

# A GLOBAL REVIEW OF CLOUD COMPUTING ADOPTION IN SMALL AND MEDIUM ENTERPRISE

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## ABSTRACT

Cloud computing is an emerging computing architecture that has gained favor among government agencies and businesses that need large-scale, low-cost computing. It allows services to be delivered in a scalable manner using machines in massive data centers. Cloud computing technology is becoming more and more significant as small and medium enterprises (SMEs) go through a digital transformation. In addition to enhancing accessibility, scalability, efficiency, and data security, it might help SMEs save money. Though several studies have been conducted on the subject, there is still a paucity of bibliometric research on the use of cloud computing in the SMEs sector. Bibliometric analyses provide a crucial role in understanding the evolution of academic research in particular fields. Consequently, a detailed examination of the trend and acceptance of cloud computing in the public sector is needed. To achieve this, bibliometric performance analysis and scientific mapping methodologies were used to analyze most publications and citations on cloud computing adoption in SMEs in this study. Finding the most productive authors, organizations, countries, and publishing sources was part of this. In addition, a clustering analysis was carried out to identify the primary research theme about SMEs' use of cloud computing during a ten-year period. With the use of the statistical programs Vosviewer and Biblioshiny, the dataset is shown and conclusions are reached while accounting for 246 articles that were extracted from the Scopus database and produced data between 2010 and 2024. The results of this study have added significantly to the body of literature and current knowledge by deepening our understanding of how cloud computing is used in SMEs.

**Keywords:** *Cloud Computing, SME, Adoption, Bibliometric Analysis, Review*

## 1. INTRODUCTION

The Cloud computing technology has emerged as a key force behind company change in this globalization-era, particularly for Small and Medium Enterprises (SMEs). One of the most important technological advancements that has altered the business environment is cloud computing. It is impossible to separate this development from the necessity for small and medium-sized businesses to boost their operational effectiveness through more convenient and adaptable access to computer resources (Yeboah-Boateng & Essandoh, 2014). SMEs can efficiently and on-demand access, store, and manage data thanks to cloud computing, all without having to worry about costly infrastructure investments. These technology advancements give small and

medium-sized enterprises the chance to successfully compete in a market that is becoming more and more competitive (Widyastuti & Irwansyah, 2018). Cloud computing adoption by SMEs fosters the development of a digital ecosystem that facilitates quick access to computing resources and synchronizes business requirements with technical advancements.

Cloud computing technology has been permeating SMEs' company structures more and more in recent years, which has greatly boosted the sector's growth and competitiveness. Cloud computing adoption by SMEs is a business strategy that can offer numerous substantial benefits, not only a technology necessity. The advantages of cloud computing adoption for SMEs are numerous and varied. Cost efficiency is one of them, where businesses can avoid having to make large upfront

investments in IT infrastructure (Gupta et al., 2013). Furthermore, cloud computing improves operational flexibility by facilitating remote access to data and applications. Another key concern is data security, with cloud providers providing cutting-edge security services to shield corporate data from possible security risks. SMEs can enhance their business operations' productivity, cooperation, and innovation speed by implementing this technology (Padhy et al., 2011).

Although cloud computing has many potential advantages, there are a number of obstacles that SMEs must overcome before implementing cloud computing technology (Vidhyalakshmi & Kumar, 2016). One of the most frequent issues is a lack of knowledge about privacy and data security in cloud environments. Due to their often lack of IT resources and knowledge, SMEs are more susceptible to security issues while handling data in a cloud environment (Khan & Al-Yasiri, 2016). In addition, issues with cross-platform compatibility and system integration are obstacles that must be resolved for the deployment of cloud computing to proceed as smoothly as possible. This is also due to the fact that certain SMEs face challenges with internal resources and technical proficiency in maintaining and integrating cloud technologies. When adopting cloud computing among SMEs, interoperability problems and worries about reliance on service providers are additional elements that must be taken into account (Trigueros-Preciado et al., 2013).

Even though a lot of study has been done on the adoption of cloud computing, not much is known, particularly when it comes to SMEs. Prior research has frequently concentrated on large-scale businesses (Arvanitis et al., 2017; Low et al., 2011; Oredo et al., 2019) They neglect to investigate the particular situation of SMEs utilizing this technology. Furthermore, prior bibliometric research on SMEs as a domain has been done. Nonetheless, their focus tends to be more general, covering a range of ICT-related topics without going into great detail about the specific topic of cloud computing in SMEs. As an illustration, the study of (Sawangwong & Chaopaisarn, 2023) have looked into how Industry 4.0's technology pillars will affect small and medium-sized businesses' (SMEs) in Thailand's supply chain performance. The goal of this research is to improve knowledge and comprehension of industry 4.0 application to enhance the effectiveness of supply chains and organizations based on five industry 4.0 technological pillars: cloud computing, big data and

analytics, additive manufacturing, cyber-security, and the Internet of Things (IoTs). As a result, the study doesn't really address cloud computing in SMEs. Likewise, the research conducted by (Hu et al., 2024) explores the nuances of digital transformation in the context of small and medium-sized enterprises (SMEs) and how the term has come to mean the strategic blending of big data, social media, cloud computing, and mobile internet. It highlights the convergence of business strategy and technical improvement in SMEs and underlines the significance of this transition for improving core competencies and sustainable development. Specifically, the importance of this study arises from its focused bibliometric analysis on cloud computing adoption among small and medium-sized enterprises (SMEs), which, despite numerous general studies in the field, remains underexplored in this specific context. Our research contributes uniquely by utilizing comprehensive bibliometric methodologies to map out the landscape of existing research, identify gaps, and highlight emerging trends that have not been thoroughly addressed by previous studies. This approach not only deepens the understanding of cloud computing's impacts on SMEs but also provides a structured insight into the evolution of this topic, thereby serving both academic researchers and practitioners seeking to leverage cloud technology for enhanced business performance. Therefore, further research is required to further our comprehension of this phenomenon pertaining to the adoption of cloud computing in SMEs in particular. In order to provide a more thorough understanding of changes, trends, and gaps in this research, the goal of this bibliometric study is to gather and evaluate the existing literature about cloud computing adoption among SMEs.

Our study varies from previous research in this regard in several ways: 1) They don't primarily focus on how SMEs can leverage cloud computing. While most research studies concentrate on the adoption of industry 4.0 and digital transformation, which encompasses various ICT technologies, our study used a more comprehensive analysis that included performance analysis of the most productive authors, institutional countries, and sources, as well as cluster analysis and science mapping of the most relevant keywords. Data for bibliometric analysis was obtained from the Scopus database. Thus, the aim of this research is to explore the trends and developments that could enhance our comprehension of cloud computing adoption in small and medium-sized enterprises. Even though a lot of research has been done on the subject, bibliometric studies on the adoption of cloud

computing in SMEs are still uncommon. Through a detailed analysis of the body of scientific literature, this study not only provides a comprehensive picture of current trends and achievements but also points out the limitations of previous research. Therefore, it is anticipated that the study's findings will be able to provide public sector policy makers and practitioners with deeper and more pertinent understandings; they will also serve as an invaluable resource for academics who wish to learn more about the complex dynamics of cloud technology adoption in the SMEs domain. The following are the research questions (RQ) that this initiative aims to address:

RQ1: Based on the volume of publications, what is the trend in cloud computing research in SMEs?

RQ2: Which authors and organizations are the most productive in terms of publications?

RQ3: According to the volume of publications and the type of cross-collaboration, which productive countries?

Which references and search terms are most relevant to the study of cloud computing in SMEs?

RQ5: Which cloud computing research articles in SMEs have gotten a lot of citations?

RQ6: What are the main research topics concerning SMEs' adoption of cloud computing?

This study is divided into six components. Section 1 covers the backdrop of the research, Section 2 explains the literature evaluation, and Section 3 covers the research methods. Section 4 then goes into further detail regarding the findings and discussions of this investigation. The study's conclusions and recommendations for future research are covered in the concluding section.

## 2. LITERATURE REVIEW

Under a new computer paradigm called "cloud computing," devices kept in large data centers can be dynamically provisioned, configured, and reconfigured to offer scalable services for a range of uses, such as scientific research, email, and video sharing (Paquette et al., 2010). Even though it's commonly referred to as a single thing, cloud computing actually consists of several things at once, such as cloud platform, cloud application, and cloud infrastructure. Cloud infrastructure is the provision of computer resources and storage as a service, such as Elastic Compute Cloud (EC2) and S3 services from Amazon (Youseff et al., 2008). Customers can configure the infrastructure

themselves and easily expand it in response to network demands with this infrastructure. A cloud platform is a computer platform or software stack that is provided as a service, such as Google's App Engine or Salesforce.com. Cloud applications, or cloud apps, are web services hosted on a cloud platform or infrastructure and made accessible to users or customers of the company. Commonly utilized applications by the general public include the office suite of Google Docs from Google and the video hosting apps from YouTube.

## 3. METHODS

The bibliometric approach was used to collect the data for this investigation. According to (Kumar, 2016), the bibliometric technique is a helpful strategy for tracking and summarizing the statistical knowledge of a specific term or idea published in a given subject. A researcher can record and analyze a source of metadata and knowledge spread using bibliometric analysis. Faithorne created the term "bibliometrics" in December 1969 to characterize the statistics of articles produced in a certain area, including but not limited to: concepts, studies, trends, methodology, keywords, and reference sources (Broadus, 1987). Because bibliometric analysis provides science mapping on the pertinent publication database, it is widely used in literature reviews to help academics gain a deeper understanding of the topic. By doing a bibliometric review, the researcher can more successfully integrate their findings into the body of existing knowledge (Abdul Rahman et al., 2022).

### 3.1 Data Source

Using Scopus, a bibliographic analysis of publications released as of October 8, 2023, in the building industry and risk management fields was carried out. Scopus was employed for this study since it is the largest collection of citations and abstracts from scholarly publications in the fields of business, management, and accounting (Fahimnia et al., 2015). About 20,000 scholarly journals are included in Scopus, along with 24,000 extra titles, 360 new magazines, 750 book series, 195,000 additional volumes, and 60 million records. A database of big might offer a comprehensive summary of all research conducted worldwide. The scientific community as a whole agrees that Scopus is a very useful resource for finding important information. Additionally, the emphasis on the Scopus database was made by (Chicksand et al., 2012) as an excellent source for compiling

publications that have undergone peer review.

### 3.2 Search Strategy

To describe the distribution patterns of research publications within particular topics and time periods, this study combined bibliometric analysis with quantitative and statistical analysis (Napitupulu & Yakub, 2021). Using keywords, we begin the data collecting process by looking for relevant literature on our research topic. A keyword is a specific kind of search string that is used to find datasets related to the topic of public sector adoption of cloud computing. It consists of a well-developed term or phrase. Thus, a query in the Scopus database was executed using the following combination of keywords: (1) cloud computing; (2) small medium enterprise. The following complete keywords were looked up using the article's title, keyword, and abstract as a guide:

(TITLE-ABS-KEY (“cloud computing”) AND TITLE-ABS-KEY (“small medium enterprise\*” OR SME\*))

Total 798 documents were found during the search procedure, making up the initial dataset. By limiting our search to the English language (IC1), article (IC2), and journal (IC3) as our inclusion criteria, we were able to narrow the scope of our investigation for this study to get relevant and quality papers. This is due to the fact that journal articles—as opposed to other type like conference papers, book, book chapters, etc.—go through a more thorough process of scientific peer review. They were our first choice above other types (Tas & Bolat, 2022). In addition, we did not limit the specific period of searching. After conducting the screening process including duplication removed, we obtain only 264 documents as seen in Figure 1.

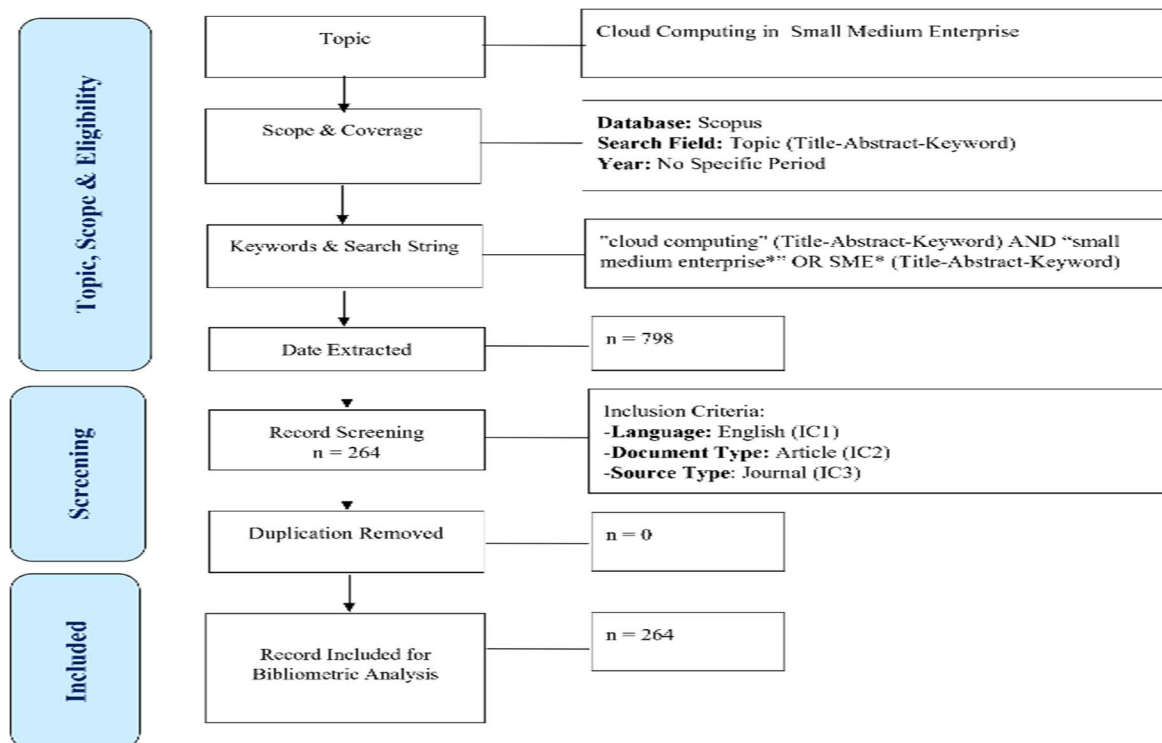


Figure 1. Flow diagram of the search strategy (Zakaria et al., 2021)

### 3.3 Data Analysis

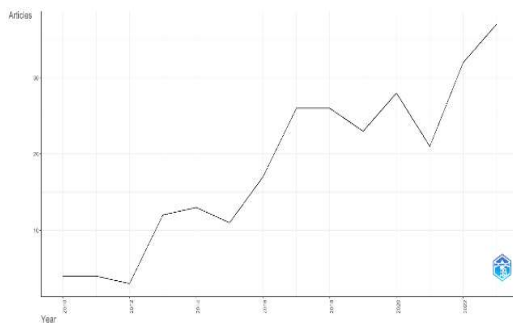
According to, there are two main methods for thorough bibliometric analysis (Donthu et al., 2021): The first two are performance analysis and science mapping. Science mapping focuses on the connections between research parts, whereas

performance analysis focusses on the contributions of research components in a specific subject. According to this viewpoint, research consists of authors, institutions, publications, countries, and affiliations. Citations represent impact and influence, whereas publications act as a proxy for output. The scientific mapping encompasses the

intellectual exchanges and structural links among research aspects. Citation analysis, co-citation analysis, bibliographic coupling, co-word analysis, and co-authorship analysis methodologies are all used in science mapping. When combined with network analysis, these techniques are helpful in illuminating the bibliometric and intellectual structure of a research topic. In this examination, we forecasted future research in the field using co-occurrence analysis and, using theme clusters, determined the primary study topic. Another helpful tool for demonstrating how a field has evolved over time is co-occurrence analysis. It's a helpful tool for locating hotspots across several sectors (Tas & Bolat, 2022). The bibliometric analysis in this study made use of Vosviewer and Biblioshiny. Vosviewer is a complex tool for organizing and displaying bibliometric networks that was developed at Leiden University in the Netherlands. It also provides text mining tools that facilitate the construction and visualization of crucial label co-occurrence networks extracted from a vast array of scientific publications (van Eck & Waltman, 2010). Since Biblioshiny allows users to conduct pertinent bibliometric and visual analyses on research constituent performance, it was used.

#### 4. RESULTS & DISCUSSION

**RQ1: Based on the volume of publications, what is the trend in cloud computing research in SMEs?**



**Figure 2.** Publishing trend in the area of cloud computing in SMEs research

Figure 2 displays the years that the relevant publications and citations were obtained. It also displays the trend of the quantity of articles generated over time. We can follow the development of research on the usage of cloud computing in the public sector based on the amount

of papers. We may also assess the impact of the research by looking at the number of citations the study produced. The general research trend for this issue has clearly increased during the last ten years (2010–2024). This demonstrates the great interest that scholars have in learning more about how cloud computing technology is used in the small medium enterprise or how the private sector may best utilize it to increase their business performance.

The publishing trend can be separated into three periods: 2010–2012, when there was only a slight increase in publications, with fewer than 5 documents published; 2013–2016, when there was a notable increase in publications, with as many as 17 documents published in 2016; and 2017–2023, when there was exponential growth, with a significant number of publications, such as 28 in 2020 and 37 in 2023, respectively. The Covid-19 pandemic has accelerated the topic's development. It explains how cloud computing technology can support small and medium-sized enterprises (SMEs) in sustaining business continuity by offering flexibility, cost savings, scalability, improved data security, and crucial tools for collaboration and communication. Cloud computing technology has not only enabled SMEs to survive during the COVID-19 pandemic, but also provided a strong foundation for their growth and adaptation amidst ongoing changes in the dynamic business environment.

2010 saw the release of the first article in this topic, titled "Cloud computing for education: A new dawn." This study argued that because of its flexibility and pay-as-you-go cost structure, cloud computing is likely to be one of those opportunities that financially strapped educational institutions seek out in hard times. It could also prove to be immensely beneficial (and empowering in some situations) for them. A brand-new paradigm for delivering computer services is cloud computing. Numerous current technologies, including as virtualization, grid computing, Web services, and the Internet, are necessary for this computing method to function. This service gains a fresh uniqueness due to its pay-as-you-go delivery model, which is primarily made possible by the widely used Internet (Sultan, 2010).

**RQ2: Which authors and organizations are the most productive in terms of publications?**

You may identify the most well-known authors and organizations on the subject of cloud computing adoption in SMEs by looking at the

number of documents that each author and institution generates. By using this strategy, the researchers will be appropriately guided in an effective manner. Using Biblioshiny as a tool, the researchers created an extensive list of the top ten authors and countries in this field. The aforementioned work was finished using collaborative authorship analysis and bibliographic data files. Figure 2 displays the investigation's findings. The results indicated that a select group of authors and institutions had created important works that attested to their significant contributions to the field. This revelation opens up a brand-new area of research.

Studies of cloud computing in SMEs are being worked on by 747 authors. Together, these authors have produced 264 research studies in the last ten years. In Figure 2, the authors who have authored numerous papers on this topic are identified in detail. It is evident from the publication of multiple publications that several authors have contributed significantly to this field. As can be observed, the majority of the top 10 authors—Baharudin AS, Gupta S, Hassan H, Li M, Lutfi A, Misra SC, Raut RD, and Wang W—published three

papers. I have submitted two documents, while Abdullah A and Adon have each supplied one.

Out of the affiliations of 312 authors, Table 1 also enumerates the top 10 universities that have contributed the most to the subject of cloud computing in SMEs. Those organizations have released at least six documents. With 13 publications, Beijing University of Posts and Telecommunications has established itself as one of the top institutions studying cloud computing in SMEs. The second well-known organization to issue 12 documents was the National Institute of Industrial Engineering (NITIE). In third and fourth position, respectively, are International Hellenic University with 10 documents and University of Kragujevac with 11 articles. Universiti Putra Malaysia (9) is the remaining one, followed by King Faisal University (7) and Universiti Sains Malaysia (USM) (7), Amrita School of Engineering Coimbatore, Bina Nusantara University and Brunel University London masing-masing have 6 documents published.

Table 1. The most relevant authors based on publications

No	Author	Document	No	Author	Document
1	Baharudin, AS	3	6	Misra, SC	3
2	Gupta, S	3	7	Raut, RD	3
3	Hassan, H	3	8	Wang, W	3
4	Li, M	3	9	Abdullah, A	2
5	Lutfi, A	3	10	Adon, I	2
No	Organization	Document	No	Organization	Document
1	Beijing University of Posts and Telecommunications	13	6	King Faisal University	7
2	National Institute of Industrial Engineering (NITIE)	12	7	Universiti Sains Malaysia (USM)	7
3	University of Kragujevac	11	8	Amrita School of Engineering Coimbatore	6
4	International Hellenic University	10	9	Bina Nusantara University	6
5	Universiti Putra Malaysia	9	10	Brunel University London	6

**RQ3: According to the volume of publications and the type of cross-collaboration, which productive countries?**

According to our research, there is interest in learning more about cloud computing in SMEs in 46 different countries. The top ten countries that we identified have contributed most to this field of study are shown in Table 2. When compared to other countries, China produced the most documents—29 published, or 13.40% of all

documents—making it the most notable. With 28 revealed documents, India ranked second, followed by Malaysia in third place with 20 documents; the United Kingdom (18), Jordan (8), Germany (7), Saudi Arabia (7), Australia (5), Romania (5), and Serbia (5) were ranked lower. China is therefore at the forefront in SMEs cloud computing research. Scholars and practitioners looking into the adoption of cloud computing in SMEs might use these findings as a guide.

Additionally, some of the top ten countries

have a high number of articles published in multiple country publications (MCPs), which are journals produced in collaboration with other countries. The top four countries are China (10), Malaysia (9), the United Kingdom (4), and Jordan (4) with the most foreign papers published in collaborations exceeding three documents. This suggests that academics from these countries commonly collaborate to carry out research on subjects connected to cloud computing in small and medium-sized enterprises. Conversely, less than three papers of collaboration are shared by Saudi Arabia (1), Australia (1), Germany (2), India (2),

and Romania (2). Surprisingly, Serbia doesn't collaborate with anyone on research. Furthermore, when it comes to publications published alone or without collaboration beyond ten, there are four countries that have the most number of single country publications (SCPs). They are Malaysia (11), United Kingdom (14) Malaysia (26), China (19), and India (19). This suggests that much of the research coming from these countries might be conducted domestically. Thus, it can be concluded that when it comes to global collaboration and productivity in the area of cloud computing for SMEs, China is at the top.

Table 2. The Most Relevant Countries Based On Documents And Collaboration

No	Country	Document	%	SCP	MCP
1	China	29	13,40	19	10
2	India	28	8,98	26	2
3	Malaysia	20	7,07	11	9
4	United Kingdom	18	5,74	14	4
5	Jordan	8	4,12	4	4
6	Germany	7	3,97	5	2
7	Saudi Arabia	7	3,24	6	1
8	Australia	5	2,06	4	1
9	Romania	5	1,91	3	2
10	Serbia	5	1,91	5	0

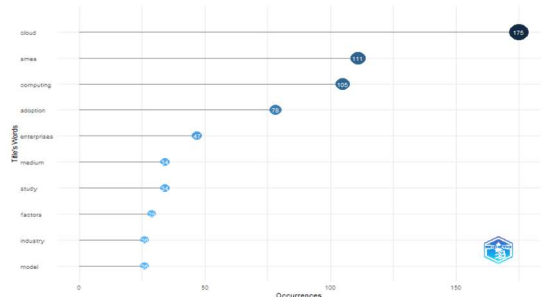
#### RQ4: Which sources and keywords are most pertinent to the field of cloud computing in SMEs research?

This study aims to enhance the resources accessible to academics and professionals by identifying terms and sources that are highly relevant to the research topic of cloud computing in SMEs. This suggests that the study's objective is to provide a carefully curated collection of terms and references that will enable further research in the field. Examining frequently occurring keywords can reveal a lot to researchers and practitioners about important issues and current trends in the subject. Keywords often represent the main subject and themes of research studies. Figure 2 shows a graphic representation of the keywords detected in this study together with their frequency of recurrence. The terms that are used the most frequently in the study literature are highlighted.

According to how frequently they appear in this survey based on Figure 3, the terms cloud (175), SMEs (111), computing (105), and adoption (78) are the most relevant ones. These keywords are often researched and most likely represent important concerns regarding the ways in which the adoption of cloud computing technology has benefited SMEs. This is because cloud computing

is a relatively new technology that offers many benefits, especially for small and medium-sized enterprises (SMEs) trying to stay in business. Moreover, terms like factors (29), model (26), performance (13) and problems (9) were significantly more common. Studies on cloud computing in small and medium-sized enterprises address several consequences. First, scientists look at the variables affecting small and medium-sized enterprises' adoption and use of cloud computing. Cost-effectiveness, scalability, security, usability, and regulatory compliance are a few examples of these variables. It is vital to comprehend these elements in order to ascertain the driving forces and obstacles behind SMEs' adoption of cloud computing technology. Second, creating or evaluating various models of cloud computing adoption and deployment that are especially suited for SMEs is a common task for researchers. To find the best strategies for SMEs, this can involve investigating several deployment types (public, private, hybrid), service models (IaaS, PaaS, SaaS), and management models (self-managed, managed services). Thirdly, research on performance looks at how effective, dependable, and efficient cloud services are for small and medium-sized businesses. This entails evaluating elements like response time, throughput, resource usage, and service availability to make sure cloud solutions live up to SMEs'

performance expectations. Lastly, research explores how to recognize and overcome the difficulties and obstacles SMEs encounter when embracing and implementing cloud computing technology. Concerns about data security and privacy, compatibility with current IT infrastructure, legal compliance, vendor lock-in, and a skills gap are a few examples of these difficulties. Comprehending



these obstacles is crucial for formulating plans and remedies to surmount them and enable SMEs to successfully embrace cloud computing.

Figure 3. The Most Relevant Keywords Based On Occurrence

Examining the most cited sources on a topic is important for numerous reasons, one of which is that you can find trustworthy sources there. By examining the most frequently cited sources, researchers can identify trustworthy and authoritative sources on a given topic. This facilitates academics' search for

reliable references for their papers or arguments. Obtaining up-to-date information is an additional benefit. Sources that are often consulted may reveal fresh advancements or industry trends. By employing this study, researchers can have a better understanding of the most current developments and breakthroughs in this field.

An analysis of the sites used to publish the majority of documents on cloud computing adoption in SMEs research reveals the top ten publication sources that have helped to publish papers in this specific field of study. Based on Table 3, The International Journal of Business Information Systems is the most well-known publication source with 10 documents (3,78%), followed by the Journal of Theoretical and Applied Information Technology and the International Journal of Information Management, both with 6 publications. The analysis also identified a few other research journals as some of the more commonly used sources in this field: the Indonesian Journal of Electrical Engineering and Computer Science (3), Sustainability (5), Applied Sciences (4), IEEE Access (4), Advanced Science Letters (3), Information and Computer Security (3), and Journal of Advanced Research in Dynamical and Control Systems (3). Further research on the number of outlets for research publication indicates that 24 research articles were published using a total of 198 different sites. Table 3 illustrates the wide variety of publication sources that are available.

Table 3. The Most Relevant Sources Of Publication

Sources of Publication	Document	%
International Journal of Business Information Systems	10	3,78
International Journal of Information Management	6	2,27
Journal of Theoretical and Applied Information Technology	6	2,27
Sustainability	5	1,89
Applied Sciences	4	1,51
IEEE Access	4	1,51
Advanced Science Letters	3	1,14
Indonesian Journal of Electrical Engineering and Computer Science	3	1,14
Information and Computer Security	3	1,14
Journal of Advanced Research in Dynamical and Control Systems	3	1,14

**RQ5: Which cloud computing research articles in SMEs have gotten a lot of citations?**



Table 4. The Most Cited Documents

Document	DOI	Total Citations	TC per Year
Moeuf A, 2018, Int J Prod Res	10.1080/00207543.2017.1372647	705	100,71
Sultan N, 2010, Int J Inf Manage	10.1016/j.ijinfomgt.2009.09.004	647	43,13
Alshamaila Y, 2013, J Enterp Inf Manage	10.1108/17410391311325225	556	46,33
Gupta P, 2013, Int J Inf Manage	10.1016/j.ijinfomgt.2013.07.001	479	39,92
Sultan Na, 2011, Int J Inf Manage	10.1016/j.ijinfomgt.2010.08.001	266	19,00
Ren L, 2015, Enterp Inf Syst	10.1080/17517575.2013.839055	244	24,40
Huang B, 2013, Int J Adv Manuf Technol	10.1007/s00170-012-4255-4	181	15,08
Brender N, 2013, Int J Inf Manage	10.1016/j.ijinfomgt.2013.05.004	158	13,17
Khayer A, 2020, Technol Soc	10.1016/j.techsoc.2019.101225	144	28,80
Taibi D, 2018, IEEE Software	10.1109/MS.2018.2141031	141	20,14

It is highly beneficial to know which publications are most commonly cited in a particular field. These books, which are widely acknowledged for their impact, mark important shifts in the field of scholarship. Analyzing these books that receive a lot of citations offers insights into the important contributions that have shaped the conversation in a certain topic. It's a sign of recognition from the academic community to come across these often referred works, and it also keeps you informed about the latest developments. These publications typically include the most recent advancements and styles, allowing academics and enthusiasts to stay up to date on the rapidly evolving subject of interest.

Table 4 lists the five most often cited papers on cloud computing in SMEs research. Having received 705 total citations (TC) and 100,71 TC annually, the paper by (Moeuf et al., 2018), This is the most important work in this topic and was published by Taylor and Francis. This study reviews the body of applied research that has been done on several Industry 4.0 concerns pertaining to small and medium-sized enterprises. Documents are categorized using a novel framework that makes it possible to determine the desired performance goals, the managerial skills needed, and the set of technologies chosen for each scenario. The findings demonstrate that SMEs frequently stick to integrating Cloud Computing and the Internet of Things rather than utilizing all the tools available to them for Industry 4.0 implementation.

The second most cited document is the paper work of (Sultan, 2010) has 647 TC and 46.13 TC annually. This Elsevier publication is titled "Cloud computing for education: A new dawn?" According to this study, businesses of all sizes are already

benefiting from the advantages that this technology offers in terms of cost, efficiency, and environmental impact. A new paradigm in computing called cloud computing promises to make it possible to supply a range of computer services in a way that has never been done before. The piece penned by (Alshamaila et al., 2013) rise to third position in terms of citations, with 556 TC and 46.33 annually. Emerald published the study "Cloud computing adoption by SMEs in the north east of England: A multi-perspective framework." This paper aims to add to the expanding body of research on cloud computing by examining the adoption process of cloud computing in small and medium-sized enterprises (SMEs). They claimed that SMEs might be able to provide goods and services that were previously exclusive to major corporations, leveling the playing field, provided they have access to scalable technologies.

Knowing which papers are most frequently cited is crucial because it can serve as a guide for navigating the intricacies of scholarly discourse, enhance one's understanding of the past and present, and empower one to meaningfully contribute to the ongoing intellectual narrative in one's area of interest.

#### **RQ6: What are the main research topics concerning SMEs' adoption of cloud computing?**

Si et al. (2019) define keywords as terms that encapsulate the methodology, main idea, and substance of scientific articles. Author keyword analysis led to the development of the co-occurrence analysis approach. Three occurrences or more was set as the criteria. Thus, out of the original pool of 860 keywords, a total of 67 keywords with at least three occurrences of each term were successfully acquired. Cleaning the data is required

because some terms have identical meanings but are formulated differently. Examples of terms that must be combined before moving on to the analysis step are AHP and analytical hierarchy process, digitalization and digitalization, IOT and internet of things, and ICT and information technology. One Vosviewer feature that allowed you to mix the

previously defined terms is the thesaurus file. Ultimately, a total of 54 keywords have been selected for additional analysis. More often occurring keywords could be taken to mean that people are interested in the study's subject.

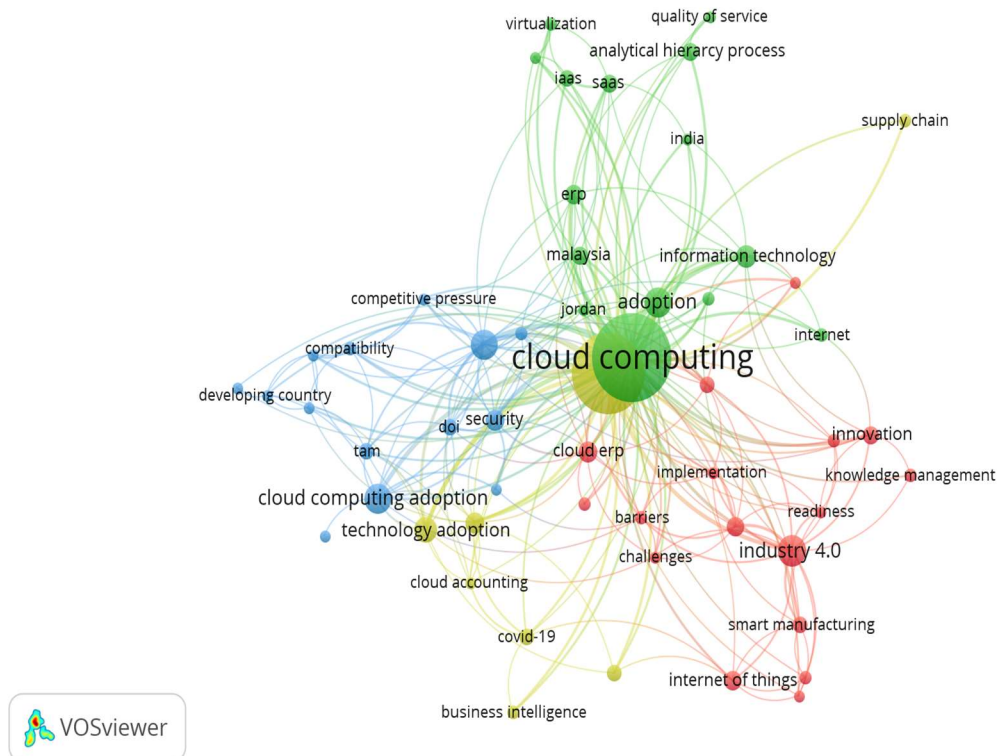


Figure 4. Network Visualization Based On Author Keywords

Figure 3 displays a network visualization, or a graphic representation of co-occurrence based on author keywords used in the analysis. The main area of investigation for cloud computing in SMEs research is shown by the co-occurrence network in Vosviewer. From mapping data analysis, it can be inferred that this field is linked to four primary clusters. The following paragraphs provide a detailed description of these clusters that were discovered through the analysis of keyword co-occurrence:

- There are 17 total keywords in Cluster 1 (red). We have given the theme "Innovation of Cloud Computing in SMEs" to this cluster. Industry4.0, cloud ERP, digitization, and innovation are the cluster's major terms. This theme looks into how cloud computing technologies can improve operations, competitiveness, and sustainability for

small and medium-sized businesses. (Saratchandra & Shrestha, 2022). This study may examine methods for integrating and putting into practice cloud ERP systems to optimize business processes; it may also examine how digitization affects organizational structures and workflows; and it may look for ways to leverage emerging technologies to foster innovation and create value. The main objective is to give SMEs the knowledge and direction they need to successfully traverse the digital transformation landscape and take advantage of the opportunities given by Industry 4.0, particularly in the area of cloud computing (Ghobakhloo & Iranmanesh, 2021).

- Cluster 2 (the green one) shows 15 keywords. The theme "SaaS and IaaS Perspective" is attached to it. In this cluster, cloud computing, adoption, SaaS, and IaaS are the essential terms. The study of cloud computing adoption in the context of small and

medium-sized enterprises (SMEs), with a focus on Software as a Service (SaaS) and Infrastructure as a Service (IaaS), entails examining the tactics, obstacles, and advantages related to SMEs shifting their operations to cloud-based solutions (Oduor, 2016). Furthermore, it looks into how SME performance, productivity, and competitiveness are affected by the adoption of SaaS and IaaS across a range of industries.

• Cluster 3 (blue) has fourteen keywords in it. This cluster has been characterized as "determinant of cloud computing adoption." Toe framework, technological acceptance model, security, and privacy are the cluster's primary keywords. This theme usually focuses on examining how these ideas interact to affect SMEs' adoption and use of technology (Skafi et al., 2020). Additionally, this theme uses behavioral science and theories like to investigate the factor or factors that drive SMEs' adoption of cloud computing. Technology Acceptance Modeling (TAM) facilitates the understanding of individual attitudes and perceptions of technology, while the Technology-Organization-Environment (TOE) framework offers an organized method for comprehending the elements impacting technology adoption within businesses (Ahmed, 2020). Concerns about security and privacy have a significant impact on how well individuals and organizations accept technology. As a result, studies in this field may examine how SMEs deal with these issues when adopting and integrating technology, all the while addressing security and privacy issues. The results of this study can be used to improve technology adoption plans and guarantee that SMEs use technology in a safe and responsible manner.

• Cluster 4 (yellow) is categorized with the theme "Covid-19 challenges" and has a total of 8 keywords. Covid-19, digital transformation, business intelligence, and supply chain are the cluster's primary keywords. This theme draws attention to research on how SMEs have had to quickly adjust to the changing economic environment, highlighting the need for a more thorough investigation into the integration of digital technologies to support operations and promote resilience (Khurana et al., 2022). Digital transformation is a crucial path that includes activities like improving an organization's online presence and implementing remote work tools and e-commerce platforms. Furthermore, the epidemic has highlighted how crucial it is to use analytics and business intelligence tools to draw actionable conclusions from data, assisting SMEs in making decisions in the face of uncertainty (Lim, 2023).

Furthermore, studies into methods for improving supply chain resilience, such as source diversity, risk-reduction techniques, and the adoption of cutting-edge technology, particularly cloud computing, have been spurred by the disruption in global supply networks.

Our research offers several novel contributions to the field of cloud computing adoption in small and medium enterprises (SMEs), a topic that has seen increasing scholarly interest but still lacks comprehensive bibliometric analyses. Unlike prior studies that primarily focus on case studies and theoretical applications, our study employs a robust bibliometric analysis to provide a systematic and quantifiable overview of the field. The novelty of our work lies in its comprehensive methodological approach using bibliometric performance analysis and scientific mapping, tools that have not been extensively used in prior research on this topic. This approach has allowed us to identify and visualize major themes and trends in cloud computing research within SMEs, offering a new perspective on how these technologies are being adopted and their impact on business practices.

In terms of research contribution, this study not only fills a gap in the bibliometric analysis of cloud computing in SMEs but also provides valuable insights that can aid policymakers and business leaders in decision-making processes. By mapping out the intellectual structure of the field, we offer a valuable resource for future research directions, aiming to foster further explorations into how cloud technologies can be effectively integrated into SME operations to drive innovation and economic growth. Furthermore, the findings have opened several research issues for future research. There remains a substantial need to explore the integration strategies of cloud technologies within different SME sectors, taking into account regional variations and industry-specific challenges. Moreover, the role of cloud computing in enhancing SME resilience against market fluctuations and global disruptions like the COVID-19 pandemic presents a rich area for exploration. There is also an opportunity to study the long-term effects of cloud adoption on SMEs' innovation capacities and competitive advantages in a digitally transformed marketplace.

## 5. CONCLUSION

The aim of this study is to investigate trends and developments that could enhance our

understanding of cloud computing adoption, specifically in small and medium-sized enterprises. Even though the subject of cloud computing adoption in SMEs has been extensively studied, bibliometric studies on the subject are still rare. The results of this study have added significantly to the body of literature and state of knowledge by deepening our knowledge and comprehension of cloud computing's application in SMEs. Furthermore, this study has filled up the information gaps found in previous bibliometric research. Through a detailed analysis of the body of scientific literature, this study not only provides a comprehensive picture of current trends and achievements but also points out the limitations of previous research. Using Vosviewer and Biblioshiny as statistics and visualization tools, we examined several significant aspects of the intellectual landscape of academic research on the adoption of cloud computing in SMEs in this study. Based on authorship, institutional collaboration, countries, and keywords, the outcome identifies prominent research themes and subjects that have a substantial impact on the body of knowledge. The citation analysis was conducted in order to evaluate the influence of research, identify important works, and follow the development of ideas within a subject. Therefore, it is hoped that the study's conclusions would be able to provide practitioners with more in-depth and relevant insights, as well as serve as a helpful resource for academics looking to learn more about the complex dynamics of cloud computing technology adoption in SMEs.

The primary strength of this study lies in its comprehensive bibliometric analysis which adds significant depth to the understanding of cloud computing adoption among SMEs. By employing both bibliometric performance analysis and scientific mapping methodologies, the study effectively captures the trends, challenges, and landscape of cloud computing adoption, thereby contributing valuable insights to the literature. Notably, the manuscript leverages an extensive dataset extracted from the Scopus database, which spans publications from 2010 to 2024, ensuring that the analysis is both robust and relevant to current and future trends.

However, the study is not without limitations. One weakness is the scope of its bibliometric approach which, while thorough, could be perceived as overly focused on quantitative metrics of publication and citation analysis. This approach may overlook the qualitative aspects of research

impact and innovation within the field. Additionally, while the manuscript identifies key trends and authors in the space, it could benefit from a deeper examination of the practical implications of cloud computing adoption for SMEs, especially in terms of operational and strategic impacts.

Looking towards future research directions, it would be beneficial to expand the study to include more diverse methodologies such as case studies or empirical research that could provide deeper insights into the practical challenges and benefits experienced by SMEs in adopting cloud computing. Furthermore, exploring the impact of emerging technologies such as artificial intelligence and machine learning on cloud computing adoption within SMEs could provide a more forward-looking perspective and align with current technological advancements.

## REFERENCES

- [1] Abdul Rahman, N. A., Ahmi, A., Jraisat, L., & Upadhyay, A. (2022). Examining the trend of humanitarian supply chain studies: pre, during and post COVID-19 pandemic. *Journal of Humanitarian Logistics and Supply Chain Management*, 12(4), 594–617. <https://doi.org/10.1108/JHLSCM-01-2022-0012>
- [2] Ahmed, I. (2020). Technology organization environment framework in cloud computing. *Telkomnika (Telecommunication Computing Electronics and Control)*, 18(2), 716–725. <https://doi.org/10.12928/TELKOMNIKA.v18i2.13871>
- [3] Alshamaila, Y., Papagiannidis, S., & Li, F. (2013). Cloud computing adoption by SMEs in the north east of England. *Journal of Enterprise Information Management*, 26(3), 250–275. <https://doi.org/10.1108/17410391311325225>
- [4] Arvanitis, S., Kyriakou, N., & Loukis, E. N. (2017). Why do firms adopt cloud computing? A comparative analysis based on South and North Europe firm data. *Telematics and Informatics*, 34(7), 1322–1332.
- [5] Broadus, R. N. (1987). Toward a definition of “bibliometrics.” *Scientometrics*, 12(5–6), 373–379. <https://doi.org/10.1007/BF02016680>
- [6] Chicksand, D., Watson, G., Walker, H., Radnor, Z., & Johnston, R. (2012). Theoretical perspectives in purchasing and supply chain management: An analysis of the

- literature. *Supply Chain Management*, 17(4), 454–472.  
<https://doi.org/10.1108/13598541211246611>
- [7] Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133(May), 285–296.  
<https://doi.org/10.1016/j.jbusres.2021.04.070>
- [8] Fahimnia, B., Sarkis, J., & Davarzani, H. (2015). Green supply chain management: A review and bibliometric analysis. *International Journal of Production Economics*, 162, 101–114.  
<https://doi.org/10.1016/j.ijpe.2015.01.003>
- [9] Ghobakhloo, M., & Iranmanesh, M. (2021). Digital transformation success under Industry 4.0: A strategic guideline for manufacturing SMEs. *Journal of Manufacturing Technology Management*, 32(8), 1533–1556.
- [10] Gupta, P., Seetharaman, A., & Raj, J. R. (2013). The usage and adoption of cloud computing by small and medium businesses. *International Journal of Information Management*, 33(5), 861–874.
- [11] Hu, Y., Pan, Y., Yu, M., & Chen, P. (2024). Navigating Digital Transformation and Knowledge Structures: Insights for Small and Medium-Sized Enterprises. *Journal of the Knowledge Economy*.  
<https://doi.org/10.1007/s13132-024-01754-x>
- [12] Khan, N., & Al-Yasiri, A. (2016). Identifying cloud security threats to strengthen cloud computing adoption framework. *Procedia Computer Science*, 94, 485–490.
- [13] Khurana, I., Dutta, D. K., & Ghura, A. S. (2022). SMEs and digital transformation during a crisis: The emergence of resilience as a second-order dynamic capability in an entrepreneurial ecosystem. *Journal of Business Research*, 150, 623–641.
- [14] Kumar, A. (2016). A Bibliometric Study of Supply Chain Management. *Management Research and Practice*, 8(1), 25–38.
- [15] Lim, W. M. (2023). Transformative marketing in the new normal: A novel practice-scholarly integrative review of business-to-business marketing mix challenges, opportunities, and solutions. *Journal of Business Research*, 160, 113638.
- [16] Low, C., Chen, Y., & Wu, M. (2011). Understanding the determinants of cloud computing adoption. *Industrial Management & Data Systems*, 111(7), 1006–1023.
- [17] Moeuf, A., Pellerin, R., Lamouri, S., Tamayo-Giraldo, S., & Barbaray, R. (2018). The industrial management of SMEs in the era of Industry 4.0. *International Journal of Production Research*, 56(3), 1118–1136.  
<https://doi.org/10.1080/00207543.2017.1372647>
- [18] Napitupulu, D., & Yakub, R. (2021). A Bibliometric Analysis of E-Government Research. *Library Philosophy and Practice (e-Journal)*, 5861, 1–12.
- [19] Oduor, C. (2016). The Factors influencing the adoption of software as a service (Saas) by small and medium size enterprises (Smes): A case study of Nairobi County in Kenya. University of Nairobi.
- [20] Oredo, J. O., Njihia, J., & Iraki, X. N. (2019). Adoption of cloud computing by firms in Kenya: The role of institutional Pressures. *The African Journal of Information Systems*, 11(3), 1.
- [21] Padhy, R. P., Patra, M. R., & Satapathy, S. C. (2011). Cloud computing: security issues and research challenges. *International Journal of Computer Science and Information Technology & Security (IJCSITS)*, 1(2), 136–146.
- [22] Paquette, S., Jaeger, P. T., & Wilson, S. C. (2010). Identifying the security risks associated with governmental use of cloud computing. *GOVERNMENT INFORMATION QUARTERLY*, 27(3), 245–253.  
<https://doi.org/10.1016/j.giq.2010.01.002> WE - Social Science Citation Index (SSCI)
- [23] Saratchandra, M., & Shrestha, A. (2022). The role of cloud computing in knowledge management for small and medium enterprises: a systematic literature review. *Journal of Knowledge Management*, 26(10), 2668–2698.
- [24] Sawangwong, A., & Chaopaisarn, P. (2023). The impact of applying knowledge in the technological pillars of Industry 4.0 on supply chain performance. *Kybernetes*, 52(3), 1094–1126. <https://doi.org/10.1108/K-07-2021-0555>
- [25] Skafi, M., Yunis, M. M., & Zekri, A. (2020). Factors influencing SMEs' adoption of cloud computing services in Lebanon: An empirical analysis using TOE and contextual theory. *IEEE Access*, 8, 79169–79181.  
<https://doi.org/10.1109/ACCESS.2020.2987331>
- [26] Sultan, N. (2010). Cloud computing for education: A new dawn? *International Journal*

- of Information Management, 30(2), 109–116.  
<https://doi.org/10.1016/j.ijinfomgt.2009.09.004>
- [27] Tas, N., & Bolat, Y. İ. (2022). Bibliometric Mapping of Metaverse in Education. *International Journal of Technology in Education*, 5(3), 440–458.  
<https://doi.org/10.46328/ijte.323>
- [28] Trigueros-Preciado, S., Pérez-González, D., & Solana-González, P. (2013). Cloud computing in industrial SMEs: Identification of the barriers to its adoption and effects of its application. *Electronic Markets*, 23, 105–114.
- [29] van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523–538.  
<https://doi.org/10.1007/s11192-009-0146-3>
- [30] Vidhyalakshmi, R., & Kumar, V. (2016). Determinants of cloud computing adoption by SMEs. *International Journal of Business Information Systems*, 22(3), 375–395.
- [31] Widyastuti, D., & Irwansyah, I. (2018). Benefits and challenges of cloud computing technology adoption in small and medium enterprises (SMEs). *Bandung Creative Movement (BCM)*, 4(1).
- [32] Yeboah-Boateng, E. O., & Essandoh, K. A. (2014). Factors influencing the adoption of cloud computing by small and medium enterprises in developing economies. *International Journal of Emerging Science and Engineering*, 2(4), 13–20.
- [33] Youseff, L., Butrico, M., & Da Silva, D. (2008). Toward a unified ontology of cloud computing. *Grid Computing Environments Workshop, GCE 2008*, 1–10.  
<https://doi.org/10.1109/GCE.2008.4738443>
- [34] Zakaria, R., Ahmi, A., Ahmad, A. H., Othman, Z., Azman, K. F., Ab Aziz, C. B., Ismail, C. A. N., & Shafin, N. (2021). Visualising and mapping a decade of literature on honey research: a bibliometric analysis from 2011 to 2020. *Journal of Apicultural Research*, 60(3), 359–368.  
<https://doi.org/10.1080/00218839.2021.1898789>