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Bibliometric Analysis on Cloud Computing in Micro, Small and Medium Enterprises (MSMEs)

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ABSTRACT
Cloud computing is a transformative technology that can improve productivity in Micro, Small, and Medium Enterprises (MSMEs). It offers low-cost, standardized, and customizable online computer services over the internet. These services are charged based on usage, making them affordable for MSMEs. This research paper reviews the literature on cloud computing in MSMEs using Biblioshiny and VOSViewer. The study examines trends over time, identifies key authors, institutions, and sources, and analyses document citations. It also explores various themes related to cloud computing in MSMEs. The findings provide insights into the adoption of cloud computing and its impact on MSMEs, guiding future research and implementation in this sector.

Keywords: Cloud Computing, MSME, Digital Transformation, Bibliometric analysis

1. INTRODUCTION

In India's changing economy, Micro Small and Medium Enterprises have become a vital for growth and development of the economy. The government supports them through the MSMED (Micro Small and Medium Enterprises Development) Act of 2006. The advancement of digital technology has significantly influenced individuals in the business sector(Ariesmansyah et al., 2021). Traditional ways of running businesses are rapidly changing due to the rise of digital transformation. Businesses now use digital tools to improve their competitiveness across various sectors of the economy. The utilization and integration of digital resources to boost competitiveness across different parts of the economy.

(Verhoef et al., 2021) highlights the significance of information technology as a key facilitator in enabling organizations, including MSMEs, to embrace innovative strategies. This shift toward digitalization affects businesses of all sizes and government bodies as well (Klierova & Kutik, 2017). Digital transformation involves a complete rethinking of how businesses utilize technology, encompassing all aspects of operations to better serve customers.

Key to this transformation is the adoption of cutting-edge technologies including Cloud Computing, the Internet of Things (IoT), Artificial Intelligence (AI), Machine Learning (ML), and Big Data analytics. These technological advancements enables MSMEs to create customized products and services , improve customer satisfaction levels, and reduce operational costs. By adopting digital technologies, India's MSME sector can become more competitive, sustainable, and adaptable to changing market conditions.

The current study presents the evolution of scientific production on the topic cloud computing in MSME. An examination of 356 articles listed in Scopus from 2009 to 2023 was carried out through bibliometric

analysis. Bibliometric analysis allows thorough examination of publications and enabling meaningful insights that can guide the formulation of a research agenda (Yu et al., 2018).

The article is organized as follows: Section 1 presents the introduction, Section 2 details the research questions, and Section 3 explains the methodology including search and filtration criteria, Section 4 presents the analysis results utilizing two software tools, Biblioshiny and VosViewer, Section 5 offers conclusions, discusses limitations, identifies scope for further research, and presents the final conclusion.

2. LITERATURE REVIEW

The Micro, Small, and Medium Enterprises (MSME) sector, which includes businesses involved in producing, manufacturing, and processing goods, plays a crucial role in economic growth and is often considered the backbone of national economies. It promotes entrepreneurship and creates jobs at low costs, second only to agriculture (Uma & Anbuselvi, 2023). MSMEs also help unskilled workers gain essential skills (Acs & Armington, 2006).

Digital technology has greatly improved MSMEs by increasing efficiency, expanding market reach, and enhancing customer engagement (Shah et al., 2024). Cloud computing, in particular, allows SMEs to access affordable online services like computing, storage, software, and data management without needing advanced resources or expertise (*Latin American Economic Outlook 2013*, 2012). It offers customizable, reliable, and secure solutions, enabling SMEs to tailor services to their needs and improve availability (Doherty et al., 2015). Cloud computing also boosts competitiveness and performance by improving communication, increasing revenue, and reducing costs (Khayer et al., 2020)). By working with cloud providers, MSMEs can find cloud-based solutions that meet their specific needs (Garg et al., 2023) .Studies show that factors like top management support, IT resources, employee skills, and external pressures influence cloud adoption in SMEs (Hassan, 2017). However, there is no research analysing the overall trends in cloud computing for MSMEs using bibliometric methods. Most studies focus on specific technologies or individual adoption cases, leaving a gap in understanding broader patterns and future directions. A comprehensive bibliometric analysis is needed to explore key themes, trends, and developments in cloud computing for MSMEs.

3. RESEARCH QUESTIONS

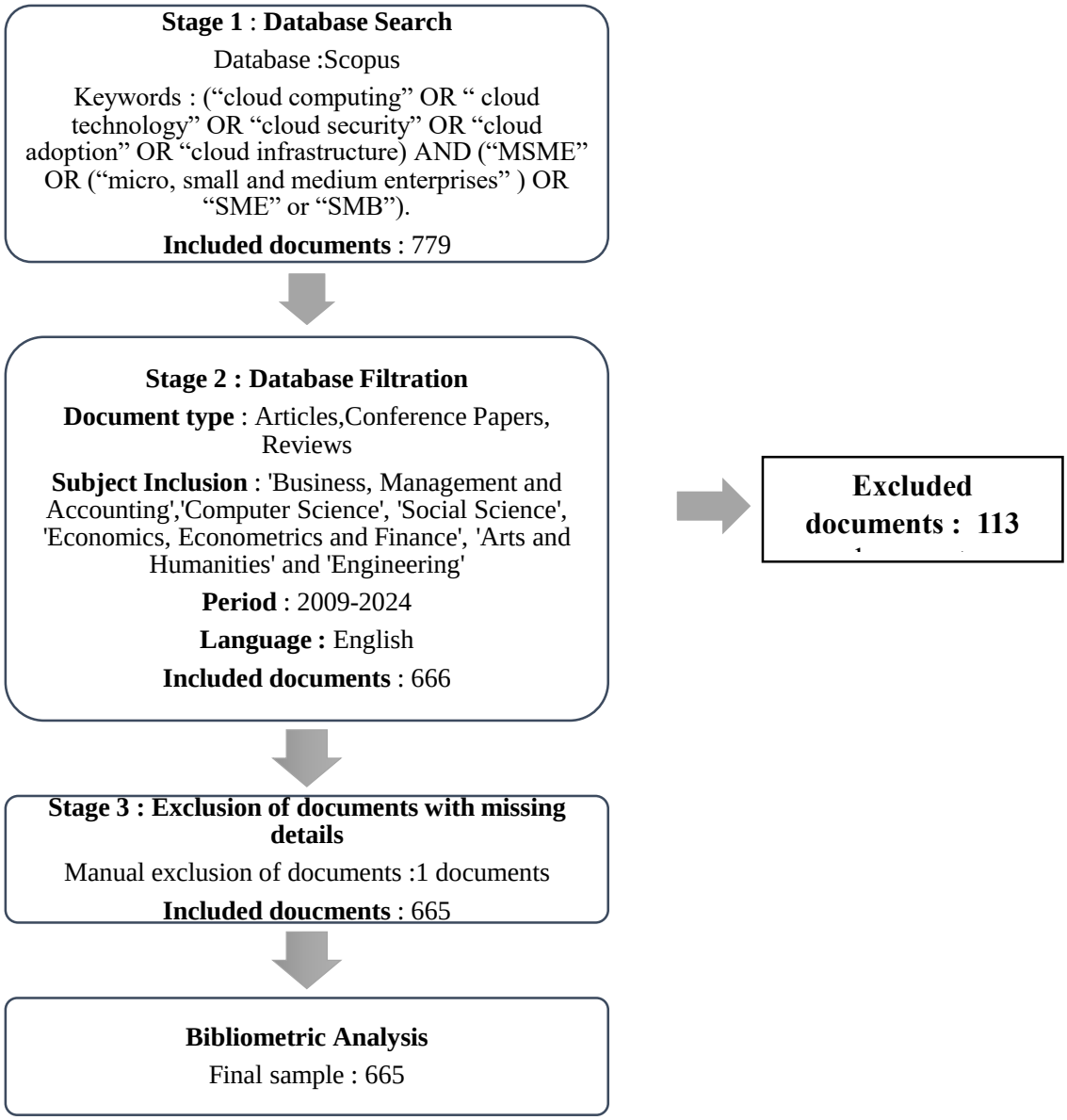
1. What is the chronological trend in the research domain of cloud computing in MSME?
2. Who are the key contributors (authors, sources and institutions) in the research domain of cloud computing in MSME?
3. Which are the top cited papers globally in this area?
4. What are the key thematic areas that emerge from the research literature in this field?
5. What are the collaborative networks among authors who studied cloud computing in MSMEs?

4. METHODOLOGY

Bibliometric analysis and network visualization were used to explore and analyse existing knowledge on "Cloud Computing and Micro, Small, and Medium Enterprises. Bibliometric analysis is helpful for examining large datasets (Donthu et al., 2021). Various types of publications were included, and bibliographic data were retrieved from the Scopus database in .csv and .bibtex formats. Biblioshiny was used for performance analysis, while VOSViewer was used for science mapping.

4.1 SEARCH AND FILTERATION STRATEGY

Figure 1: Search and Filtration strategy



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5. ANALYSIS

5.1 Analysis using Biblioshiny

Biblioshiny is a powerful and user friendly web application which helps to do bibliometric analysis in a simple way. It helps to simplify the process of extracting, organizing, and visualizing intricate research data. The following table shows the main information about the data extracted for the purpose of bibliometric analysis on the topic cloud computing in MSME.

Table 1 : Main Information About Data

Timespan	2009:2024
Sources (Journals, Books, etc)	453

Documents	665
DOCUMENT TYPES	
Article	259
Conference paper	390
Review	16

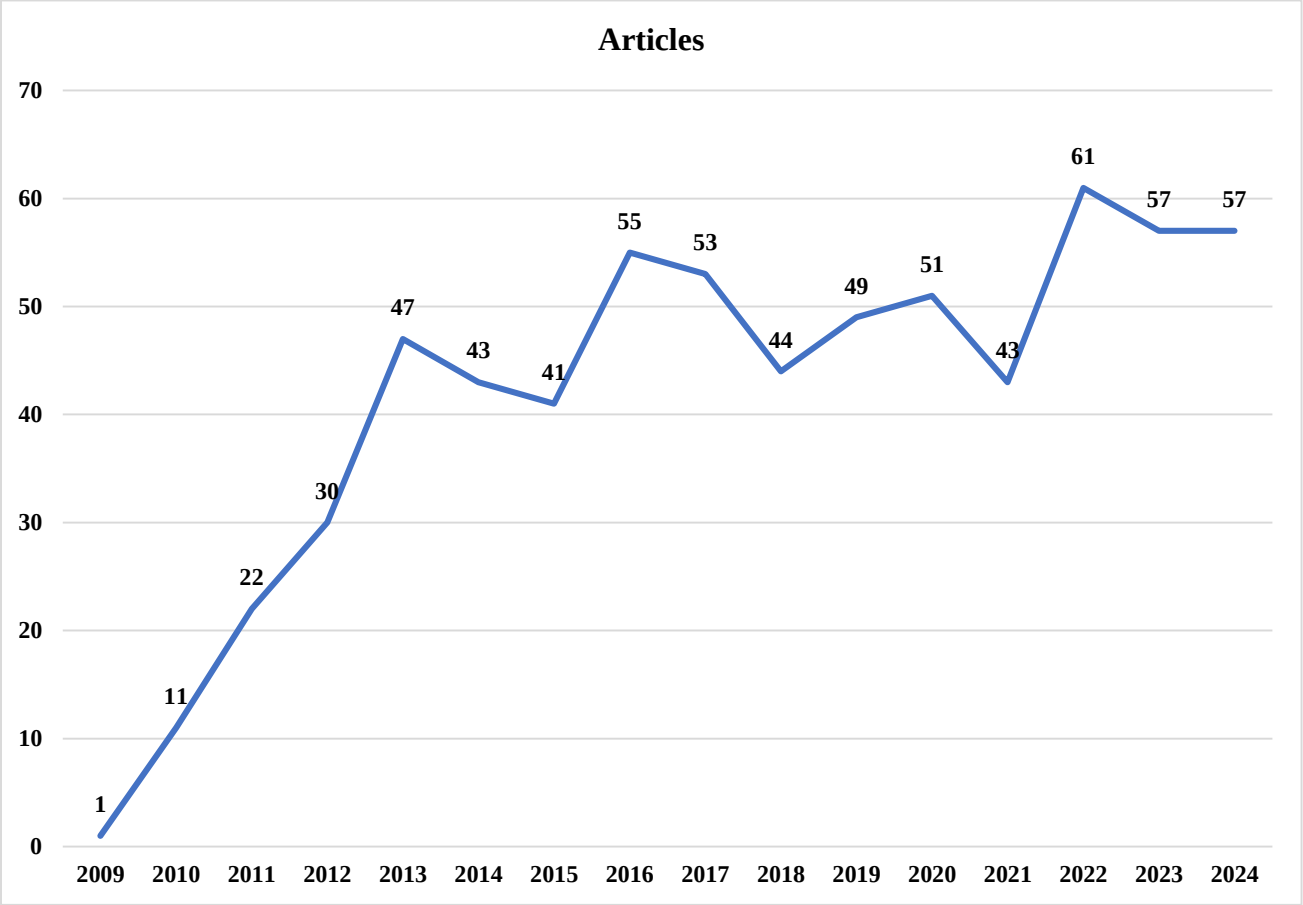
Source : Created by author using Biblioshiny

1. Trend Analysis

Trend analysis helps identify the growth of scientific literature over time and shows if interest in the field has increased, decreased, or stayed the same (Punjani et al., 2023). Since the Scopus database provides articles on cloud computing in MSMEs starting from 2009, only articles published between 2009 and December 2024 were included in the study.

a) Annual Scientific Production

Figure 2 : Chronological trend in research

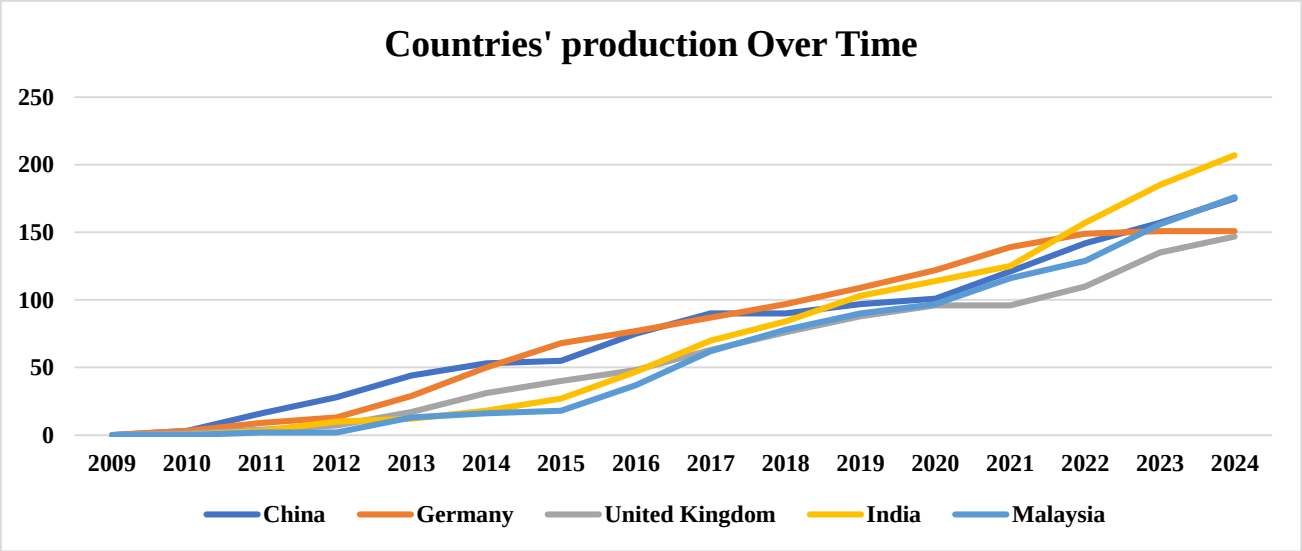


Source : Created by author using Biblioshiny

Figure 2 presents an overview of the research literature on cloud computing in MSMEs from 2009 to 2023. The first article on the topic was published in 2009, but significant growth in research began after 2015. The majority of the articles included in this study were published between 2015 and 2024. The year 2023 and 2024 marked the peak in the number of published articles, reflecting a rising interest in exploring the role of cloud computing in MSMEs.

b) Countries Production over time

Figure 3 : Countries' Production over time



Source : Created by author using Biblioshiny

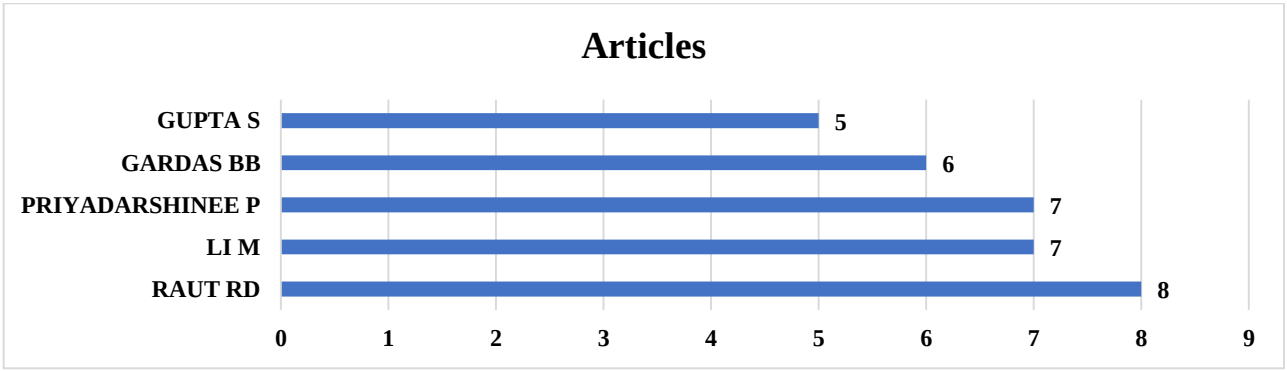
The Fig.3 shows the countries production over the period 2009-2024. Over the period, there has been a steady rise in publication output, which signals increasing interest in the topic cloud computing in MSMEs. Notably India's production rose, surpassing that of China which had dominated the field till 2016. Meanwhile countries like United Kingdom, Malaysia and Germany maintained a steady production. Overall, the graph illustrates an increasing trend in the production of publications in all the countries.

2. Key Contributors

Key contributors are identified in the form of top authors, relevant sources and top affiliations or institutions that are actively involved in research within the domain. It helps in the identification of primary contributors within the field of cloud computing in MSME.

a) Top Authors

Figure 4 : Top Authors



Source : Created by author using Biblioshiny

The fig.4 shows the top authors in the field of research domain cloud computing in MSME. The graph illustrates influential researchers in the field of cloud computing for MSMEs. Raut R D, stands out as the most productive author, having contributed 8 documents, indicating substantial contributions

and recognition within the academic community. Priyadarshinee P and Li M follows closely with 7 articles each while Gardas BB and Jha MK contributed 6 and 5 articles respectively.

b) Top Sources

Table 2 : Most relevant sources

Sources	Articles
Lecture Notes In Computer Science (Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics)	17
ACM International Conference Proceeding Series	14
Communications In Computer And Information Science	10
International Journal Of Business Information Systems	10
Advances In Intelligent Systems And Computing	9

Source : Created by author using Biblioshiny

Table 2 shows the most relevant sources that provides research documents in the field of cloud computing in MSME. "Lecture Notes In Computer Science" has published 17 articles in the field of cloud computing in MSME making it the most relevant source of information in this field. "ACM International Conference Proceeding Series" has produced 14 articles. and "Communications In Computer And Information Science" and "International Journal Of Business Information Systems" and has published 10 articles each.

c) Top Institutions / Affiliation

Table 3 : Top 5 Institutions / Affiliations

Affiliation / Institutions	Articles
National Institute of Industrial Engineering (NITE)	23
Beijing University of Posts and Telecommunications	22
Universiti Putra Malaysia	15
Universiti Sains Malaysia	11
University of Kragujevac	11

Source : Created by author using Biblioshiny

Table 3 shows the top 5 institutions contributing to research on cloud computing and MSMEs include well-known universities and organizations from around the world. The "National Institute of Industrial Engineering" leads with 23 articles, focusing on how cloud technology can help small businesses. "Beijing University of Posts and Telecommunications" comes next with 22 articles, exploring ways for businesses to adopt cloud solutions. "Universiti Putra Malaysia" has 15 articles, looking at how cloud computing can make small businesses more efficient. The "Universiti Sains Malaysia" and "University of Kragujevac" contributed 11 articles, studying how technology can improve business practices.

3. Analysis of Citation

Citation denote relationships between citing and cited research literature (Griffin, 2016). Citation analysis gives an understanding to how extend a research document has gained acceptance by the academicians through the number of times the research has been cited by other researchers. In this paper the author has included the top 10 cited countries, top 10 globally cited papers and top 10 locally cited papers. Global citations means the citations from documents not restricted to the sample dataset and local citations means citations within the dataset.

Top 10 Globally Cited Documents

Table 4 : Top 10 Globally cited documents

S R No.	Paper	Author and Year	Published in	Global Citation
1	The Industrial Management Of SMEs In The Era Of Industry 4.0	Moeuf A.; Pellerin R.; Lamouri S.; Tamayo-Giraldo S.; Barbaray R. (2018)	International Journal of Production Research	829
2	Cloud Computing for Education: A New Dawn?	Sultan N. (2010)	International Journal of Information Management	669
3	Cloud Computing Adoption by SMEs In the North East of England: A Multi-Perspective Framework	Alshamaila Y.; Papagiannidis S.; Li F. (2013)	Journal of Enterprise Information Management	612
4	The Usage and Adoption of Cloud Computing by Small and Medium Businesses	Gupta P.; Seetharaman A.; Raj J.R. (2013)	International Journal of Information Management	515
5	Reaching for the "Cloud": How SMEs Can Manage	Sultan N.A. (2011)	International Journal of Information Management	282

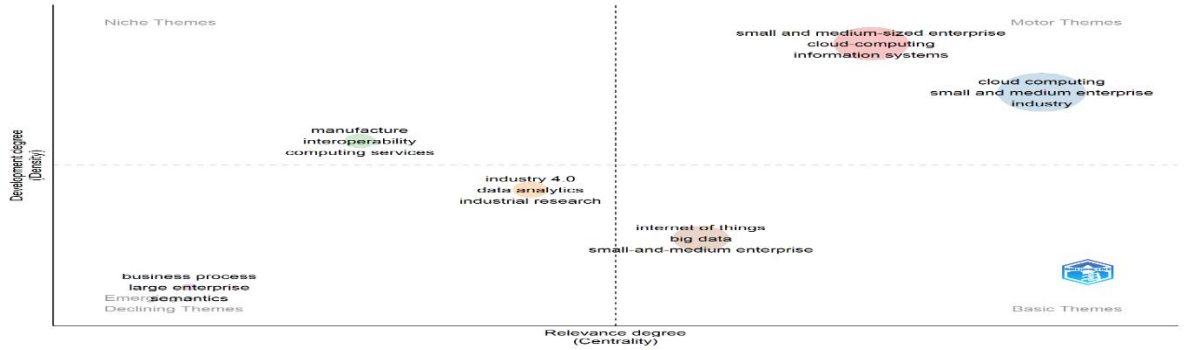
Source : Created by author using Biblioshiny .

Table 4 shows the top 10 globally cited papers. The research paper "The Industrial Management Of SMEs In The Era Of Industry 4.0" by Moeuf A et al. (2018) is the most globally cited document on the topic "Cloud computing in MSME," with 829 citations. The high citation count of this paper shows its significant impact on advancing research in cloud computing for MSMEs. The second most cited paper is "Cloud computing for education: A new dawn?" by Sultan N. (2010), with 669 citations. It was published in the International Journal of Information Management.

4. Thematic Map

A thematic map typically refers to a visual representation of the main themes, niche themes, disappearing or emerging themes, and basic or foundational themes within a dataset (Liao & Liu, 2023). The thematic map gives researchers a visual overview of the dataset's themes. It helps them identify key areas of focus, see trends in research themes over time, and explore relationships between themes.

Figure 5 : Thematic Map



Source : Created by author using Biblioshiny

Figure 6 shows the thematic map of the dataset. The first quadrant (Q1) highlights the main themes, such as “cloud computing", “information systems” and "small and medium-sized enterprises" are both well-developed and highly relevant which are highly relevant and advanced, driving innovation in the field. The second quadrant (Q2) includes niche or specialized themes, such as " manufacture, interoperability, and computing services. These are specialized areas with limited connections to broader research. The third quadrant (Q3) contains emerging or declining themes, shows less developed and less relevant topics, like business process, large enterprise, and semantics. These themes are either new and growing or becoming less important over time. Finally, the fourth quadrant (Q4) presents basic or foundational themes like “big data”, “internet of things”, and “small-and-medium enterprises”, which are fundamental areas that require more research.

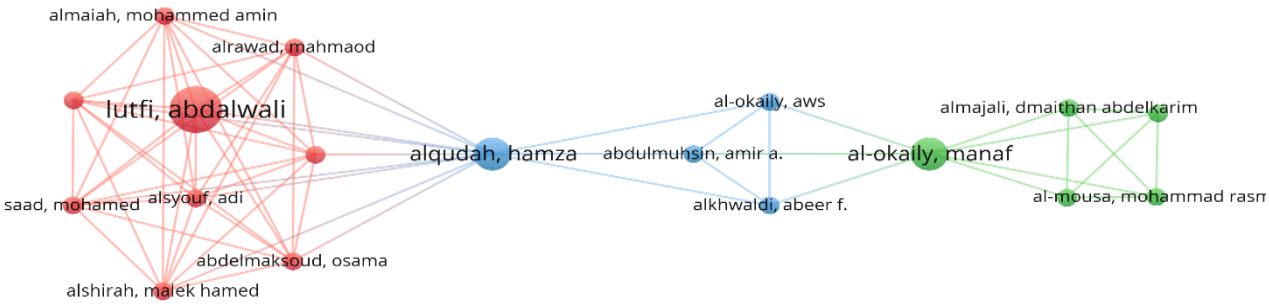
4.2 Analysis using VOSviewer

VOSviewer helps to create a graphical visualisation of the contents addressed in the papers(Iacob et al., 2024). Employing VOSviewer as a bibliometric tool for systematic literature analysis offers numerous advantages, such as facilitating a thorough examination of the literature and enabling unprecedented scope in investigations (Markoulli et al., 2016).

5. Collaborative Network Among Authors/ Co-authorship Analysis

A collaborative network among authors refers to a visual representation of the collaboration relationships based on co-authorship in scientific publications. Each author is depicted as a node, and edges between nodes signify co-authorship.

Figure 6 : Collaborative network/ Co-authorship among authors



Source : Created by author using VOSviewer

The fig.7 displays the collaborative network or co-authorship relationships among authors based on shared publications. In the collaborative network created using VOSviewer, a minimum of one paper was required for inclusion. The red cluster, led by Lutfi, Abdalwali, indicates a closely connected research group with multiple collaborations. The blue cluster, centered around Alqudah, Hamza, connects authors across different teams, acting as a bridge. The green cluster, with Al-Okaily, Manaf as a key figure, represents another distinct research group. Strongly connected authors indicate frequent collaboration, while smaller nodes suggest limited joint research.

6. LIMITATIONS

No study is completely free of any limitations. The Bibliometric Analysis on Cloud Computing in MSME also possess certain limitations. The study used only Scopus to collect data. Other databases like Web of Science, PubMed, Google Scholar, IEEE Xplore, and JSTOR were not included, which may have caused

some bias due to limited coverage. Only English-language documents were analyzed, excluding research published in other languages.

7. SCOPE FOR FURTHER RESEARCH

This study focuses only on bibliometric and network visualization analysis of cloud computing in MSMEs. Future research should investigate why MSMEs are hesitant to adopt cloud computing, the challenges they face, and how to overcome these challenges. Studies should also analyse the performance and costs of cloud computing to find the best strategies for different types of MSMEs. Researchers could explore how emerging technologies, like artificial intelligence, can be combined with cloud computing to drive innovation and benefit MSMEs.

8. CONCLUSION

To conclude, this study analysed the field of cloud computing in MSMEs using bibliometric and network visualization methods. It examined 665 documents out of 776 found in this field. The results highlight the evolution of research on this topic, key authors, institutions, sources, citations, research themes, and co-authorship patterns. The study found a rising trend in publications, showing growing interest and recognition of cloud computing's potential to boost productivity in MSMEs. This analysis shows the importance of cloud computing and its potential for future research and development. The co-occurrence of keywords and co-authorship networks revealed connections between documents and researchers, offering insights into collaboration. These networks were visualized using Biblioshiny and VOSviewer tools.

In summary, this study improves understanding of cloud computing for MSMEs, highlights its opportunities for application, and points to directions for future research. It also opens new possibilities for studies to support the growth and survival of small and medium-sized enterprises in the digital age.

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