	The feeling of being safe and secure	
The economic growth rate of the country	Non-aeronautical activities (concessions and other commercial activities)	Average aircraft size serving an airport and its movements	The capability of the runway system (Number of runways or the total runway length)	Emission per landing			

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Economic Indicators	**Commercial Indicators**	**Airport Traffic indicators**	**Service Quality Indicators**	**Environmental Indicators**	**Competitive Indicators**	**Safety and Security Indicators**	**Social Indicators**
Fuel costs	Airport operating hours	Short-run impacts of cargo traffic, Long-run equilibriums	Docking & Navigation	Airport carbon/noise local levels			
Total and long-term leverage	Outsourcing	Infrastructure usage	Night movement limits	Locational advantages of HSR stations relative to airports			
Return on assets	Open-skies agreements	Hub-status	Plane Load Factor	Internal environment (lighting, air conditioning ,.. Etc.)			
Return on Equity	Airline mergers	Traffic mix	Perceived airport quality	Visibility of signages			
Route profitability	Presence of low-cost carriers	Runway capacity	Perceived service quality				
Capital spending	Effect of low-cost carrier	Number of baggage belts	Aircraft landing-and-take-off (LTO) cycles				
Airport profit margin	Revenues	Airline transport capacity	Operating hours				
Labour productivity	Joint ventures	Total cargo transportation	Just-in-Time (JIT)				
Financial leverage	Sales and profitability	Gates and runways	Total Quality Management (TQM) principles				
Operating and maintenance costs	International tourism growth	General aviation movement	Corruption Perception Index (CPI)				
Macro-economic environment	Sustainable brand	Apron capacity	Control of Corruption Index (CCI)				

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Economic Indicators	**Commercial Indicators**	**Airport Traffic indicators**	**Service Quality Indicators**	**Environmental Indicators**	**Competitive Indicators**	**Safety and Security Indicators**	**Social Indicators**
Large and small scale investments	Mix and intra-terminal location of retail space	Number of check-in counters	Density/Space available per passenger				
Capacity cost	Operations of low-cost carriers	Short/medium/long haul flights					
Potential savings	Features of F&B services	Fleet mix					
Annual operating budget	Ownership Status	The intermodal linkage between the airport and its nearest HSR station					
Cost of capital	Airport Improvement Program (AIP) grants	Number of airport gates					
Cost of Labour	Availability of telephone and internet						
Return on Investment (ROI)	Arts and Exhibitions						
Annual revenue	The size of the commercial area						
Airport aeronautical price							

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Conclusion

The bibliometric review focused on finding out the performance indicators of the airport. The 222 articles revealed more than 300 drivers, which could be broadly classified into eight categories, such as (i) productive efficiency, (ii) service quality, (iii) safety and security, (iv) commercial, (v) economic or financial, (vi) environmental, (vii) social, and (viii) competitiveness. Besides, the review has brought forward a number of insights. The study shows that the majority of the previous literature focused on measuring airport profitability (Kalemba & Campa-Planas, 2018; Zuidberg, 2017; Abbruzzo et al., 2016; Merkert & Assaf, 2015; Fuerst & Gross, 2018; Stephenson et al., 2018). The division of the articles into three time zones reveals the requirement for more articles on operational efficiency (Tsui et al., 2014; Kashiramka et al., 2016). Moreover, when a majority of papers utilise the DEA approach, there is a need for employing some integrated approaches like the integrated AHP/DEA-AR technique (Lai et al., 2012).

While the objective of the research is to provide a comprehensive review of airport performance drivers, the selection criteria have imposed a few limitations. Firstly, the literature in the English language alone is included and articles published on or after 1992 are only accounted for. Because of this, some valuable contributions to the topic in other languages have been left out. However, the researched articles in the study are obtained through a systematic methodology and hence provide a holistic view of performance indicators for airports.

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