

A Bibliometric Analysis of Decision Support System Using VOSviewer

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Abstract: This study aims to analyze the development of research related to decision support systems based on publications in international journals during the 2019-2023 period indexed in the Scopus database. The research method used is bibliometric analysis by utilizing Vosviewer software to visualize network patterns from bibliometric elements. The results of the analysis show that there is a downward trend in publications even though research interest is still quite high. Based on keyword mapping, 5 main clusters of research topics were found, namely the application of new technologies, the health sector, risk assessment, big data and visualization. Overall, decision support system research opportunities are still wide open, especially on topics that have not been explored in depth. This research is expected to guide future efforts to innovate and develop decision support systems that can meet the challenges of complex decision making.

Keywords: Decision Support Systems, Bibliometric, Research Trends, Vosview.

1. INTRODUCTION

In today's information age, decision making is increasingly complex and critical in a variety of contexts, whether in business (Dhara et al., 2022; Haj Qasem et al., 2023; Mboli et al., 2023), education (Dergacheva, 2022; Taeza-Cruz & Capili-Kummer, 2023; Xiaohang & Lin, 2022), or government (Adiwijaya et al., 2023; Hariguna, 2023; Soliman & El-Barkouky, 2020). To assist individuals and organizations in the decision-making process, decision support systems have become a highly relevant element. These systems combine information technology (Yun et al., 2021), data analysis (Rupnik et al., 2019), and information processing (Fitriyani et al., 2020) to provide valuable guidance in making better and informed decisions.

The existence of decision support systems has major implications in improving the efficiency and effectiveness of decision making (Langer et al., 2021). Applying the principles of artificial intelligence, advanced data analysis, and increasingly advanced computing technology. Decision support systems can help decision makers to understand the complexity of situations (Fertier et al., 2020), identify opportunities (Ara et al., 2021), manage risks (Andry et al., 2023; Brandtner, 2023;

Di Gangi et al., 2023), and take appropriate steps (Pavlova et al., 2023).

This bibliometric research is geared towards providing in-depth insights into the development of research related to decision support systems. Through bibliometric analysis, we will identify key trends in this research, key contributors, leading journals, as well as key concepts related to decision support systems. Our main goal is to understand how decision support systems research has evolved over time and how it has impacted various disciplines.

With a better understanding of the current research trends and focus, we hope this study will provide valuable guidance to researchers, practitioners, and decision makers interested in understanding and applying decision support system concepts in various aspects of life. Moreover, this research aims to inspire innovation in the development of increasingly sophisticated and effective decision support systems. With a deeper understanding of research developments and past developments, we can plan future research directions that will meet the increasingly complex demands in decision making.

This research is expected to provide an important foundation for the advancement of decision support system technology that

will provide significant benefits to various aspects of life and industry. The increased use of decision support systems in various fields will bring great benefits, including time savings, resources, and more informed decision making in the face of complex challenges faced by society and organizations today. The purpose of this study is to determine an overview of decision support system research trends based on bibliometric analysis of articles published in reputable international journals. The results of this study are expected to provide information on the topics and trends of decision support system research that are currently developing. In addition, the results of this study can also be a reference for future researchers in choosing research topics in the field of decision support systems.

2. METHODOLOGY

This research uses a descriptive bibliometric analysis method by focusing on publication data related to decision support systems in the period 2019 to 2023. This research limits itself to discussing the topic of "Decision Support System" obtained through a literature search indexed in the Scopus database.

Once the data has been collected and saved in CSV (Comma Separated Value) file format, the next step is to import the file into the Vosviewer software. The purpose of this step is to produce visualizations of network patterns or interactions

between bibliometric elements in three categories, namely network visualization and density visualization. Network visualizations are used to illustrate the extent of the relationship between different research terms and the extent of interconnectedness between them. Overlay visualizations aim to visualize the progression of research by publication year, while density visualizations are used to show the level of density or focus within a particular research group.

Bibliometric analysis is the application of statistical and mathematical methods to various types of literature, including books, journals, online publications, and other communication media (Dhiman et al., 2023). With the mapping results generated by Vosviewer, this information can be used as a basis for more accurate content analysis. This analysis involves aspects such as researcher identification by name, publication year, researcher productivity, and research trends in the decision support system domain. In this study, bibliometric analysis was used to identify collaboration between authors in decision support system research and to analyze bibliometric relationships based on co-occurrence of keywords.

3. RESULTS AND DISCUSSION

The development of decision support system research in the interval 2019 - 2023 experienced a fluctuating increase and decrease, as shown in Figure 1.

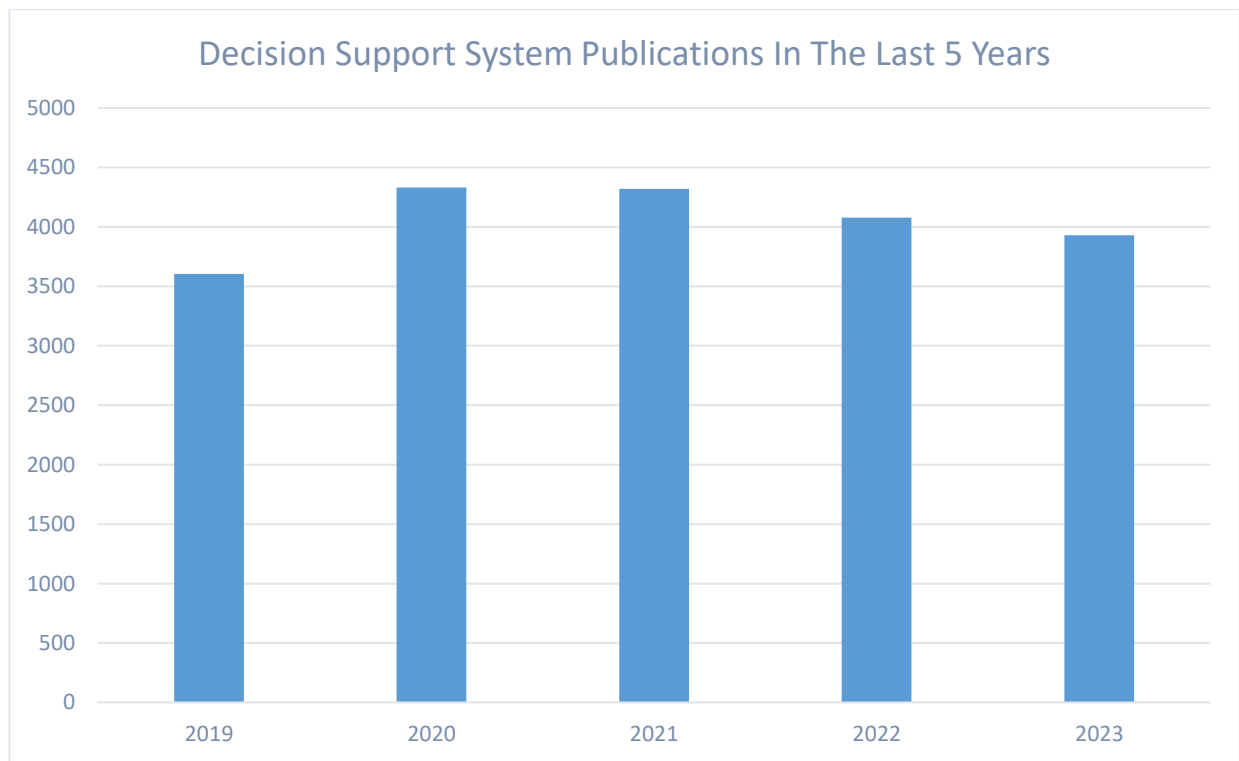


Fig. 1 Decision Support System Publications in the Last 5 Years

Figure 1 shows a significant increase in 2019 and 2020. However, over time from 2021 to 2023 the level of decision support system research publications slowly decreased.

Although there are regulations governing the requirements for final project publications as part of the degree requirements for undergraduate, master's, and doctoral students, this development has decreased. Official guidelines regulated by

Circular Letter of the Director General of Higher Education No.152/E/T/2013 dated January 27, 2012 and Regulation of the Head of the Indonesian Institute of Sciences No.9 of 2015 emphasize that researchers who reach the level of research professor must publish their research results in reputable international journals (Maryono & Surajiman, 2017). However, the graph shows that interest in research in this sector in the world is still high and continues to grow every year.

Table. 1 Most Productive Researchers in Publishing Decision Support System

No	Authors	Number of Publications
1	Abdullah, S.	38
2	Ewlyn, G.	28
3	Wright, A.	26
4	Kawamoto, K.	26
5	Hoogenboom, G.	26
6	Durand, M.A.	21
7	Bates, D.W.	21
8	Ashraf, S.	21
9	Stacey, D.	20
10	Nguyen, P.T.	20

Table 1 shows that of all the researchers listed, Abdullah, S. from Abdul Wali Khan University Mardan is the most prolific in terms of journal publications related to decision support systems. Abdullah, S. has published no less than 38 articles on the topic. This number far surpasses any other researcher on this list. After Abdullah, S., Ewlyn, G. is ranked second with a total of 28 publications. In third place, there are 3 researchers with the same number of publications of 26 articles, namely Wright,

A., Kawamoto, K., and Hoogenboom, G. Furthermore, Durand, M.A., Bates, D.W., and Ashraf, S., are ranked fourth with 21 publications each. Finally, Stacey, D., and Nguyen P.T. are in fifth place with a total of 20 publications for each researcher. Overall, this table clearly shows the publication productivity of researchers in the field of decision support systems based on data on the number of publications that have been produced. The correlation between researchers can be seen in Table 2.

Table. 2 Article Data in the Field of Decision Support System

Title	Refs
Clinical-grade computational pathology using weakly supervised deep learning on whole slide images	(Campanella et al., 2019)
2019 European League Against Rheumatism/American College of Rheumatology Classification Criteria for Systemic Lupus Erythematosus	(Aringer et al., 2019)
SARS-CoV-2 Transmission from People without COVID-19 Symptoms	(Johansson et al., 2021)
Use of Telemedicine and Virtual Care for Remote Treatment in Response to COVID-19 Pandemic	(Bokolo Anthony Jnr., 2020)
Adversarial attacks on medical machine learning	(Finlayson et al., 2019)
A decision support system for demand management in healthcare supply chains considering the epidemic outbreaks: A case study of coronavirus disease 2019 (COVID-19)	(Govindan et al., 2020)
Evaluation and accurate diagnoses of pediatric diseases using artificial intelligence	(Liang et al., 2019)
Explainability for artificial intelligence in healthcare: a multidisciplinary perspective	(Amann et al., 2020)
Detection of breast cancer with mammography: Effect of an artificial intelligence support system	(Rodríguez-Ruiz et al., 2019)
Blockchain in the built environment and construction industry: A systematic review, conceptual models and practical use cases	(Li et al., 2019)

Title	Refs
Generalised framework for multi-criteria method selection	(Wątróbski et al., 2019)
Human–computer collaboration for skin cancer recognition	(Tschandl et al., 2020)
OR-methods for coping with the ripple effect in supply chains during COVID-19 pandemic: Managerial insights and research implications	(Ivanov & Dolgui, 2021)
Rapid response to COVID-19: Health informatics support for outbreak management in an academic health system	(Reeves et al., 2020)
XGBoost Model for Chronic Kidney Disease Diagnosis	(Ogunleye & Wang, 2020)
2021 American College of Rheumatology Guideline for the Treatment of Rheumatoid Arthritis	(Fraenkel et al., 2021)
Society of Interventional Radiology Consensus Guidelines for the Periprocedural Management of Thrombotic and Bleeding Risk in Patients Undergoing Percutaneous Image-Guided Interventions—Part II: Recommendations: Endorsed by the Canadian Association for Interventional Radiology and the Cardiovascular and Interventional Radiological Society of Europe	(Patel et al., 2019)
Digital twin-driven rapid individualised designing of automated flow-shop manufacturing system	(Liu et al., 2019)
KDIGO Clinical Practice Guideline on the Evaluation and Management of Candidates for Kidney Transplantation	(Chadban et al., 2020)
Hybrid decision tree-based machine learning models for short-term water quality prediction	(Lu & Ma, 2020)

Based on table 2, it can be seen that the most cited article is the article by Campanella et al. (2019) entitled "Clinical-grade computational pathology using weakly supervised deep learning on whole slide images" with 1018 citations. This article discusses the application of machine learning in the field of computational pathology.

Some of the key topics of the articles featured include the use of artificial intelligence/machine learning in healthcare, decision support systems for healthcare supply chain management, disease detection, and the application of blockchain and digital twin technologies in construction and manufacturing. This shows the topics related to smart technology such as.

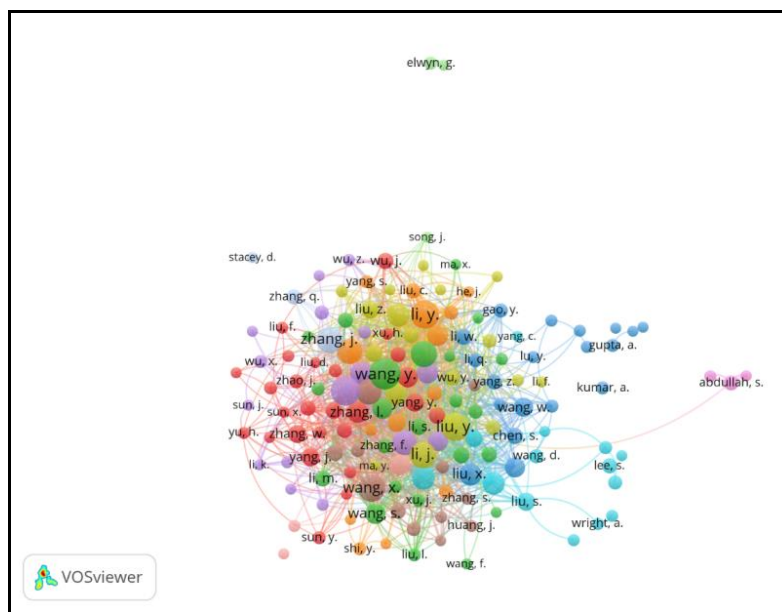


Fig. 2 Collaboration Map between Researchers

In 2022, Abdullah, S. and Ashraf, S. collaborated in conducting research related to decision support systems. Abdullah S. and Ashraf S. wrote one of the articles entitled "EDAS method for decision support modeling under the Pythagorean probabilistic hesitant fuzzy aggregation information".

Despite coming from different universities, both are researchers from Pakistan working in the Department of Mathematics. Abdullah, S. is from Abdul Wali Khan University Mardan,

while Ashraf, S. is from Bacha Khan University. This collaboration shows a good relationship between decision support system researchers, especially those with similar academic backgrounds. By collaborating, researchers can produce more comprehensive and high-quality research to advance the field of decision support systems.

Mapping the development of decision support system research trends as shown in Figure 3, obtained through the application of the full counting method.

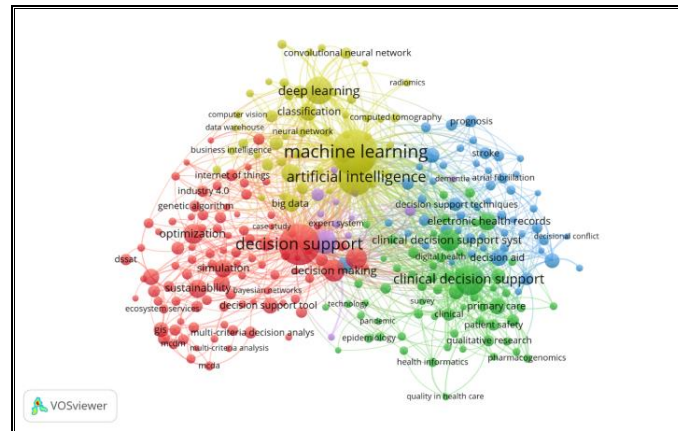


Fig. 3 Keyword Distribution Map on Decision Support System Research Trends

The mapping in Figure 3 shows the relationship between important terms in decision support system research from 2019 to 2023. There are 5 main clusters consisting of 273 terms, where cluster 1 consists of 97 terms such as blockchain, decision analysis and digital twin. Cluster 2 consists of 62 terms such as critical care, technology and health informatics. Cluster 3 consists of 53 terms such as risk factor, risk prediction and risk stratification. Cluster 4 consists of 49 terms such as big data, cloud computing and data mining. And cluster 5 consists of 12 terms such as expert system, visualization and knowledge base.

This mapping illustrates that decision support system research in the last 5 years has focused on several key themes. Cluster 1 shows high interest in advanced technologies such as blockchain to aid decision analysis. Cluster 2 emphasizes the application of decision support systems in healthcare. Cluster 3 focuses on the use of decision support systems to assess and mitigate risk. Cluster 4 covers core terms in the fields of big data and data mining relevant to decision support systems. And cluster 5 relates to the use of decision support systems to visualize and interpret decision support system outputs. Overall, this mapping provides valuable insights into the key research trends and growing areas of interest in decision support systems today.

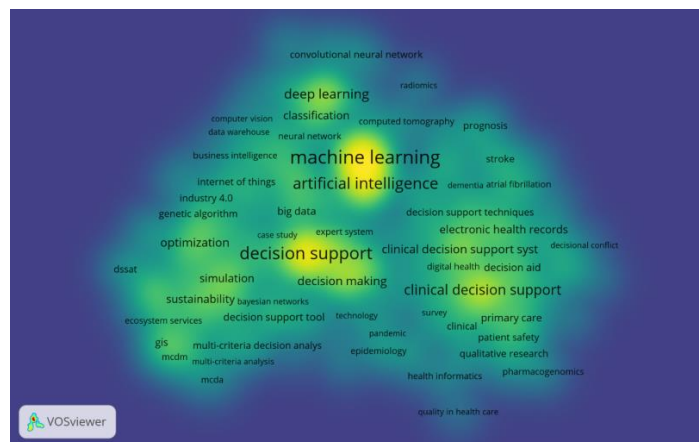


Fig. 4 Density Mapping by Keyword

Figure 4 displays the density of keywords found in the field of decision support systems. The density of research terms is indicated by a solid yellow color that depicts the amount of decision support system research. That is, the lighter the density in the Density Visualization indicates the more research conducted in the area. This result reveals that decision support system research is highly novel. For example, topics such as decision support, machine learning, deep learning, and clinical decision support have been widely researched. And topics such as digital twin and expert system in relation to decision support system have not been widely researched and discussed in depth, so there are still great opportunities to explore these topics further.

Overall, this Density Visualization provides valuable insights into current decision support system research trends. Research-dense areas indicate mature topics that can be further

developed. While sparsely researched areas identify new opportunities for future exploration and innovation. Researchers can use this mapping to guide the future direction of decision support system research.

4. CONCLUSION

This research shows that research interest in decision support systems is still quite high despite fluctuations from year to year. Based on keyword mapping, 5 main clusters were found to be the focus of current decision support system research, namely the application of advanced technologies such as blockchain, applications in health care, risk assessment and mitigation, big data and data mining, and visualization and interpretation of output.

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