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A Bibliometric Analysis on Cloud Computing Literature Development

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***Abstract*—The purpose of this paper is to present a bibliometric analysis on cloud computing literature development since year 2008. A systematic search strategy was carried out through Scopus as the single electronic citation database in this bibliometric analysis. The findings reveal that the publication of cloud computing has been steadily maintained at the same rate for last few years except in 2020 which could be due to higher concentration on COVID related publications. Besides that, the cloud computing publications were reduced could be due to work from home situation which pull down the work efficiency and another possibility is cloud computing publications have started to decline and overtaken by other technologies due to the interest and demand from the academics and market, but this must be observed in next following 2 to 3 years to confirm on this. Precisely, the finding of this bibliometric analysis shows that countries with higher cloud computing literature publications tends to have higher cloud computing growth rate which implies that local government and related bodies are playing an important role to facilitate the technology awareness and transformation. This study contributes to cloud computing research by providing holistic insights of its literature development since 2018 by understanding its development, growth pattern, and contributions by the topmost affiliations/institutions, countries, authors, publishers in this area. In future, bibliometric analysis on cloud computing could be extended to other citation databases as this study is only referring to single citation database.**

***Keywords*—Cloud computing, Cloud technology, Bibliometric analysis, Adoption, Public cloud**

I. INTRODUCTION

Throughout the years, technologies have been used to improve many fields, such as lifestyle, communication, healthcare, transportation, education, energy, productivity, and so on. Among such technologies, John McCarthy founded the cloud computing concept in the 1960s and predicted that future calculations would be carried out through public utilities (Arutyunov, 2012). According to Foster *et al*. (2008), cloud computing is a paradigm where information is permanently stored on the internet and cached temporarily on the client's device. Cloud computing enables on-demand IT services and resource consumption over networks, which releases users from directly managing and maintaining underlying resources and infrastructure, from computation and storage up to the application level (Nutanix, 2021). The key benefits of cloud computing are agility, elasticity, scalability, simplified operations, disaster recovery, and many more. Cloud computing has been gaining popularity since 2006, when Amazon launched its Elastic Compute Cloud called Amazon EC2. Shortly after, in 2008, Google launched its Google App Engine (GAE), which is a platform-as-a-service. In 2010, Microsoft launched its Window Azure platform, a cloud computing service to build, test, deploy, and manage applications and services. Not wanting to miss the boat helmed by these top cloud computing vendors, other technology vendors then started offering cloud computing services in unique ways. Examples include Alibaba Cloud's Aliyun with its Taobao 11.11 shopping festival in 2010, SmartCloud Application Services by IBM in 2011, Oracle Cloud in 2012, and Tencent Cloud in 2013 with its flagship products QQ and WeChat. All seven cloud service providers are listed in Gartner's (2020) Magic Quadrant for cloud infrastructure and platform services, where Amazon Web Services (AWS), Microsoft Azure Cloud, and Google Cloud Platform (GCP) are listed in the "Leaders" quadrant while Alibaba Cloud, Oracle Cloud, IBM Cloud, and Tencent Cloud are listed in the "Niche Players" quadrant. According to Gartner (2021), Amazon, Microsoft, and Alibaba led the cloud market in 2020 by capturing 70% of the global infrastructure-as-a-service (IaaS) public cloud services market share.

Forbes (2020) listed cloud and edge computing as one of the next 25 technology trends that will define the upcoming decade, while the distributed cloud was listed as one of Gartner's top strategic technology trends for 2021. Among the next 25 technology trends named by Forbes (2020) are artificial intelligence (AI), machine learning, Internet of Things (IoT), Big Data, blockchain, and 5G. These trends and their literature development over the last decade were analyzed in this study as well for comparison with cloud computing's literature development. Many studies have found that adopting cloud computing can significantly improve firm performance (Raut *et al*., 2018; Priyadarshinee *et al*., 2017), particularly by increasing operational effectiveness and reducing operational costs (Sallehudin *et al*., 2019). Unsurprisingly, the cloud computing market share has grown exponentially, from USD 5 billion in 2008 to USD 236 billion in 2020 (Statista, 2021). This growth is likely to continue, as the global cloud computing market size is expected to grow from USD 371.4 billion in 2020 to USD 832.1 billion by 2025 at a Compound Annual Growth Rate (CAGR) of 17.5% (Research and Markets, 2020). According to another source, the cloud computing market size was valued at USD 264.8 billion in 2019 and is projected to reach USD 927.5 billion by 2027 at a CAGR of 16.4% (Allied Market Research, 2020). Considering this high growth rate, it is worth spending time and effort to understand the development of the cloud computing literature and publications in the past years, especially across regions, countries, institutions, authors, and sources, to predict its future development and growth pattern.

II. OBJECTIVES OF THE STUDY

Generally, this study aimed to identify, examine, and analyze publications and relevant areas in the cloud computing literature from 2008 to the period after the COVID-19 pandemic. The following are the specific objectives of the study.

- To examine the quantification of cloud computing literature publications over the study period
- To examine the quantification of cloud computing literature publications by subject area over the study period
- To examine the quantification of cloud computing literature publications by source title over the study period
- To examine the quantification of cloud computing literature publications by document type over the study period
- To analyze the growth pattern of cloud computing literature publications in comparison to other latest technologies
- To identify the top affiliations/institutions of cloud computing literature publications over the study period
- To identify the top countries of cloud computing literature publications over the study period
- To identify the most prolific authors and affiliations of cloud computing literature publications over the study period
- To identify the topmost cited publications and authors of cloud computing literature publications over the study period
- To identify the topmost sources and publishers of the most cited cloud computing literature publications over the study period

III. METHODOLOGY

This study employed bibliometric analysis to summarize large quantities of bibliometric data and present the state of the intellectual structure and emerging trends in the cloud computing literature. The meta-analysis and systematic literature review approaches were outside the scope of this study. This bibliometric study was based on several main techniques, including performance analysis, citation analysis, co-citation analysis, and science mapping of publication-related metrics and citation-related metrics. A systematic search strategy was carried out through Scopus as the single electronic citation database in the analysis. Scopus was chosen instead of other sources like Web of Science is due to couple of reasons such as Scopus covers more journals and records, Scopus provides citation data from a wider range of sources, Scopus provides a wider range of metrics to evaluate research impact and others (Somasundaram, 2023). The keywords used to search through only article titles were "cloud computing" or "cloud technology". The search process generated a total of 20,516 documents from the Scopus database since 2003. A larger total of 90,338 documents were derived from the Scopus database since 1979 when the aforementioned keywords were used to search through articles, abstracts, and keywords. The reason for searching for the keywords only in article titles was to ensure that all the identified articles precisely focused on cloud computing. For example, one of the most cited articles from the keyword search of article titles, abstracts, and keywords was Gubbi *et al*.'s (2013) research on the vision, architecture, and future of the Internet of Things (IoT), which did not exactly focus on cloud computing. The search was redefined to specify the duration between 2008 and 2022, yielding a total of 20,514 articles as there were only two cloud computing articles prior to 2008 (i.e., one from 2003 and one from 2004). This specific duration also aligned with the cloud computing systems launched by Amazon in 2006, Google in 2008, and Microsoft in 2010. These companies constitute the top three largest public cloud vendors, controlling over 61% of the cloud market share (Statista, 2021). The final search of this study was done in the Scopus database on 4th July 2021 with the following search query string.

TITLE ("cloud computing" OR "cloud technology") AND (EXCLUDE (PUBYEAR , 2004) OR EXCLUDE (PUBYEAR , 2003))

IV. ANALYSIS AND DISCUSSION

Fig. 1 shows the number of cloud computing publications since 2008 based on the search strategy described in the study's methodology. From the initial total of 20,516 relevant publications, two were removed as they were published in 2003 and 2004 respectively, rendering them insignificant for the present bibliometric analysis. The contribution of the cloud computing literature is considered to have started in

2008, in line with the public cloud service launch by Amazon in 2006, Google in 2008, and Microsoft in 2010. The number of publications on cloud computing has proliferated since 2008, peaking at around 2,000 publications yearly. Nonetheless, the number of publications in 2021 and 2022 should be ignored, since publications for these two years are still ongoing. Notably, publication numbers were markedly fewer in 2020, which could be due to the pandemic.

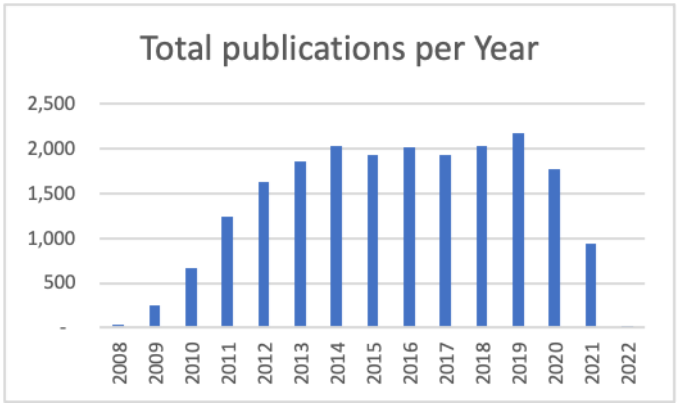

Fig. 1. Cloud computing literature publications per year

This is supported by Aviv and Rosenfeld's (2021) study, which explained that the sharp increase in COVID-19-related publications with significantly faster acceptance times partially came at the expense of non-COVID-19 publications like cloud computing. The large volume of research publications related to COVID-19 were expedited at an extraordinary speed, with a median time from receipt to acceptance of six days for a journal article (Palayew *et al.*, 2020); undoubtedly, this has impacted other non-COVID-19 articles. On the other hand, among the 704 academics in Aczel *et al.*'s (2021) study, half felt that the pandemic lockdown decreased their work efficiency, which could be another reason cloud computing publications slowed down in 2020.

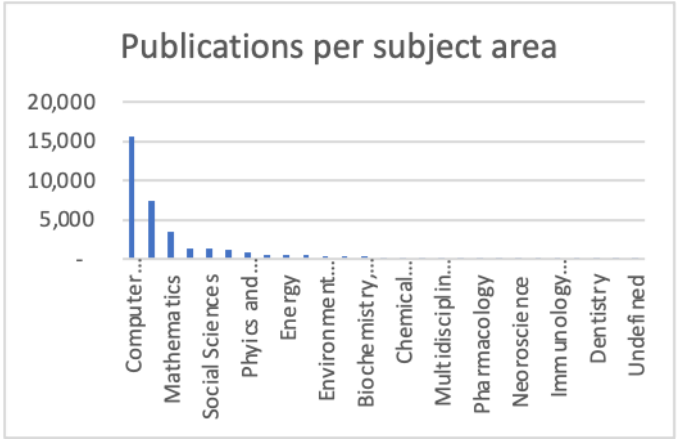

Fig. 2. Cloud computing literature publications per subject area

Understanding the subject areas or fields of cloud computing publications can not only provide better clarity on the topic's development but also highlight the fields that draw the interest and attention of scholars. Among the subject areas, computer science reported the highest publications with 15,696, followed by engineering, mathematics, decision science, social science, and others. However, there is some overlap in these figures as the sum of all the publications in this figure is 35,117, which is greater than the total publication number of 20,514 from the Scopus search result. This is plausible because it has been validated by the Scopus website that some journal articles tag more than one subject area.

TABLE 1. Cloud computing literature publications by source title

Source Title	Quantity	CiteScore
Lecture Notes In Computer Science	567	1.8
Advances In Intelligent Systems And Computing	485	NA
Communications In Computer And Information Science	333	0.8
ACM International Conference Proceeding Series	305	1.2
Applied Mechanics And Materials	302	NA
Lecture Notes In Electrical Engineering	221	0.5
Advanced Materials Research	189	NA
IEEE Access	178	4.8
Future Generation Computer Systems	160	13.3
Journal Of Physics Conference Series	157	0.7

Table 1 reveals the top 10 source titles in the cloud computing literature, which include conference papers, articles, book chapters, reviews, and so on. Lecture Notes in Computer Science, Advances in Intelligent Systems and Computing, Communications in Computer and Information Science, and Lecture Notes in Electrical Engineering are book-relevant sources while ACM International Conference Proceeding Series, Applied Mechanics and Materials, Advanced Materials Research, IEEE, Future Generation Computer Systems, and the Journal of Physics Conference Series are either conference proceedings or journals. CiteScore is a metric for measuring a journal's impact, much like the Journal Impact Factor (JIF). The difference is that CiteScore is based on the number of citations received by a journal in the last four years divided by the number of documents published in the journal in those four years, while JIF uses the last two years of the published papers (Kamat, 2020). Okagbue and da Silva (2020) established that CiteScore and JIF have a strong and significant positive correlation. In the present analysis, Future Generation Computer Systems showed the highest CiteScore compared to the others; the value of 13.3 refers to the average citations per document received by the Future Generation Computer Systems journal.

TABLE 2. Document type of cloud computing literature publications

Document Type	Quantity
Conference Paper	10,850
Article	7,657
Book Chapter	895
Review	326
Conference Review	300
Editorial	272
Book	90
Note	41
Erratum	28
Short Survey	26
Letter	10
Retracted	10
Undefined	9

Table 2 exhibits the document type of the cloud computing publications. Conference papers and articles were the top two document types, equaling 90% of the total publications with 18,507 papers. Conference papers and articles are the two most important sources for research and literature reviews; hence, having a high number of publications in these two domains is crucial. It should be noted that conference papers differ from journal articles, whereby a journal is a periodic publication which focuses on a certain subject area and contains peer-reviewed papers, whereas a conference is a place where people gather to discuss research and development in a certain subject area (IEREK, 2018).

TABLE 3. Literature publications across the latest technologies

Technologies	Total Publications	Peak (Qty, Year)
Cloud Computing	20,516	2,170, 2019
Internet of Things	20,824	3,949, 2019
Artificial Intelligence	27,230	5,536, 2020
Blockchain	13,435	4,913, 2020
5G	16,771	3,919, 2020
Machine Learning	58,908	16,200, 2020
Augmented Reality	13,834	2,023, 2020
Virtual Reality	21,342	3,110, 2020
Big Data	32,081	5,334, 2020

To better understand the development of the cloud computing literature throughout the years, Table 3 compares cloud computing with other trending technologies using the same search methodology in the Scopus database. In terms of total number of publications since 2008, cloud computing is rather similar to other trends except machine learning and big data, which have much higher publications of 58,908 and 32,081, respectively. Considering the number of publications during their peak year, cloud computing peaked with 2,170 publications in 2019, which is quite low compared to other technologies like AI, big data, and blockchain, which peaked with approximately 5,000 publications in 2020. In fact, machine learning had 16,200 publications in the year 2020 alone. This finding shows that other technologies are gaining much more attention than cloud computing. This could be due to cloud computing's gradual evolution into a commodity, as highlighted by Forbes (2014) several years ago. However, there is a commonality among these technologies, as all of them exhibited peak publications in the recent years of 2020 and 2019, proving that they are still relevant, in trend, and in development.

Fig. 3 depicts the top 20 affiliations or institutions of cloud computing publications. There were eight affiliations from China in the top 10, followed by India and Australia. Therefore, to gain more clarity, the top 20 affiliations were listed down in this study. Among the top 20, 12 affiliations were from China, three from India, two from Malaysia, and one each from Australia, South Korea, and Saudi Arabia. There were only two ASEAN affiliations in the top 20 publications, both of which were from Malaysia. All 12 affiliations from China contributed 64% of the total publications from the top 20 affiliations.

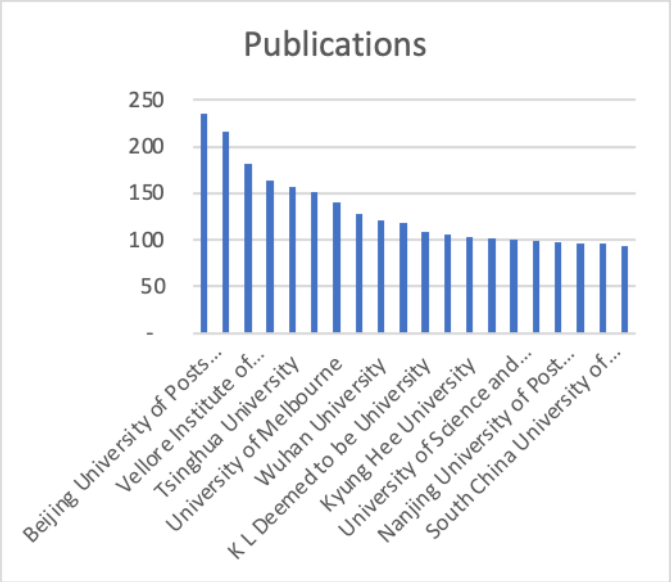

Fig. 3. Cloud computing literature publications by affiliation/institute

China's contribution to this research area could be one of the reasons cloud computing in China is growing strongly and is expected to have a CAGR of 34% from 2019 to 2023 (Mirae Asset, 2021), far higher than the predicted global CAGR of 17.5% and 16.4% (Research and Markets, 2020; Allied Market Research, 2020). The China Internet Watch (2021) reported that cloud infrastructure service spending in China grew by 55% year-over-year in the first quarter of 2021. China is also the second-largest cloud infrastructure service market after the United States. According to He *et al.* (2012), the Chinese government has put a lot of effort into IT infrastructure investment, as cloud and IoT technologies have been positioned as a strategic priority for the domestic economy. Another reason for China's dominance in this area could be its cyber-control measures and other protectionist policies that prevent major foreign cloud service providers from penetrating China's market (Kshetri, 2016). Consequently, local cloud service providers gain advantages in building their capabilities with support from the local government and private sector.

TABLE 4. Cloud computing literature publications by country

Country/Territory	Quantity
China	5,903
India	3,957
United States	2,396
United Kingdom	843
South Korea	683
Australia	630
Taiwan	595
Malaysia	568
Germany	530
Canada	475

Table 4 presents top publications by country. It is not surprising that China recorded the most publications, followed by India and the United States, while the rest had less than 1,000 publications accumulated over the years. Both the United States and China are global leaders in terms of cloud computing spending (Statista, 2021); as such, it is plausible for them to have top publications related to cloud computing. India had the most publications after China, despite not yet becoming a top cloud computing spending country. Nevertheless, according to Gartner (2021), India recorded growth rates of 31.4% and 26.4% in 2021 and 2022, respectively. The United States is the third top publication country, though there is no United States affiliation/institution in the top 20 list. This can be justified by its well-developed cloud computing market compared to other countries, since the United States has always been the pioneer in new technology adoption. Another possibility is that publications were scattered across the United States' affiliations/institutions. Indeed, according to Webometrics (2021), there are 2,565, 3,216, and 5,288 universities in China, the United States, and India, respectively. The total publications of the rest of the top countries were far behind China, the United States, and India, with less than 1,000 publications since 2008. Malaysia is the only ASEAN country in the list of top 10 publications by country. In fact, Abdullah *et al*. (2020) stated that Malaysia ranked second among ASEAN countries in the cloud computer readiness index in 2018, whereby the index is influenced by various factors such as network connectivity speed, broadband internet cost, and so on.

Table 5 presents the top 20 authors of cloud computing publications. These authors could be the first, second, corresponding, or even third or fourth authors of their respective papers. The top author is Buyya Rajkumar from the University of Melbourne, Australia with 118 publications. Among the top 20 authors, there are seven from China, three from Australia, two from South Korea, and one from other countries (i.e., Malaysia, the United Kingdom, Norway, Iran, Jordan, Italy, the United States and Pakistan). The publications of all seven authors from China contributed 30% to the total publications of the top 20 authors, indicating the seriousness and focus of China in developing the cloud computing literature. Unexpectedly, the top three authors with the most publications are from Australia, South Korea, and Malaysia, which are not the topmost publication countries. This could be because there are more researchers and academics in publication-heavy countries like China, the United States, and India compared to Australia, South Korea, and Malaysia. This is supported by the previous discussion that the seven authors from China contributed 30% of the total publications by the top 20 authors.

TABLE **5**. Cloud computing literature publications by author

Author	Qty	Affiliation
Buyya, R.	118	University of Melbourne
Huh, E.N.	54	Kyung Hee University
Hashem, I.A.T.	46	Universiti Malaysia Sabah
Li, J.	35	Guangzhou University
Jin, H.	32	National Engineering Research Center
Chen, X.	31	Xidian University
Li, K.	31	Hunan University
Vasilakos, A.V.	30	Fuzhou University
Chang, V.	28	Teesside University
Rong, C.	28	Universitetet i Stavanger
Rahmani, A.M.	26	Islamic Azad University
Jararweh, Y.	25	Jordan University of Science and Technology
Park, J.H.	25	Seoul National University of Science and Technology
Villari, M.	24	Università degli Studi di Messina
Shen, J.	23	Jiangsu Collaborative Innovation Center
Zomaya, A.Y.	23	The University of Sydney, School of IT
Shiraz, M.	22	Federal Urdu University of Art
Calheiros, R.N.	21	Western Sydney University
Gai, K.	21	Beijing Institute of Technology

Table 6 depicts the most cited publications in the cloud computing literature. The most cited publication is by Armbrust *et al*. (2010) with 6,114 citations, followed by Buyya *et al*. (2009) and Calheiros *et al*. (2011) with 3,959 and 3,194 citations, respectively. All the top 10 most cited publications are articles, as peer-reviewed journal articles are high quality sources that have undergone a rigorous editorial review process by the journal editor and a group of reviewers who are experts in the relevant field. Armbrust *et al*. (2010) are from the United States while Buyya *et al*. (2009) and Calheiros *et al*. (2011) are from Australia/Austria and Australia/Brazil, respectively. On the other hand, the most cited machine learning paper is "Scikit-learn: Machine learning in Python" (Pedregosa *et al*., 2011) with more than 24,000 citations, while the most cited big data paper is "Business intelligence and analytics: From big data to big impact" (Chen *et al*., 2012) with close to 2900 citations. Armbrust *et al*. (2010) and Pedregosa *et al*. (2011) have the highest citations in the cloud computing and machine learning articles, which were written by many authors (i.e., 11 and 16 respectively).

TABLE 6. Cloud computing literature publications by citation

Author	Title	Cited
Armbrust *et al*., 2010	A view of cloud computing	6,114
Buyya *et al*., 2009	Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility	3,959
Calheiros *et al*., 2011	CloudSim: A toolkit for modeling and simulation of cloud computing environments and evaluation of resource provisioning algorithms	3,194
Zhang *et al*., 2010	Cloud computing: State-of-the-art and research challenges	2,137
Foster *et al*., 2008	Cloud Computing and Grid Computing 360-degree compared	1,911
Beloglazov *et al*., 2012[i]	Energy-aware resource allocation heuristics for efficient management of data centers for Cloud computing	1,834
Subashini & Kavitha, 2011[ii]	A survey on security issues in service delivery models of cloud computing	1,694
Hashem *et al*., 2015[iii]	The rise of "big data" on cloud computing: Review and open research issues	1,421
Marston *et al*., 2011[iv]	Cloud computing - The business perspective	1,381
Dinh *et al*., 2013[v]	A survey of mobile cloud computing: Architecture, applications, and approaches	1,362

Table 7 is similar to Table 6 but has additional information like source, publisher, year of publication, and country. Communications of the ACM by Armbrust *et al*. (2010) is the most cited publication and was published by ACM, while the second and third most cited publications were published by Elsevier and Wiley. Of the top 10 most cited publications, five were published by Elsevier, two by Wiley, and one each by ACM, SpringerLink, and IEEE. Buyya *et al*.'s (2009) article in Future Generation Computer Systems, published by Elsevier, recorded the highest CiteScore in Table 1 and is the second most cited article after Armbrust *et al*. (2010). All the most cited publications were published five to 10 years ago, with the top five being closer to a decade old (i.e., Armbrust *et al*., 2010; Buyya *et al*., 2009; Calheiros *et al*., 2011; Zhang *et al*., 2010; Foster *et al*., 2008). Among the top 10 most cited articles, three are from institutions in Australia and the United States while the others are from Canada, India, Malaysia, and Singapore.

With regard to previous bibliometric analyses of cloud computing research, only seven articles were found in the Scopus database. Four studies were published before the COVID-19 pandemic while three were published after the pandemic. One of the studies pertained to cloud computing security, which diverges from this study's focus area. Fortis and Fortis' (2021) study investigated the impact of projects implemented in 2009 through the European Commission's FP7 ICT Call 5. Waghmare's (2020) study was based solely on India's research contribution and only contained basic information without much interpretation. Rajeswari and Praveena's (2021) study is quite similar to Waghmare's in terms of the information provided, but it was not limited to India. They also retrieved articles from the Web of Science database instead of Scopus. Bharati and Singh's (2019) paper is also like those of Waghmare (2020) and Rajeswari and Praveena (2021), although it was published before the COVID-19 pandemic. In fact, all three articles were published by the same source, Library Philosophy and Practice. The two remaining studies were authored by Yu *et al*. (2018) and Cai *et al*. (2015), both of which are alike in their provision of basic information. Nonetheless, Cai *et al*. (2015) performed a more complete analysis than the rest. Even so, the paper was published back in 2015. Hence, the present study is essential to provide insights on the latest development of the cloud computing literature, especially after the COVID-19 pandemic.

With the latest 2023 bibliometric studies, Waghmare (2020)'s bibliometric study based on the Scopus database aims to analyze the Indian research contribution to cloud computing from 2011 to 2020. A total of 1482 articles were discovered to have been published on the topic from 2011 to 2020, with an increasing trend. The highest number of articles was recorded in 2019 with 439. The number of articles published between the years 2008 and 2020 increased significantly, particularly from 2016, according to a different bibliometric study by Goncalves *et al*. (2023) that is also based on the Scopus database and takes into account 1,330 articles extracted. The analysis of the landscape also revealed that India is the country that published the most articles on the theme, followed by the USA and China. Such findings have some similarities with the findings of this bibliometric analysis.

TABLE **7**. Cloud computing literature publications by source & publisher

Author	Source	Publisher	Year	Country of Institute
Armbrust *et al*., 2010	Communications of the ACM	ACM	2010	US
Buyya *et al*., 2009	Future Generation Computer Systems	Elsevier	2009	Australia/Austria
Calheiros *et al*., 2011	Software - Practice and Experience	Wiley	2011	Australia/Brazil
Zhang *et al*.,2010	Journal of Internet Services and Applications	SpringerLink	2010	Canada
Foster *et al*., 2008	Grid Computing Environments Workshop, GCE 2008	IEEE	2008	US
Beloglazov *et al*., 2012	Future Generation Computer Systems	Elsevier	2012	Australia
Subashini & Kavitha, 2011	Journal of Network and Computer Applications	Elsevier	2011	India
Hashem *et al.*, 2015	Information Systems	Elsevier	2015	Malaysia/US
Marston *et al*., 2011	Decision Support Systems	Elsevier	2011	US
Dinh *et al.*, 2013	Wireless Communications and Mobile Computing	Wiley	2013	Singapore

V. CONCLUSION

This bibliometric analysis allows us to better understand how the literature on cloud computing has developed across the globe since 2008. With the market size of cloud computing predicted to reach USD 800 billion to USD 900 billion by 2025 and 2027, it is essential to understand cloud computing's development and subsequently, to inform technology vendors, governments, private sectors, and consumers on how to gain advantages by leveraging the vast opportunities in the cloud computing market over the next decade. One of the key findings of this bibliometric analysis is that countries with more cloud computing publications tend to have greater cloud computing growth, which is valid as more research and support in a country can boost the knowledge, acceptance, and adoption rate of a particular technology in that country. Also, the cloud computing literature has been developing steadily for the past few years, except for 2020. The publication declines in 2020 can be attributed to the sharp increase in COVID-19-related publications with significantly faster mean acceptance times at the expense of non-COVID-19 publications like cloud computing. In addition, the decrease in cloud computing publications at the time could be due to the work-from-home situation, which reduced work efficiency and shifted the focus to non-academic matters amid the difficult pandemic period that affected many groups. Another possibility is that cloud computing publications have started to decline because cloud computing is maturing and being overtaken by other technologies that draw more interest and demand from academics and practitioners. However, this phenomenon has to be observed in the following two to three years before a solid conclusion can be made; hence, future bibliometric studies could investigate or validate the assumptions made as above. Among the various technology trends, cloud computing remains one of the central and most relevant technologies, as can be seen from its publications. Even so, it is not the most popular technology, as machine learning and big data are reporting much higher publication numbers recently, indicating they are more important technologies moving forward. The evidence also suggests that cloud computing has been well-developed over the past decade; thus, its publications have not been growing much but have steadily maintained a similar rate. Although this bibliometric analysis was based only on the Scopus database, which may not represent the entire citation database, it offers good guidance and a holistic view of cloud computing's literature development over the past decade. Future analysis should consider including other citation databases such as Web of Science or narrowing the scope to specific geographic locations or countries such as ASEAN.

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