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Exploring Cloud Computing in Accounting Research Publication using a Bibliometric Analysis

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ABSTRACT

Cloud computing is the future of the accounting industry and it is changing the way accountants manage their financial data efficiently. This study aims to (i) identify the major contributors to cloud computing in accounting research and (ii) understand the trends and distribution of research documents to assess the global research developments related to cloud computing and accounting. In this study, 284 publication documents in the fields of business, management, and accounting were analysed using a Scopus database dated 11 July 2022, covering the period from 2008 to 2021, as interest in this topic area is growing. The data was analysed using descriptive bibliometric analysis while Microsoft Excel was used to perform the frequency analysis. The results showed that the number of publications on the topic of "Cloud Computing in Accounting Research" has continuously increased over 13 years since 2008. Most publications were by researchers from the United States, followed by China, Germany, India, Australia, and the United Kingdom. India was the only Asian country listed in the top 10 national contributors by country. The citation analysis showed that the article by Oliveira et al. was the most highly cited in 2014, with 635 citations and that the preferred language for scientific publications was English. The analysis of research trends revealed an increasing trend of publications from 2013 to 2020 with more than 60% of documents published as journal articles. In the analysis of keywords, "cloud computing" was the most frequently used keyword (n=156) in the collected documents. These findings provide important insights that could guide and promote the use of cloud computing for accountants and practitioners by defining future research lines and a research agenda for academic researchers.

Keywords: *bibliometric analysis, cloud accounting service, cloud computing*

INTRODUCTION

According to a consulting company named International Data Corporation (IDC), increasing volumes of data generation in websites and mobile apps double approximately every two years, leading to the growth of emerging technologies (IDC, 2021). Today's emerging technology has completely changed

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the way organizations access a greater range of digital capability development that enabled them to make more proactive decisions. Emerging technologies, such as big data and Artificial Intelligence (AI), are gaining traction leading to the growth of the cloud computing market globally. Cloud computing can be a remarkably cost-effective method for organizations, mitigating risks, achieving greater scalability and flexibility to move and store data, reducing storage and infrastructure complexities, as well as improving business efficiency (Marketsandmarkets, 2021). The global pandemic of coronavirus disease 2019 (COVID-19) has caused severe disruption around the globe. All businesses became highly dependent and reliable on digital technology, leading to the growth of cloud services including cloud accounting services which has revolutionized accounting job operations (Tarboush, 2018).

Over the years, many authors have contributed to the literature on cloud computing. Some of them used bibliometric analysis to assess the growth of publications in different research disciplines (Garg et al., 2019; Ezenwoke et al., 2019). The data was analysed based on the most active author, the highest number of published papers, top publication by countries, top publication journal, the most productive institution, the most prevalent keyword, the most cited authors, language use, and document types. However, limited studies have been found conducting bibliometric analysis on cloud computing in accounting (Atanasovski & Tocev, 2022) which does not adequately cover the scientific progress in the publication development of cloud computing in accounting research. Hence, as narrative literature reviews are subjected to bias (Abdullah et. al., 2018) and the number of research papers is growing in this area, this paper closed this gap by using bibliometric analysis in responding to the following research questions: (i) Who and what are the major contributors on cloud computing in accounting research? (ii) What are the trends and distribution of research documents on cloud computing in accounting research? To determine the major contributors, an analysis was done on the national contributions of countries, the most research-active institutions, top contributing authors and researchers, the most highly cited articles, and language use. Furthermore, to understand the trends and distribution of research documents, an examination was carried out by analysing research publications by year, sources and document types, research area, and frequently used keywords. This study would provide valuable references for research scholars, especially in the mapping of related research publications on cloud computing in accounting. Besides, it would also indirectly provide some insight for practitioners for future practices, particularly living in this "new normal" life due to the COVID-19 pandemic.

LITERATURE REVIEW

Cloud computing is the delivery of computing services to customers over the internet. It is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources for instance, networks, servers, storage, applications, and services (Mohanty & Mishra, 2017). The development of cloud computing technologies has changed the game for various industries and the accounting profession is no exception. The major driver of this change is cloud computing which enables accountants to have better and faster access to business intelligence that they can then use to advise clients (Japee & Joshi, 2018). Cloud computing allows a company to access applications from an offsite provider via the internet in real-time, rather than from traditional accounting-based software. This has made the account preparation process more efficient with detailed business information (Mohanty & Mishra, 2017).

Bibliometric analysis studies and classifies bibliographic material quantitatively. In recent years, it has become more popular to assess the publication growth of different research disciplines, mainly motivated by the development of emerging technologies and the Internet (Merigó & Yang, 2017). Furthermore, bibliometrics analysis provides a general picture of a research area, which is very useful in predicting forward trends of various disciplines. Several researchers have studied trends and developments in cloud computing publications using bibliometric analysis in different areas of study (Garg et al., 2019; Ezenwoke et al., 2019). Their studies analyse the top author, the number of

publications, the top countries, the top journal, the most productive institutions, the most prevalent keyword, the most highly cited authors, language use, and document types. Some studies have demonstrated extensive literature on the accounting research field using bibliometric indicators to assess the current state of knowledge. Merigó and Yang, (2017) explored a bibliometric overview of accounting research using the Web of Science database from 2003 until 2012, identifying the most relevant research in the field classified by papers, authors, journals, institutions, and countries. They found that the United States was the most dominant country in the field with a very strong position in all the top journals since it has a long tradition of accounting research.

Some authors studied bibliometric analysis focusing on emerging technologies including big data, data analytics, cloud, artificial intelligence, and blockchain in the accounting field. Varma et al., (2021) visualized the research trend in Big Data and accounting research. The data was retrieved from the Scopus database to ascertain the authors, countries, keywords, and journals that have contributed the most to this field of study. The result indicated that the publication trend was dominated by the United States and other English- speaking countries, except for China and Italy. A study by Lardo et al., (2022) found that research on blockchain technology and accounting has been growing rapidly over the last three years. Meanwhile, Atanasovski and Tocev (2022) used the bibliometric method to analyse the number of published articles by academia and practitioners on emerging technologies in the accounting field. They discovered that both academia and practitioners showed a positive trend in terms of the number of published articles. Nevertheless, research publications on cloud computing in the accounting field are still lacking among academicians as compared to practitioners even though the recent trends in cloud computing research activities are growing in established literature databases. Therefore, this study aimed to analyse the major contributors, trends, and distribution of research documents on cloud computing applied in accounting research using bibliometric analysis. Thus, the result will assist researchers to understand the global trends and distribution of research publications and subsequently strategize future research.

METHODOLOGY

Search Strategy

This study employed bibliometric analysis as well as quantitative and statistical analysis to describe distribution patterns of research articles within specific topics and time (Martí-Parreño et al., 2016). The quantitative research approach was adopted in the form of a bibliometric method to assess the documents of cloud computing and accounting research in the Scopus scientific database dated 11 July 2022. The data was collected during the time frame from the beginning of 2008 until 2021. Search strings containing "cloud computing" and "accounting" were used to obtain relevant documents in any language and the publication years were limited to 2008 until 2021. The first paper was published in the Scopus database in the year 2008. A total of 1,894 research papers with the search string contained in the document were returned from the search made. The search string was limited to business, management, and accounting subject areas due to the growing interest in that field with 284 research papers analysed.

Selection Process and Data Analysis

The documents were analysed through the feature of "Analyse search result" in Scopus. The results were exported to Microsoft 365 Excel file to calculate the frequencies and percentage of the published materials and the data was analysed using ten bibliometric indicators. The indicators were used to determine the research trend on cloud computing in accounting research as follows: (i) the major contributors of countries; (ii) the most research-active institutions; (iii) top contributing authors and researchers; (iv) the most highly cited articles; (v) language use in publication; (vi) research publication by year; (vii) sources title; (viii) document types; (ix) subject areas; and (x) frequently used keywords.

It should be noted that for all the following results shown here, the source of publication was based on documents from conference proceedings, book chapters, and journals that are in the coverage of the Scopus database.

RESULT AND DISCUSSION

Analysis of Major Contributors to Cloud Computing in Accounting Research

Table 1 indicates the top 10 countries that contribute to cloud computing in accounting research. The United States led with 21.83%, succeeded by China with 10.56%, Germany with 7.75%, India with 7.39%, Australia with 6.69%, and the United Kingdom with 5.28%. The remaining contributions of countries were less than 5% and have spread around the world. This finding supported Varma et al. (2021) and Merigó and Yang (2017) who found that the United States was the most productive country with a huge difference from the second-ranked country in their studies. This indicates that this subject area is becoming significant to be explored throughout the world.

Table 1: Countries contributing the most to cloud computing in accounting research

Country	Number of documents	Percentage (%)
United States	62	21.83
China	30	10.56
Germany	22	7.75
India	21	7.39
Australia	19	6.69
United Kingdom	15	5.28
Italy	13	4.58
Brazil	7	2.46
Canada	7	2.46
Ireland	7	2.46

Table 2 shows the top 10 institutions from all over the world that contributed to the highest number of publications on cloud computing in accounting research. Out of the 284 documents, the National Institute of Industrial Engineering (India) contributed the highest publications, 3.17% (n = 9). This was followed by Osnabrück University (Germany) at 2.46% (n = 7), while the Queensland University of Technology (Australia) and DCU Business School (Ireland) shared the same percentage of 2.11% (n = 6). Meanwhile, other institutions contributed less than 2% (n < 6). The increase in the number of research publications among the top three institutions might be due to funding and support of research activities by the institutions themselves. Rawat and Meena (2014) reported that the success of the institutions' research publications would raise awareness among academicians. Hence, it would attract more external funding to the institute from industries and government agencies.

Table 2: Top 10 institutions' contributions to cloud computing and accounting research documents

Institution Name	Country	Number of documents	Percentage (%)
National Institute of Industrial Engineering	India	9	3.17
Osnabrück University	Germany	7	2.46
Queensland University of Technology	Australia	6	2.11
DCU Business School	Ireland	6	2.11
Bucharest University of Economic Studies	Romania	5	1.76
Università degli Studi di Napoli Federico II	Italy	4	1.41
Chinese Academy of Sciences	China	4	1.41
Singapore Management University	Singapore	3	1.06

Washburn University	United States	3	1.06
Dublin City University	Ireland	3	1.06

From the 284 publications examined in this study between the periods of 2008 to 2021, Priyadarshinee, P. (India) and Teuteberg, F. (Germany) produced the highest number of publications (n = 7) among the top 10 active authors (Table 3). This was followed by Raut, R. D. (India, n = 6), Ferri, L. (Italy, n = 4), and Jha, M. K. (India, n = 4), while others contributed the same number of publications (n = 3). It can be observed that India has the most active authors and institutions in research publications on cloud computing and accounting.

Table 3: Most active authors on cloud computing in accounting research with affiliation

Author	Affiliation	NOD
Priyadarshinee, Pragati	Chaitanya Bharathi Institute of Technology, Hyderabad, India	7
Teuteberg, Frank	Osnabrück University, Osnabruck, Germany	7
Raut, Rakesh D.	National Institute of Industrial Engineering, Mumbai, India	6
Ferri, Luca	Università degli Studi di Napoli Federico II, Naples, Italy	4
Jha, Manoj Kumar	National Institute of Industrial Engineering, Mumbai, India	4
Cavallari, Maurizio	Università Telematica Internazionale UNINETTUNO, Rome, Italy	3
Gardas, Bhaskar B.	M H Saboo Siddik College of Engineering, Mumbai, India	3
Green, Peter F.	Queensland University of Technology, Brisbane, Australia	3
Jede, Andreas	Osnabrück University, Osnabruck, Germany	3
Kasemsap, Kijpokin	Suan Sunandha Rajabhat University, Bangkok, Thailand	3

Note: NOD=Number of documents

Table 4 shows the top 10 most highly cited articles for each author (based on the number of times the document was cited) as per the Scopus database between 2013-2019. All the articles that received the highest citation were journal articles. An article by Oliveira et al. in 2014 received the highest number of citations with 635, followed by Moeuf et. al. (2018) with 451 citations and Gupta et. al. (2013) obtained 416 citations. Furthermore, it was noted that the highest cited articles in this area depended on their publication year. An article by Oliveira et. al. (2014) contributed more than 29% as compared to Moeuf et. al.'s (2018) publication. Generally, it will take between four to ten years for the articles to be cited (Abdullah et al., 2018). This was consistent with Thulesius (2011) who claimed that the early publications of the articles have much time available to be cited.

Table 4: The top 10 authors with the highest citations

Authors	Title	Year	Total Citation
Oliveira T., Thomas M., Espadanal M.	Assessing the determinants of cloud computing adoption: An analysis of the manufacturing and services sectors	2014	635
Moeuf A., Pellerin R., Lamouri S., Tamayo-Giraldo S., Barbaray R.	The industrial management of SMEs in the era of Industry 4.0	2018	451
Gupta P., Seetharaman A., Raj J.R.	The usage and adoption of cloud computing by small and medium businesses	2013	416
Bardhan I.R., Demirkan H., Kannan P.K., Kauffman R., Sougstad R.	An interdisciplinary perspective on IT services management and service science	2010	190
Schneider S., Sunyaev A.	Determinant factors of cloud-sourcing decisions: Reflecting on the IT outsourcing literature in the era of cloud computing	2016	146
Bhimani A., Willcocks L.	Digitization, Big Data and the transformation of accounting information	2014	146

Gill S.S., Tuli S., Xu M., Singh I., Singh K.V., Lindsay D., Tuli S., Smirnova D., Singh M., Jain U., Pervaiz H., Sehgal B., Kaila S.S., Misra S., Aslanpour M.S., Mehta H., Stankovski V., Garraghan P.	Transformative effects of IoT, Blockchain and Artificial Intelligence on cloud computing: Evolution, vision, trends and open challenges	2019	144
Brender N., Markov I.	Risk perception and risk management in cloud computing: Results from a case study of Swiss companies	2013	139
Gonul Kochan C., Nowicki D.R., Sauser B., Randall W.S.	Impact of cloud-based information sharing on hospital supply chain performance: A system dynamics framework	2018	93
Guha S., Kumar S.	Emergence of Big Data Research in Operations Management, Information Systems, and Healthcare: Past Contributions and Future Roadmap	2018	90

As presented in Table 5, English was the common language used in the publications representing 97.54% of the total documents. Some of the publications were also published in Portuguese, Spanish and Chinese languages. One of the publications was found to be published in dual languages that are English and Portuguese. It was observed that most publications were in English due to the tendency for non-native English researchers to make their articles more visible and cited. Furthermore, English articles have a higher number of citations than those published in other languages since they are accessible to a larger audience (Di Bitetti & Ferreras, 2017).

Table 5: Language use in publications

Language	No. of publications	Percentage (%)
English	278	97.54
Portuguese	4	1.40
Spanish	2	0.70
Chinese	1	0.35

*One document has been published in dual languages.

Analysis of the Trends and Distribution of Research Documents

Table 6 presents the yearly publications on cloud computing in accounting research from the year 2008 to 2021. It shows an increasing trend in the number of publications starting from 2008 (n = 1) to 2021 (n = 39) recorded in the Scopus database. There was a significant increase in the number of published documents in 2013 (n = 18) compared to 2012 (n = 9). Based on the pattern and growth of publications, it seems that cloud computing in accounting research will continue to be a prominent research area for academics to explore.

Table 6: Number of publications by year

Year	Number of documents	Percentage (%)
2008	1	0.35
2009	0	0.00
2010	4	1.41
2011	5	1.76
2012	9	3.17
2013	18	6.34
2014	27	9.51
2015	25	8.80
2016	23	8.10
2017	32	11.27
2018	29	10.21

2019	29	10.21
2020	43	15.14
2021	39	13.73
Total	**284**	**100**

Table 7 shows the top 10 publication sources of research documents on cloud computing in accounting research. The Journal of Information Systems was proven to be the leading journal of published research related to cloud computing in accounting research which represented 3.52% (n = 10). A series called Lecture Notes in Business Information Processing was the second-highest publication with 3.17% (n = 9). This was followed by the International Journal of Scientific and Technology Research 2.46% (n = 7). The number of published documents in the journals showed an increasing trend from the year 2019 to 2020 (4.93%) probably due to the use of cloud technologies during the COVID-19 pandemic (Samyan & Flour, 2021).

Table 7: Top 10 sources of research documents

Source Title	Number of documents	Percentage (%)
Journal of Information Systems	10	3.52
Lecture Notes in Business Information Processing	9	3.17
International Journal of Scientific and Technology Research	7	2.46
Information and Management	6	2.11
International Journal of Business Information Systems	6	2.11
Journal of Corporate Accounting and Finance	6	2.11
International Journal of Accounting Information Systems	5	1.76
Journal of Enterprise Information Management	5	1.76
Journal of Management Information Systems	5	1.76
Wit Transactions on Information and Communication Technologies	5	1.76

Table 8 shows that journal articles were the most prevalent document types, representing 63.03% (n = 179) of the total, followed by conference papers at 17.61% (n = 50), and book chapters at 11.27% (n = 32). The other document types such as reviews, books, conference reviews, notes, and editorials, each constituted less than 4% of the total publications respectively.

Table 8: Document types

Document Type	Number of documents	Percentage (%)
Article	179	63.03
Conference paper	50	17.61
Book chapter	32	11.27
Review	9	3.17
Book	7	2.46
Conference Review	4	1.41
Note	2	0.70
Editorial	1	0.35
Total	**284**	**100.00**

The number of documents was classified based on their subject area, as presented in Table 9. The data indicated that research on cloud computing in accounting research has evolved in a diverse subject area. It was found that most of the studies involving cloud computing in accounting research were in business, management, and accounting are 39.55% (n = 284) of the total documents, followed by publications in computer science at 17.69% (n=127) and decision sciences 16.30% (n=117). Other subject areas accounted for less than 8% (n < 60) of publications.

Table 9: Classification of the subject area

Subject area	Number of documents	Percentage (%)
Business, Management and Accounting	284	39.55
Computer Science	127	17.69
Decision Sciences	117	16.30
Economics, Econometrics, and Finance	56	7.80
Engineering	53	7.38
Social Sciences	36	5.01
Others	45	6.27
Total	**718**	**100.00**

Table 10 indicates the frequently used keywords on cloud computing in accounting research. The result showed that the "cloud computing" keyword appeared 156 times (39.8%) in the 284 documents being analysed, followed by Software-as-a-service (Saas) 28 times (7.14%). Other common keywords have been found to appear less than 20 times (below 5%). Thus, it is important to emphasize that keywords generated in Figure 10 are the trending words used in cloud computing research.

Table 10: Frequently used keywords

Keywords	Number of frequencies	Percentage (%)
Cloud Computing	156	39.80
Software-as-a-service (Saas)	28	7.14
SMEs	16	4.08
Information technology	15	3.83
Technology Adoption	12	3.06
Structural equation modelling	12	3.06
Cloud services	15	3.83
Cloud computing adoption	12	3.06

CONCLUSION

The objectives of this study are to identify the major contributors and understand the trends and distribution of research documents of cloud computing in accounting research using bibliometric analysis. According to Akhavan et al. (2016), the study on bibliometric analysis explains factors that support the contribution of studies in a research area and guide researchers toward producing impactful outcomes. The study findings provide new insights into cloud computing in the accounting research area on the ten bibliometric indicators. Despite the fact that the United States is the major contributor of published documents, the most productive institutions and authors are from India. Furthermore, it has been observed that the most cited publications are neither from the most active authors nor institutions. This result indicates that a research publication can be important in a field regardless of the author's origin or university or country (Djeki et al., 2022). Moreover, English is a dominant language and thus, they are accessible to a larger audience. Journal articles are the main publication type that has been published representing more than 60% of the total publications and "cloud computing" is the most common keyword used in the publication titles by most authors.

Yet, this study merely focused on the Scopus database as the main source of the documents. It did not cover all available sources even though Scopus is among the most extensive databases that index all scholarly works (Ahmi & Mohamad, 2019). Moreover, the analysis only covered the subject area of business, management, and accounting. Other related areas such as computer science, decision sciences, economics and econometrics, and finance were excluded from the study. This study enhances and complements previous findings on cloud computing in accounting literature by using a bibliometric approach and providing meaningful insights on the trends of previous literature for future researchers.

It is also suggested that research on cloud computing in accounting should be conducted in other developing countries, including Malaysia, as the impacts on technologies are global. There are some studies on the adoption of cloud computing in small and medium enterprises (SMEs) conducted by Malaysian researchers (Asiaei & Rahim, 2019). Different types of cloud services could facilitate the management of strategic business resources and help to improve performance. Goh et al. (2019) found that the level of awareness regarding cloud computing among Malaysian construction professionals is low, as it is a new concept and is still at an early stage of development. Hence, education or training courses on cloud computing should be organized by all relevant agencies. Future studies should include other available databases such as Web of Science, Google Scholar, and Dimensions and expand to other topics that will contribute to more comprehensive and valuable results.

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AUTHORS' CONTRIBUTION

All authors contributed to the study's conception and design. Material preparation, data collection, analysis, and the first draft of the manuscript were performed and written by Nor Kartini Mohd Rodzi, Norshimah Abdul Rahman, Azura Mohd Noor, and Marjan Mohd Noor. All authors read and approved the final manuscript.

CONFLICT OF INTEREST DECLARATION

We certify that the article is the Authors' and Co-Authors' original work. The article has not received prior publication and is not under consideration for publication elsewhere. This research/manuscript has not been submitted for publication nor has it been published in whole or in part elsewhere. We testify to the fact that all Authors have contributed significantly to the work, validity, and legitimacy of the data and its interpretation for submission to Jurnal Intelek.

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