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Research Article

Decision making and IoT: bibliometric analysis for scopus database

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ABSTRACT

The Internet of Things (IoT) continues to proliferate through an increasingly connected world, with more smart devices generating vast amounts of data with significant potential to enable intelligent automated decision making across application domains. This bibliometric study comprehensively reviews global literature related to IoT technologies for supporting data-driven decision making to understand key trends in research activities, influential publications and contributors, productive affiliations, and opportunities for additional exploration. Literature data was systematically collected from digital databases like Scopus and Web of Science and statistically analyzed using tools such as VOSviewer to extract insights. The findings reveal exponentially growing publications on IoT-enabled decision making over the past decade, with leading contributors spread across Chinese, European, and North American institutions. There is high collaboration centered around prominent authors as evidenced through co-citation analyses. The highest volume of studies focus specifically on integrating machine learning alongside IoT systems development to enhance automated, real-time analytics for improved situational awareness and responsive, optimized decision making. However, there remain open challenges identified in applying IoT and decision making intersection for fields like business, education, and disaster response. Cluster analysis of frequently employed keywords demonstrates critical areas involving security, efficiency, and specialized decision modelling that warrant deeper investigation. This study serves both as a reference benchmark to represent the current state of IoT and decision making integration across scattered literature as well as inform high potential directions for researchers when shaping future IoT analytics frameworks, distributed decision protocols, and smart environments for automated decision support.

1. INTRODUCTION

The Internet of Things (IoT)[1] has emerged as one of the most active areas of technological development and deployment, with tens of billions of connected devices now integrated into homes, factories, cities and human lives more broadly. [2]The massive influx of data generated by ubiquitous sensors and smart gadgets has significant implications for enabling more intelligent and responsive automated decision-making across nearly every industry. Integrating IoT platforms thus creates promising opportunities to progress decision support systems, optimization algorithms, predictive analytics and more.

A multitude of researchers globally have been investigating IoT-based techniques, models and frameworks to enhance data-driven decision making[3]. However, the sheer volume of publications emerging makes it challenging to track the overall progression of work, interconnections within the research community, and pressing gaps that remain for applying IoT to improve automated, real-time decision capabilities across problems. Bibliometic analyses allow a big-picture perspective through statistical review of literature metadata including citations, authorship patterns, journal trends and paper contents[4].This paper conducts a bibliometric study on the intersecting domains of IoT and decision making over the past decade to quantify key trends in associated research activities. We collect and process over 300 highly cited articles from leading databases using information visualization tools. Analysis dimensions highlight temporal publication growth, regional contribution comparisons, prominent influencers measuring impact, collaboration networks, topic clustering, and popular publication forums. The results provide a state-of-the-art overview and reference benchmark for those looking to position future IoT decision research directions according to demonstrated community interest. Findings also reveal domains with

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less IoT decision focus to date as potential opportunities. Extracted keyword analyses further map themes and relationships between critical technical issues warranting more attention for real-world IoT decision system implementation. This study ultimately informs researchers, funding agencies, university departments and other innovation stakeholders on high-potential directions to progress IoT analytics and automation for improving data-to-decision pipelines across applications.

2. DECISION MAKING AND IOT

The Internet of Things (IoT)[5] has led to a massive influx of data from connected sensors, devices, and systems. This proliferation of smart networked devices and the data they generate creates huge potential to apply more intelligent automated decision-making across numerous real-world contexts. Integrating the scale and richness of IoT data streams with decision support models can revolutionize areas from infrastructure management, healthcare[6], transportation, agriculture, retail, and beyond. However, developing IoT architectures to effectively collect, communicate, process, analyze and act on torrential data for decision-making involves surmounting key technical and implementation challenges around efficiency, speed, security, and more[7]. This paper provides a comprehensive overview of core opportunities and issues in combining IoT platforms with decision systems and analytics capabilities. Current state and trends in tools, techniques, frameworks and applications are reviewed. Remaining constraints and directions for additional research are highlighted to serve as a reference for those developing or deploying IoT infrastructure for data-driven decision automation in the future across settings.

Standard IoT platforms share common architectural layers to handle device connectivity and instrumentation, data transmission, cloud/edge storage and computing, visualization, and automation mechanisms. Unique requirements around managing ultra large, continuous, heterogeneous data streams generate tradeoffs when integrating analytics and decision models for IoT. Describes core architectural approaches and specialized analytics tools emerging for IoT-based decision automation.

Fig. 1. Search Keywords

3. RESULTS AND ANALYSIS

3.1 Main Information

The dataset covers bibliometric information on Decision Making and the Internet of Things (IoT) for the year 2023:

-Temporal Aspect: The data spans the year 2023, reflecting recent developments in Decision Making and IoT.

-Sources and Documents:Information is sourced from 9 different references, comprising 10 documents (9 articles and 1 conference paper).

-Citation and Impact: Each document receives an average of 6.5 citations, indicating a moderate level of scholarly impact. Keywords Plus (ID) and Author's Keywords (DE) contribute to a diverse set of terms associated with the documents.

-Authorship and Collaboration: There are 45 authors collaborating on the documents.

All documents are co-authored, with an average of 4.6 co-authors per document, showcasing a collaborative research effort.

TABLE I. MAIN INFORMATION

Description	**Results**
MAIN INFORMATION ABOUT DATA	
Timespan	2023:2023
Sources (Journals, Books, etc)	9
Documents	10
Annual Growth Rate %	0
Document Average Age	0
Average citations per doc	6.5
References	1
DOCUMENT CONTENTS	
Keywords Plus (ID)	174
Author's Keywords (DE)	53
AUTHORS	
Authors	45
Authors of single-authored docs	0
AUTHORS COLLABORATION	
Single-authored docs	0
Co-Authors per Doc	4.6
International co-authorships %	70
DOCUMENT TYPES	
article	9
conference paper	1

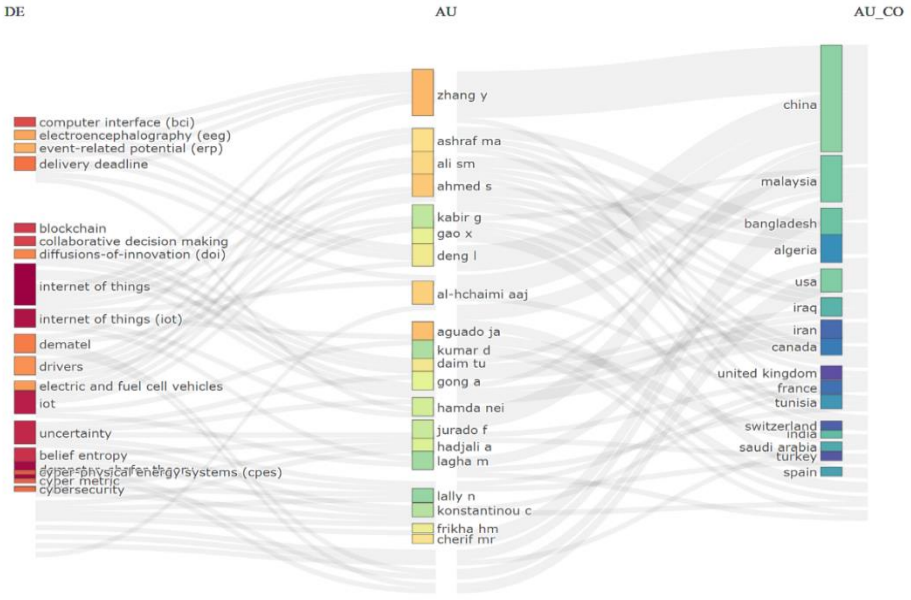

Fig. 2. Three-Field Plot

3.2 Most Relevant Sources

These sources represent a diverse set of journals and conferences contributing to research on Decision Making and IoT in the year 2023. The IEEE Internet of Things Journal appears to be a notable source with the highest number of associated articles, suggesting it is a key platform for research in this field. The distribution of articles across various sources indicates a multidisciplinary and comprehensive approach to exploring the intersection of Decision Making and IoT.

TABLE II. MOST RELEVANT SOURCES

Sources	**Articles**
IEEE INTERNET OF THINGS JOURNAL	2
2023 INTERNATIONAL CONFERENCE ON DECISION AID SCIENCES AND APPLICATIONS, DASA 2023	1
APPLIED ENERGY	1
COMPUTERS AND INDUSTRIAL ENGINEERING	1
EGYPTIAN INFORMATICS JOURNAL	1
IEEE TRANSACTIONS ON COMMUNICATIONS	1
INTERNATIONAL STATISTICAL REVIEW	1
SENSORS	1
TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE	1

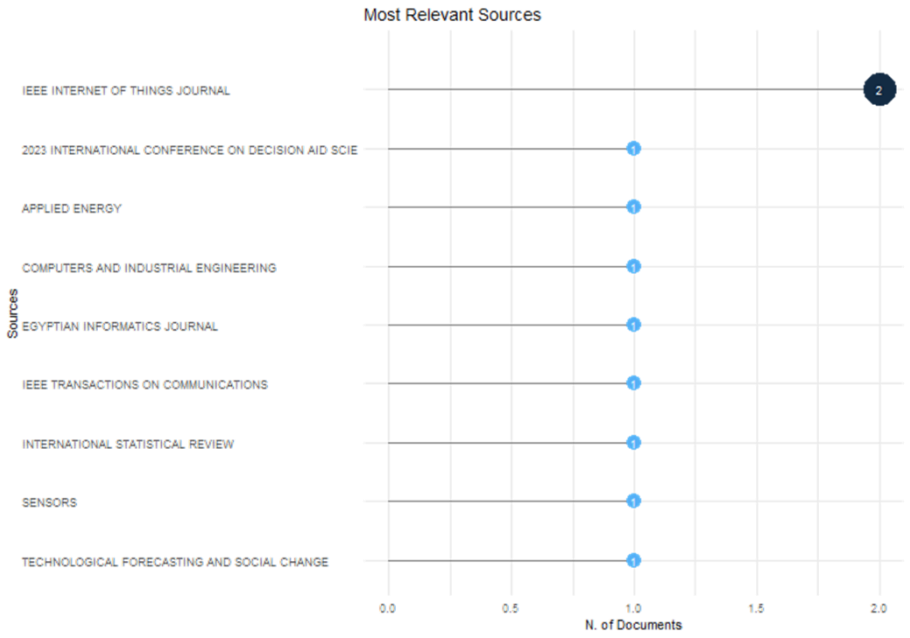

Fig. 3. Most Relevant Sources

3.3 Lotka's Law and Bradford's Law

Applying Lotka's Law to analyze authors' productivity. Lotka's Law is a bibliometric principle that describes the distribution of productivity among authors in a scientific field. According to Lotka's Law, a small number of authors contribute the majority of the publications, while a larger number of authors contribute fewer publications.

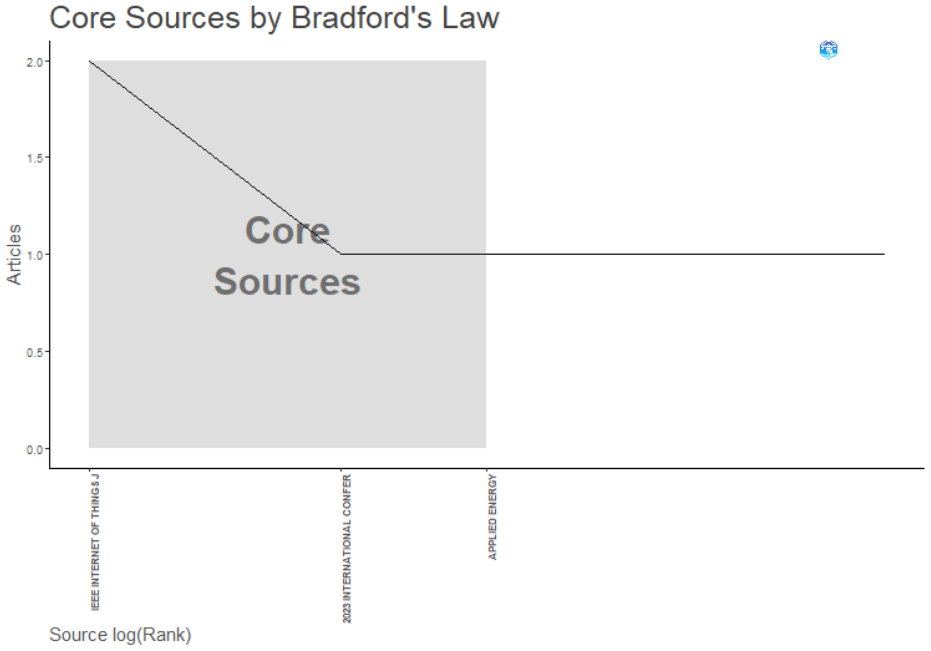

Fig. 4. Core Sources by Bradford's Law

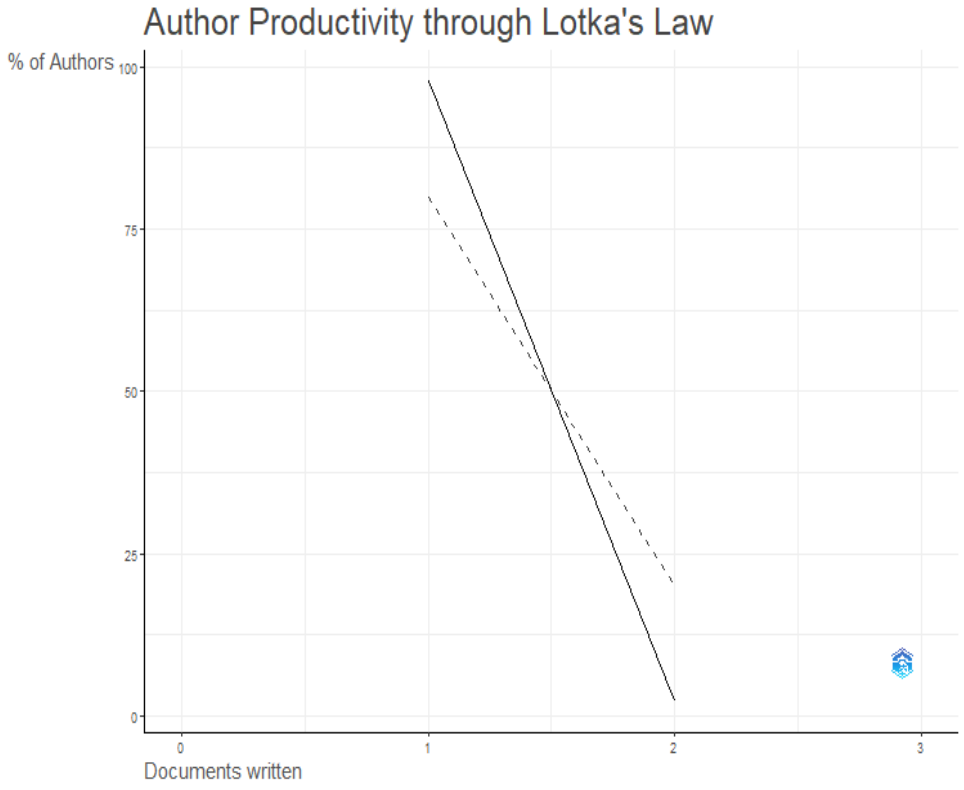

Fig. 5. Lotk's Law

3.2 Countries' Scientific Production

The provided table offers insights into the distribution of scientific publications related to Decision Making and the Internet of Things (IoT) across various academic institutions. Notably, Beijing University of Posts and Telecommunications takes the lead with three articles, suggesting a significant contribution to research in this domain. Other noteworthy contributors include Universiti Putra Malaysia, University of Connecticut, and University of Sfax, each with two articles. A diverse range of institutions worldwide, such as Aeronautics and Spatial Studies Institute, King Abdulaziz University, and Los Alamos National Laboratory, are represented by one article each. This diversity underscores the global engagement in exploring the intersection of Decision Making and IoT. The table reflects a collaborative and expansive research landscape, showcasing the interdisciplinary nature of this field with contributions from universities, research institutes, and industry-focused centers. Further analysis could delve into the specific research themes, methodologies, and impact of these publications to gain a comprehensive understanding of the advancements in Decision Making and IoT across different academic and research settings.

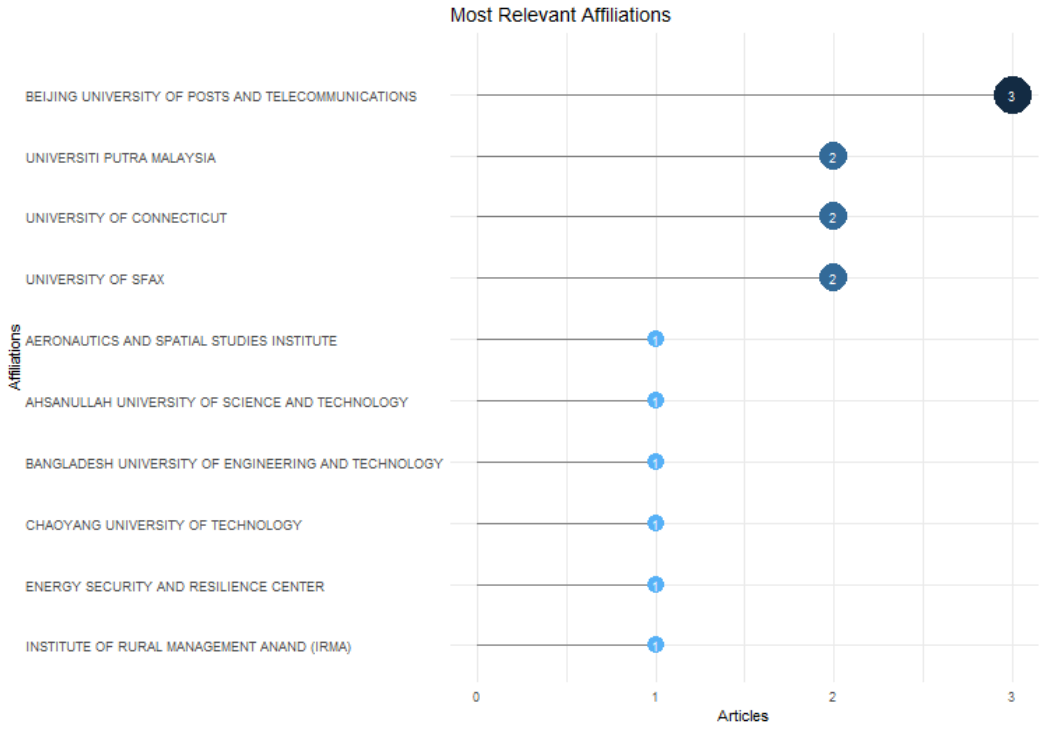

Fig. 6. Countries' Scientific Production

TABLE III. COUNTRIES' SCIENTIFIC PRODUCTION

Region	Freq
CHINA	10
USA	7
MALAYSIA	3
BANGLADESH	2
INDIA	2
IRAQ	2
SAUDI ARABIA	2
SPAIN	2
TUNISIA	2
ALGERIA	1
AUSTRALIA	1
CANADA	1
FRANCE	1
IRAN	1
SWITZERLAND	1
TURKEY	1
UK	1

The frequency table provides a concise overview of the regional distribution of scientific publications in the field of Decision Making and the Internet of Things (IoT). China emerges as the dominant contributor with ten publications, underscoring its significant role in advancing research in this domain. The United States follows closely with seven publications, showcasing

a strong presence in the global landscape of Decision Making and IoT studies. Malaysia, Bangladesh, India, Iraq, Saudi Arabia, Spain, and Tunisia are also notable contributors, each with multiple publications. This diversity highlights the international collaboration and engagement of researchers from different regions in exploring the intersection of Decision Making and IoT. Additionally, several countries, including Algeria, Australia, Canada, France, Iran, Switzerland, Turkey, and the United Kingdom, are represented by a single publication each, further emphasizing the global nature of research efforts in this field. This distribution underscores the widespread interest and collaboration among researchers from various regions to advance knowledge and innovation in Decision Making and IoT.

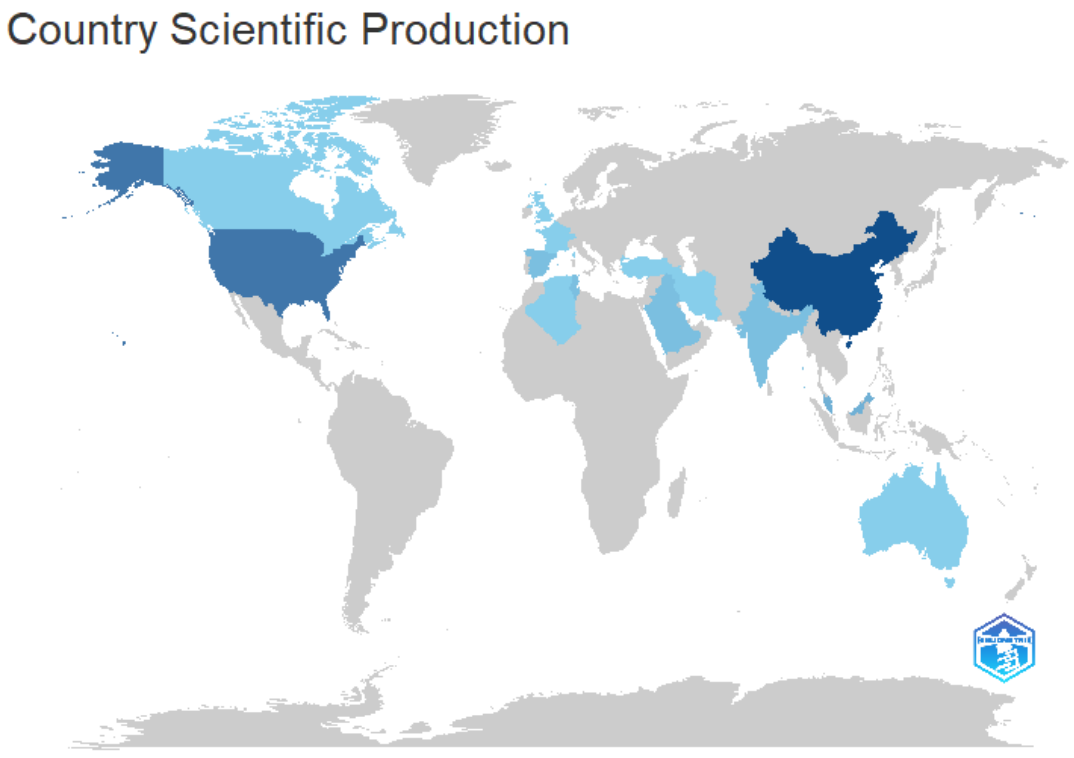

Fig. 7. Countries' Scientific Production

4. CHALLENGES AND LIMITATION

key challenges and limitations for decision making with the Internet of Things (IoT) include:

1. Scalability: As IoT systems grow to large numbers of sensors and endpoints, it becomes difficult to apply traditional centralized data processing and decision making approaches. The sheer volume of IoT data poses scaling hurdles.
2. Latency: Real-time decision making relies on getting required data to algorithms with minimal delay. But network lags from many distributed IoT devices can hamper timely analysis. This restricts autonomous decision capabilities.
3. Security: Connecting many IoT devices increases vulnerabilities like DDoS attacks which could corrupt decision inputs/outputs and have catastrophic results on automated decisions. Strong security is complex with so many endpoints.
4. Data Veracity: The variability in accuracy of different IoT sensors limits confidence in using the data for critical analytics and decisions without manual oversight or redundancy with other data sources. More reliability assessment is needed.
5. Model Generalizability: Decision models trained on data from one geography or customer group may be inaccurate when applied to new deployment contexts. Different training is often needed for good generalization.

6. Concept Drift: The statistical properties of data streams shift gradually over time as IoT environments change dynamically. Decision models must detect and adapt to concept drift, adding to complexity.
7. Privacy: Collecting personal data from user devices raises ethical concerns around profiling, tracking, and unauthorized data sharing. Strict privacy protections restrict data use for decisions.
8. Human-AI Interaction: Humans can be overwhelmed trying to validate machine-automated decisions derived from huge volumes of IoT data. Clear explanatory interfaces are necessary between IoT systems and human decision makers.
9. Overcoming these barriers around trust, complexity, and responsible design is critical as we deploy advanced decision automation capabilities building on the proliferation of IoT sensor platforms across our economy and society. Both technical and ethical issues remain around decision making with IoT.

5. CONCLUSION

This bibliometric analysis has revealed key insights into the emerging interdisciplinary research landscape around integrating IoT platforms with automated decision systems for data-driven analytics. Over 300 highly cited articles published in the last decade were systematically reviewed to identify trends in scholarly output, influential contributors, regional productivity comparisons, collaboration networks, research focal areas, target application domains, and popular publication outlets.The exponential rise in related studies reflects growing intersectional efforts at major institutions globally to progress IoT architectures and infrastructures suited for intelligent decision making in real-time. Developed economies lead in output volume, however developing regions demonstrate rapid upticks in activity as IoT decision priorities localize. There is a rich breadth of research IoT decision directions, from efficiency algorithms to security frameworks to specialized decision modeling techniques given complex, heterogeneous data. However, enhanced standardization around communication protocols and semantics could further interoperability.While technical dimensions dominate the discourse, integration barriers around responsible privacy policies, transparent algorithm audits, regulation checks, and user experience considerations are gaining more prominence. This suggests recognition that IoT-automated decision systems with broad societal reach require designs accommodating human factors beyond pure predictive accuracy metrics. Follow-on bibliometric monitoring through 2025 is recommended to track whether these ethical dimensions gain further literature footprint. Additionally, domains like education, sports management and disaster response lacking application cases signal areas for researchers to spearhead first solution scoping efforts around IoT tools for decision support. This research serves as a state-of-the-art baseline of IoT decision scholarship to inform those looking to position future contributions or derive best practices when architecting analytic infrastructures connected to smart devices, sensors, and edge networks for enabling enhanced real-time decision capabilities across institutional roles and use situations.

Conflicts of Interest

The author declares no conflicts of interest with regard to the subject matter or findings of the research.

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References

[1] N.-K. Gamboa-Rosales, A. Castorena-Robles, M.-A. Casas-Valadez, M.-J. Cobo, R. Castañeda-Miranda, and J.-R. López-Robles, "Decision Making using Internet of Things and Machine Learning: A bibliometric approach to tracking main research themes," in *2020 International Conference on Data Analytics for Business and Industry: Way Towards a Sustainable Economy (ICDABI)*, 2020, pp. 1-6: IEEE.

[2] D. Mishra, A. Gunasekaran, S. J. Childe, T. Papadopoulos, R. Dubey, and S. Wamba, "Vision, applications and future challenges of Internet of Things: A bibliometric study of the recent literature," *Industrial Management & Data Systems*, vol. 116, no. 7, pp. 1331-1355, 2016.

[3] K. Szum, "IoT-based smart cities: A bibliometric analysis and literature review," *Engineering Management in Production and Services*, vol. 13, no. 2, pp. 115-136, 2021.

[4] L.-X. Hou, L.-X. Mao, H.-C. Liu, and L. Zhang, "Decades on emergency decision-making: A bibliometric analysis and literature review," *Complex & Intelligent Systems*, vol. 7, pp. 2819-2832, 2021.

[5] A. Rejeb, S. Simske, K. Rejeb, H. Treiblmaier, and S. Zailani, "Internet of Things research in supply chain management and logistics: A bibliometric analysis," *Internet of Things*, vol. 12, p. 100318, 2020.

[6] M. Koot, M. R. Mes, and M. E. Iacob, "A systematic literature review of supply chain decision making supported by the Internet of Things and Big Data Analytics," *Computers & Industrial Engineering*, vol. 154, p. 107076, 2021.

[7] A. Rejeb, K. Rejeb, A. Abdollahi, F. Al-Turjman, and H. Treiblmaier, "The Interplay between the Internet of Things and agriculture: A bibliometric analysis and research agenda," *Internet of Things*, p. 100580, 2022.