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Trends and Research Landscape of Warehouse IOT: A Bibliometric Analysis

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ABSTRACT

Technologic can now reap the benefits of the increasing use of the Internet in Malaysia. Warehouse IOT are very important for businesses that tend to expand their business into an online platform and using technologic. Therefore, this study considered on provide a scalable and sustainable method to improving academic and professional achievements in an increasingly digital environment by concentrating on topics like warehouse IOT and offering useful advice for warehouse IOT. Numerous academics are interested in this field because of the possibilities of warehouse IOT. This study report may provide readers with additional information on the topic. The study includes a comprehensive examination of 1846 publications collected between 1938 and 2025. This essay will focus on the findings of significant writers, publications, nations/regions, and fields of study. This article also attempted to discover many themes that evolved and evolved during the active years through the use of co-citation and co-occurrence networks. Because of the growing number of research articles and the widespread adoption of warehouse IOT in many countries, bibliometric analysis must be used to provide a comprehensive set of data that can help researchers find the most relevant work to date. This can be achieved by utilizing the VOS Viewer and Biblioshiny tools to explore different facets of the warehouse research topic and discover potential future study directions.

1. Introduction

The integration of the Internet of Things (IoT) into warehouse management has transformed traditional logistics, enabling real-time data collection, automation, and intelligent decision-making. Bibliometric studies provide a systematic lens to map the evolution, trends, and research gaps in this rapidly advancing field. Warehouses are pivotal nodes in supply chains, historically serving as storage points but now evolving into dynamic, technology-driven hubs due to the advent of Industry 4.0 and IoT technologies. The increasing complexity of global trade, customer expectations for rapid delivery, and the need for operational efficiency have driven the adoption of IoT in warehouse management.

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IoT enables the seamless connection of physical assets such as pallets, racks, and vehicles with digital systems, facilitating real-time monitoring, inventory tracking, and process automation, which "was also done prior research [7,9,18]". This digital transformation is not merely a technological upgrade but a strategic shift requiring organizational change, investment in infrastructure, and the development of new competencies, which "was also undertaken Steven Andreas Gunawan *et al*., [7]".

Bibliometric analysis, which applies quantitative and qualitative methods to map scientific literature, has become an essential tool for understanding the intellectual landscape of IoT applications in warehousing. By analyzing publication trends, influential authors, key journals, and thematic clusters, bibliometric studies reveal the evolution of research, highlight dominant technologies (RFID, wireless sensor networks), and identify emerging topics such as AI integration, blockchain, and sustainability, which "was also done prior research [1-4,6,11,12,16,18]". This approach also uncovers research gaps and future directions, guiding both academics and practitioners in navigating the complex terrain of warehouse IoT.

IoT research in warehousing has grown exponentially over the past two decades, reflecting the broader digital transformation in supply chain management (SCM) and logistics, which "was also done prior research [1-4,6,11,12,16,18]". Early studies focused on foundational technologies like RFID and wireless sensor networks, which enabled basic tracking and automation, which "was also done prior research [1,4,11]". As the field matured, research expanded to encompass advanced topics such as real-time data analytics, AI-driven optimization, and the integration of IoT with other Industry 4.0 technologies, which "was also done prior research [2-3,6,12,18]". Bibliometric analyses consistently identify RFID, Industry 4.0, and blockchain as central themes in warehouse IoT research, which "was also done prior research [1-2,4,6,11,12,16]". Thematic clustering using keyword co-occurrence networks reveals that research has shifted from technology-centric studies to broader explorations of digital transformation, security, sustainability, and supply chain resilience, which "was also done prior research [2,3,6,12,16,18]". For example, the integration of AI and machine learning with IoT is now recognized as a key driver of predictive analytics, autonomous decision-making, and operational efficiency, which "was also done prior research [3,12,18]".

IoT adoption in warehouses leads to improved inventory accuracy, reduced order processing times, enhanced customer satisfaction, and better financial performance, which "was also done prior research [7-9,11,12,18]". However, successful implementation requires more than technological investment; it demands organizational change, top management support, and the development of human capital, which "was also done prior research [7-9,11,12,18]".

IoT applications in warehousing span multiple industries, including food, retail, healthcare, and manufacturing, which "was also done prior research [1,4,6,11,12,16,18]". Research output is globally distributed, with significant contributions from China, India, the United States, and Europe, which "was also done prior research [2,6,14,19]". International collaboration networks are expanding, reflecting the global relevance of warehouse IoT research, which "was also done prior research [2,6,14,19]". Most bibliometric studies note a predominance of conceptual and review articles, with limited empirical and analytical modeling research, which "was also done prior research [10,17]". There is a need for more case studies, experimental research, and real-world validations to bridge the gap between theory and practice, which "was also done prior research [10,17]". Additionally, future research should address the unique challenges of small and medium-sized enterprises (SMEs), which often face resource constraints in adopting IoT technologies, which "was also done prior research [7-9,12,18]".

Despite the recent surge in interest in warehouse IOT, the present body of research is still fragmented and has a narrow focus. The majority of research focuses on bibliometric metrics like

publication patterns, co-citations, and keyword analysis, but it ignores the more profound qualitative facets of the organizational, technological, and environmental components of warehouse IOT in Malaysian manufacturing. Furthermore, there has not been enough discussion of the impact of new technologies like digital and smart warehouse. Many research continues to focus on the past while ignoring consequences for academic advancement in the future. These discrepancies highlight the necessity for a more comprehensive and proactive investigation of digital or smart things in connection to warehouse internet of things (IOT)performance. This study is significant because it offers one of the first comprehensive bibliometric mappings of warehouse IOT, consolidating scattered literature into a structured overview. By analyzing 1846 publications from the Scopus database, it identifies leading authors, influential journals, and key thematic evolutions in the field. The findings provide practical insights for warehouse and policymakers on how warehouse IOT can be designed to improve manufacturing outcomes capabilities of technological, organizational and environmental on Logistics and smart warehouse. This study also highlights the broader role of warehouse IOT in addressing capabilities and reshape to digital logistics environments. Importantly, this study fosters interdisciplinary collaboration across technological, organizational and environmental. As such, it serves as a valuable foundation for future research and practice in the digital transformation of warehouse. The endeavor will use bibliometric analysis to address a number of topics. Find out how many articles have been published on warehouse IoT by searching academic databases and research archives. Break out the total number of research articles published each year to examine the publishing trend over time. Please provide a list of the most prominent scholarly publications that publish articles on warehouses. To find out which nations have published the most on this subject, look for studies or analyses that detail the distribution of warehouse research by geography. Sort the writers in the area of warehouse IOT by publication volume and citation count to find the most important and relevant ones. Locate the names of the most referenced research articles, sorting them by the number of citations they have received both internationally and domestically. Locate the most referenced or cited research article by looking at its title. Find out what the present and future theme structure of warehouse IoT research is by looking at previous literature reviews and meta-analyses. To back up the previous results, this research described the trends of publications on warehouse IOT using bibliometric analysis of the Scopus database. Accessibility, language, subject matter, source title, most cited works, publishing trends, and authors' keywords were some of the criteria used to evaluate various publications in this research. Following this outline, the remainder of the paper may be structured as follows. In part (2), we will provide the approach for bibliometric analysis. In part (4), we will give the findings. In parts (4) and (5), we will draw conclusions.

2. Methodology

The bibliometric toolbox will be used to do the bibliometric analysis. The primary technique and the enrichment technique are the two methods included in the toolbox. Performance analysis (A) and science mapping (B) are the two key components of the approach. Although the main methodologies have many potential applications, this study will narrow its focus to just a handful. R and VOSViewer were two programs that were useful for bibliometric analysis. The term "bibliometric analysis" refers to a quantitative investigation of a large dataset; the findings are then shown as descriptive analysis, research elements, themes, and networks. This bibliometric analysis "was also undertaken by Badenes-Rocha *et al*., [5]" and may be used to study the development and topical organisation of a certain discipline. Furthermore, there is no subjective bias in this investigation. The bibliographic data analysis in this article was also carried out by Nasir *et al*., [15]. " The patterns and

future directions of the study were derived via the use of scientific mapping and performance analysis. Performance analysis is a method for evaluating the roles played by various stakeholders in a research project, such as authors, counties, publishers, journals, and institutions in the study area. The goal of scientific mapping is to establish relationships between different parts of the research process. Combining scientific mapping and enrichment methodologies provides us with the conceptual framework of a study area and the essential subjects of the problem, as was "also undertaken by earlier studies [5,15]," thereby connecting various elements of the research.

2.1 Bibliometric Search

Scopus is used to compile a database for bibliometric analysis. "Was also undertaken by Jakhar *et al*., [13]," says the Scopus database, which is widely considered the gold standard in bibliometrics. The argument that "was also done prior research [5,15,16]" has been backed by Scopus's reputation as the top database for bibliometric analysis. As a result, publications must adhere to stringent standards in order to be included in Scopus, making it the most complete database that covers a broad variety of article information.

"Logistics 4.0," "Warehouse 4.0," and "Warehouse IOT" are among the recognized keywords for the best search. "Warehouse IOT" was the best keyword. This article provided an analysis on Warehouse IoT. After doing a search on the Scopus database with the keyword "Warehouse IOT," 1846 publications were finally retrieved.

2.2 Filtration

The initial filter was a language filter, which limited the selection to periodicals written in English. Then, the articles that were chosen for publication in journals were chosen. In the end, 1846 articles were considered for study. No other sorting criteria were used except these two due to concerns that further filtering would reduce the article count and impact the bibliometric analysis.

3. Results

3.1 Total Publication and Number of Active Years of Publication

The total publication is one method for performance analysis. Consideration is given to the total amount of publications about the subject of the research. Eleven hundred forty-six results from published publications make up the annual scientific output. The articles were categorised according to the year in which they appeared in the journals. Figure (1) allows us to deduce that there is a yearly growth in warehouse IOT research. There was just one publication in 1938; nevertheless, by 2012, there were 23 publications overall, and in 2022 and 2023, there were 217 and 255, respectively. 246 papers are counted until August 2025. A phenomenon's "active years of publishing" indicate the length of time that researchers have been actively studying it. As of the beginning of the active year in 1938, groundbreaking research was already underway. Additional research is necessary on this topic since, as indicated in Figures (1) and (2), the number of studies undertaken each year is still far lower than expected.

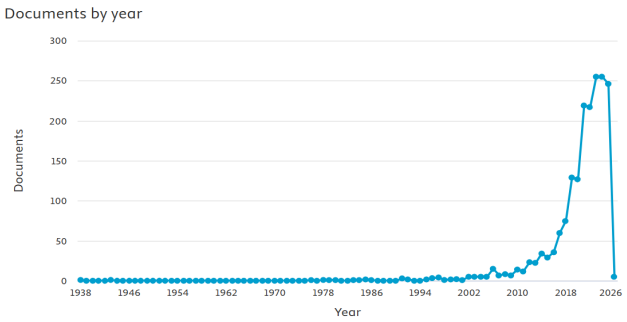

Fig. 1. Shows year-to-year publications from 1938 to 2026

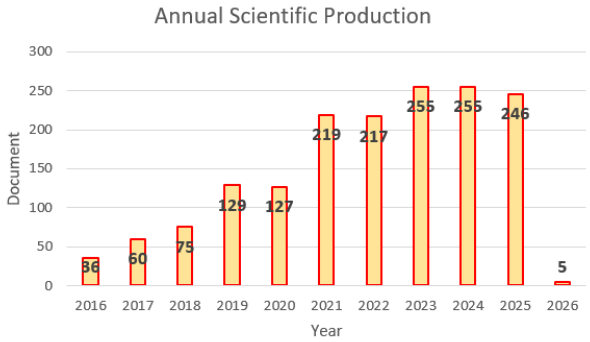

Fig. 2. Shows year-to-year publications from 2016 to 2026

3.2 Most Promising Journals

Promising journals are those that publish the highest number of papers on a certain field. In order to find prospective publications, we used R software to apply Bradford's rule. The ten most promising publications in the field of warehouse IoT are shown in Table (1). When compared to other publications, JAMA Network Open has the upper hand when it comes to warehouse IoT, with 52 papers covering the subject. One advantage that Plos One has over other journals is the total number of 32 papers that cover warehouse IOT. The Applied Sciences Switzerland has a leg up on other journals when it comes to warehouse IoT, with 22 papers on the topic and 26 publications in the Lecture Notes in Mechanical Engineering. As can be seen in Table (1), certain journals offer benefits over others. Publishing works that had potential led to the selection of Bradford's legislation for scrutiny. The outcome was a graph showing the number of articles published by a journal together with the name of the source. The graph was transformed into a table, as seen in Table (1). Researchers may utilise Bradford's law analysis to quickly uncover and choose a handful of journals that will assist their study of warehouse IoT and future research by selecting the most relevant journals that are leading the way in releasing information about this topic. The more articles a journal publishes on a certain subject, the more of an influence it may have on subsequent researchers in that area.

Table 1
The name of the journal along with the number of a paper published

No.	Name of journals	No. of published
1.	JAMA Network Open	52
2.	Plos One	32
3.	Lecture Notes in Mechanical Engineering	26

4.	Applied Sciences Switzerland	22
5.	IFAC Papersonline	20
6.	Procedia Computer Science	19
7.	Health Services Research	16
8.	Journal of General Internal Medicine	14
9.	Journal of Stored Products Research	13
10.	Medical Care	11

3.3 Dominant Countries

Nations are considered to be dominant in the subject of research if they have the largest number of published papers and citations. The analytical job involves examining the database using R software. In order to determine which countries are in the forefront of warehouse IoT, the data are analysed based on their research output and citations. To find out which countries are dominating, we look at both the number of articles and the number of citations. For this reason, we will be looking at the top 10 countries from both perspectives. By comparing numbers (2) and (3), we can see that the United States has more documents than any other country (747), even though Hong Kong has the highest average article citations (45.19). Despite publishing less than 28 publications, the Qutar unexpectedly ranks second for average article citations. In terms of citations, Sweden fell behind numerous other countries, including the United Kingdom, Australia, Canada, and others, even though these nations had more published texts. India is facing a similar predicament. This country's counterpart in Hong Kong received fewer publications but more citations overall. To make the study easier to understand, the data from figures (3) and (4) were translated into a tabular format in Table (2). It follows that the US and Hong Kong are leading the pack when it comes to warehouse IoT research. Colombia, Hong Kong, Papua New Guinea, and Qatar stand up when looking at average article citations.

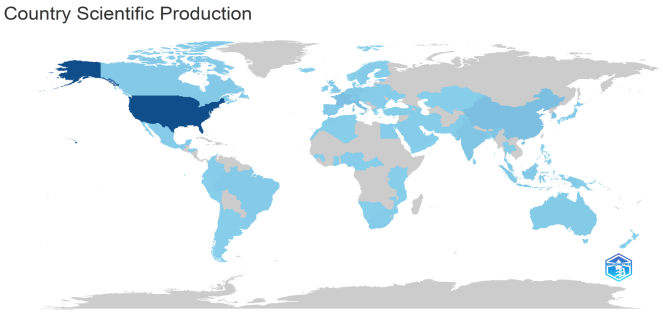

Fig. 3. A world map depicting the number of documents published by each country

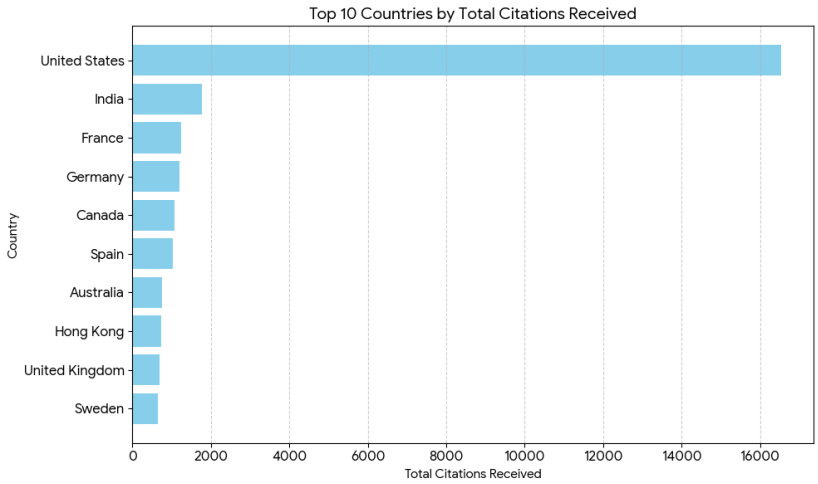

Fig. 4. The number of citations received by each country's documents

Table 2
The countries' names, the number of documents published and the number of citations received

Rank	Country	Document	Rank	Country	Average Article Citations
1	United States	747	1	Hong Kong	45.19
2	India	99	2	Qatar	43
3	France	69	3	Papua New Guinea	42
4	Germany	68	4	Colombia	37.25
5	Canada	56	5	Lithuania	33.17
6	Spain	35	6	Spain	29.66
7	Australia	39	7	Finland	28.25
8	Hong Kong	16	8	Egypt	28
9	United Kingdom	49	9	Estonia	27
10	Sweden	28	10	Malaysia	27

3.4 Most Relevant Authors

To find the most relevant authors, look at their publication rates. Consequently, it was computed using R software by tally of the number of articles pertaining to warehouse IOT. A higher number of publications authored by an author is associated with a greater level of relevance, according to the statistics. Figure 5 displays the 10 authors who are most relevant (5). The fact that Sangaralingham Lindsey R., Shah Nilay D., and Mccoy Rozalina Grubina each have 21 and 18 papers, respectively, is obvious. Readers may have a better understanding of the work of the top 10 authors listed and identify areas that need more attention.

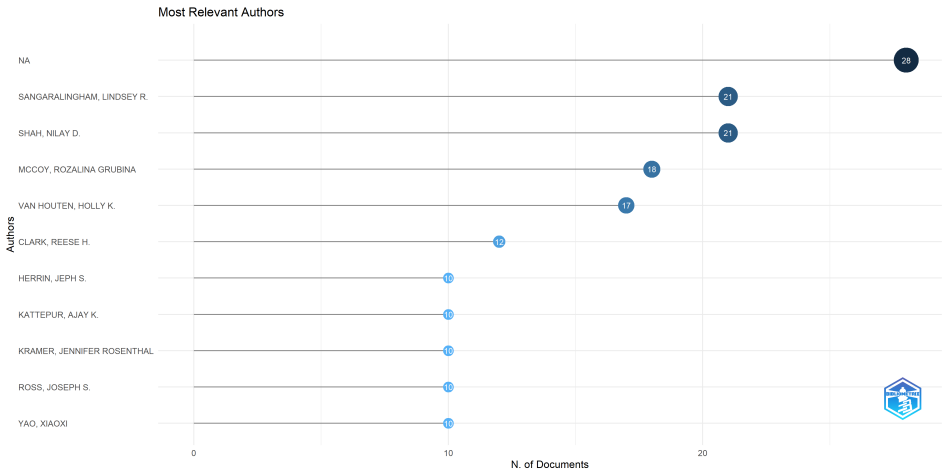

Fig. 5. Shows the authors' names and the number of papers published by them

3.5 Influential Authors

In every given topic, the most cited writers are those who have garnered the most amount of scholarly articles. All that is required are the citations. Thus, writers were ranked according to the total number of documents they received. A higher total document count indicates a more influential author, while a lower total document count indicates a less prominent author. In terms of total documents, authors like Crown William H. (1098) and Shah Nilay D. (1034) stand head and shoulders above the competition. On the other hand, writers like Marc R. Larochelle and Christine E. Chaisson come in at number three and four, respectively. In figure (6), you can see the remaining writers.

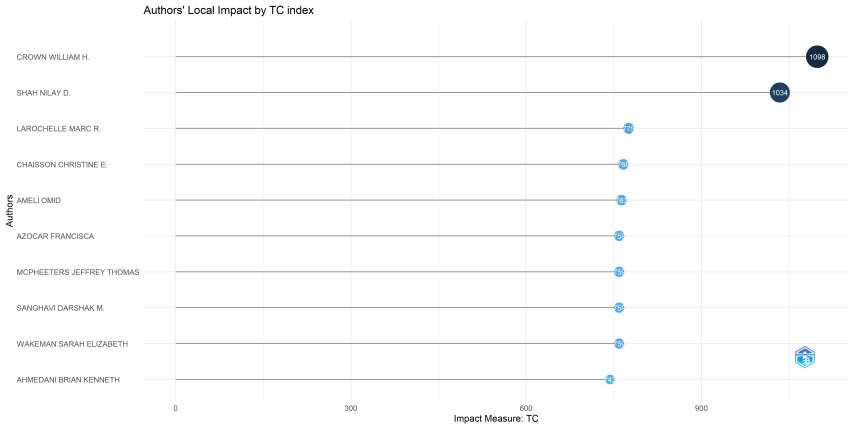

Fig. 6. Authors' names and numbers of total document

3.6 Citation Analysis

Analysing citations is a method for scientific mapping. A reference is a connection to a publication when it appears in another publication. "Jakhar *et al*., [13]" also accomplished this. Global citation and local citation are the two main criteria utilised in citation analysis. One way to measure an article's influence in citation analysis is by looking at how many citations it receives from readers.

3.6.1 Most global cited documents

Publications that get the highest number of citations outside of any kind of filtering including subject domain are called the most globally referenced literature. According to Krishnamoorthi et al. (16), this study was also conducted. A publication is considered to have received global citations if and only if it has been referenced both inside and outside of its subject area. It is arguable that the ten most cited publications in the world significantly influence the choice of citation style used by subsequent authors. These sources are cited in both the articles that deal with warehouse IoT and the ones that don't. Figure (7) shows the top 10 papers, and table (3) provides an analysis of them. Figure (7) was used to determine the top ten most cited publications on a worldwide level. Table (3) includes the names of the articles, authors, and citation counts for these ten publications.

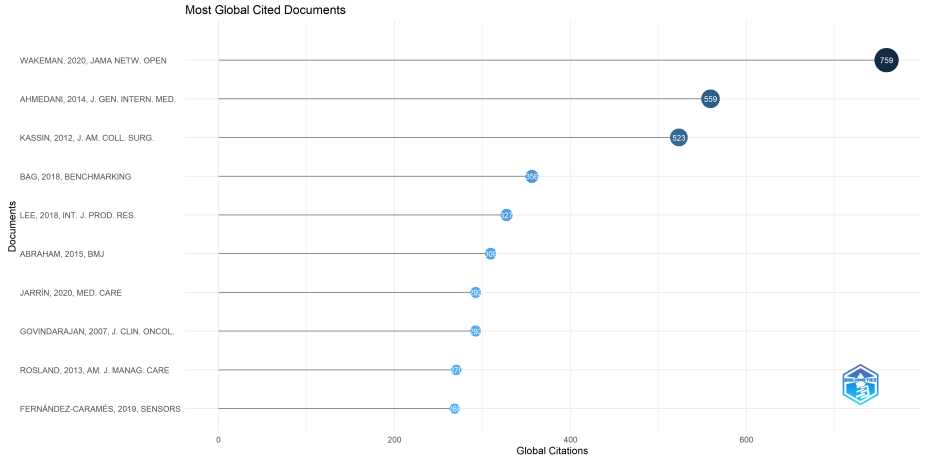

Fig. 7. The most influential papers in terms of global citation

Table 3
The article name, authors' name, and citations of the top 10 globally cited documents

No.	Article Title	Authors	Global citation
1.	Comparative effectiveness of different treatment pathways for opioid use disorder	Wakeman, 2020, Jama Netw. Open	759
2.	Health care contacts in the year before suicide death	Ahmedani, 2014, J. Gen. Intern. Med.	559
3.	Risk factors for 30-day hospital readmission among general surgery patients	Kassin, 2012, J. Am. Coll. Surg.	523
4.	Industry 4.0 and supply chain sustainability: framework and future research directions	Bag, 2018, Benchmarking	356
5.	Design and application of Internet of things-based warehouse management system for smart logistics	Lee, 2018, Int. J. Prod. Res.	327
6.	Comparative risk of gastrointestinal bleeding with dabigatran, rivaroxaban, and warfarin: population based cohort study	Abraham, 2015, Bmj	309
7.	Validity of race and ethnicity codes in Medicare administrative data compared with gold-standard self-reported race collected during routine home health care visits	Jarrín, 2020, Med. Care	292
8.	Thiazolidinediones and the risk of lung, prostate, and colon cancer in patients with diabetes	Govindarajan, 2007, J. Clin. Oncol.	292
9.	The patient-centered medical home in the Veterans Health Administration	Rosland, 2013, Am. J. Manag. Care	270

10.	Towards an Autonomous Industry 4.0 Warehouse: A UAV and Blockchain-Based System for Inventory and Traceability Applications in Big Data-Driven Supply Chain Management	Fernández-Caramés, 2019, Sensors	268

3.6.2 Most local cited documents

One piece of writing on warehouse IoT cites another piece of writing about the same topic. Consequently, most articles that are cited locally focus on works that are often discussed or referred to in the field. To learn more about the subject, look at the documents shown in figure (8). These resources are great starting points for research papers as they are directly related to the topic of warehouse IoT. For the reasons laid forth in their description, it is important to note that local citations will never exceed global citations. Table (4) concludes the study of Figure (8).

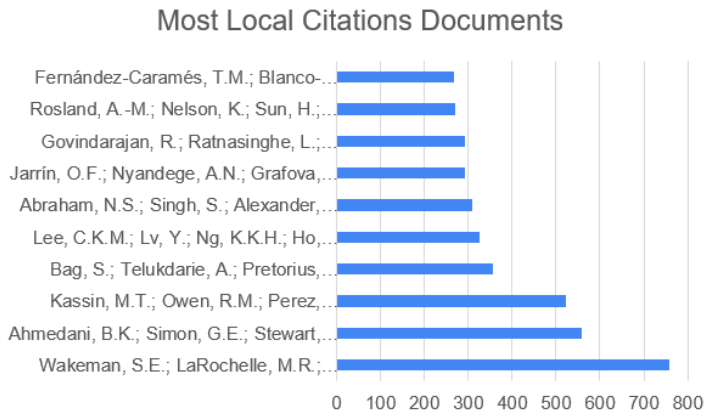

Fig. 8. Shows documents receiving a total number of local citations

Table 4
The article name, authors' name, and citations of the top 10 locally cited documents

No.	Article Title	Authors	Local Citations
1.	Comparative Effectiveness of Different Treatment Pathways for Opioid Use Disorder	Wakeman, S.E.; LaRochelle, M.R.; Ameli, O.; Chaisson, C.E.; McPheeters, J.T.; Crown, W.H.; Azocar, F.; Sanghavi, D.M.	759
2.	Health care contacts in the year before suicide death	Ahmedani, B.K.; Simon, G.E.; Stewart, C.; Beck, A.; Waitzfelder, B.E.; Rossom, R.C.; Lynch, F.; Owen-Smith, A.; Hunkeler, E.M.; Whiteside, U.; Operskalski, B.H.; Coffey, M.J.; Solberg, L.I.	559
3.	Risk factors for 30-day hospital readmission among general surgery patients	Kassin, M.T.; Owen, R.M.; Perez, S.D.; Leeds, I.; Cox, J.C.; Schnier, K.; Sadiraj, V.; Sweeney, J.F.	523
4.	Industry 4.0 and supply chain sustainability: framework and future research directions	Bag, S.; Telukdarie, A.; Pretorius, J.H.C.; Gupta, S.	356
5.	Design and application of internet of things-based warehouse management system for smart logistics	Lee, C.K.M.; Lv, Y.; Ng, K.K.H.; Ho, W.; Choy, K.L.	327

6.	Comparative risk of gastrointestinal bleeding with dabigatran, rivaroxaban, and warfarin: Population based cohort study	Abraham, N.S.; Singh, S.; Alexander, G.; Heien, H.; Haas, L.R.; Crown, W.; Shah, N.D.	309
7.	Validity of Race and Ethnicity Codes in Medicare Administrative Data Compared with Gold-standard Self-reported Race Collected during Routine Home Health Care Visits	Jarrín, O.F.; Nyandege, A.N.; Grafova, I.B.; Dong, X.; Lin, H.	292
8.	Thiazolidinediones and the risk of lung, prostate, and colon cancer in patients with diabetes	Govindarajan, R.; Ratnasinghe, L.; Simmons, D.L.; Siegel, E.R.; Midathada, M.V.; Kim, L.; Kim, P.J.; Owens, R.J.; Lang, N.P.	292
9.	The patient-centered medical home in the veterans health administration	Rosland, A.-M.; Nelson, K.; Sun, H.; Dolan, E.D.; Maynard, C.; Bryson, C.; Stark, R.; Shear, J.M.; Kerr, E.A.; Fihn, S.D.; Schectman, G.	270
10.	Towards an Autonomous Industry 4.0 Warehouse: A UAV and Blockchain-Based System for Inventory and Traceability Applications in Big Data-Driven Supply Chain Management	Fernández-Caramés, T.M.; Blanco-Novoa, O.; Froiz-Miguez, I.; Fraga-Lamas, P.	268

3.7 Co-citation Analysis

Collaborative citation analysis is one way to map scientific literature. It is considered that two references are connected or have a similar content structure when they are discussed together in a third work. Krishnamoorthi *et al*., [16] also employed co-citation analysis to reveal the theoretical underpinnings of a certain area of study. This method also helps us find the most significant articles by using the clusters we generated. A specific basis serves as the basis for each cluster, which all have a common subject. Once the documents have been clustered, the most relevant articles for each topic may be found using the co-citation analysis. This analysis allows researchers to get additional knowledge about the article according to their interests. Furthermore, academics of the future may compile works on a certain subject by perusing the relevant journals. When doing the analysis, the VOSViewer application makes use of a co-citation strategy. We choose just those books and journals that have received at least five citations in other published works. Out of 8415, just 250 make it to the citation limit. We looked at Figure 9 by giving the linkages some weight.

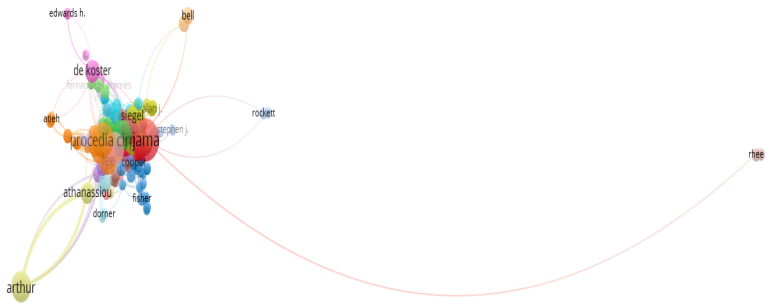

Fig. 9. Shows a map of co-citation analysis based on the authors' name

In all, seventeen clusters are formed. To demonstrate the extent to which other publications are connected to those in the reference list, you might give more weight to the relationships. A higher number of links indicates that the work is more suited for study.

Table 5
The interpretation of the co-citation map

Colour of cluster	Author name	Citation
Red	2 Suppl.	6
	Adams	5
	Benjamin	9
	Berger	5
	Bmj	30
	Burke	5
	Chan	7
	Christopher J.L.	6
	Coleman	5
	David B.	5
	David C.	5
	David J.	12
	David R.	5
	Davis	9
	Deyo	5
	Edwards	5
	Emelia J.	9
	Eric A.	8
	Ford	6
	G.	6
	Jama	69
	John A.	10
	John J.	6
	John N.	5
	John S.	5
	Kim	7
	Kristin M.	6
	Marc L.	5
	Maron	6
	Mehta	5
	Michael A.	11
	Michael D.	5
	Murray	6
	Paul J.	18
	Richard A.	8
	Richard P.	5
	Ross	5
	Schwartz	10
	Scott M.	5
	Shah	7
	Shannon M.	5

	Steven R.	6
	Wallace	16
	William C.	6
	William H.	9
	Wong	6
	Young	5
Green	A.	9
	Ahmedin M.	6
	Amy M.	5
	Benjamin A.	8
	Brady	5
	Chen	9
	Cohen	13
	Communications Of The Acm	5
	Huang	6
	James R.	5
	Jemal	6
	John D.	11
	John W.	6
	Julian M.	7
	Lecture Notes In Networks And Systems	8
	M.	18
	Mark S.	6
	Matthew J.	9
	Michael	7
	Michael C.	7
	Muller	6
	N.	6
	P.	12
	Philip A.	5
	Plos One	37
	Proceedings Of The Ieee	14
	R.	5
	Robert E.	7
	Rubin	6
	Steven J.	6
	Thomas J.	9
	Trivedi	6
	Vladimir A.	5
	Wang	5
	William J.	6
	Wolf	5
	Yu	5
Bule	Aberle	5
	Alan R.	5
	Barnes	5
	Bernard L.	5
	Blumenthal	8

	Bozer	6
	Charlson	6
	Cooper	9
	David L.	5
	David U.	6
	Denise R.	5
	Elizabeth A.	7
	Fisher	8
	H.	5
	J.	9
	James K.	10
	James M.	6
	Jeffrey D.	5
	Jennifer A.	5
	Johnson	7
	Mary E.	7
	Michael F.	8
	Murphy	5
	U.	6
	Walter	5
	Whitney	5
	Yavuz A.	6
Gold	Alan J.	10
	Anderson	13
	Christopher R.	5
	Frank C.	5
	Garber	9
	James A.	6
	Jennifer L.	8
	Katherine E.	5
	Long	6
	Mark A.	8
	Martin	17
	Michael G.	5
	Michael J.	9
	Miller	10
	Nelson	7
	Nguyen	6
	Patel	15
	Ray	7
	Rebecca L.	16
	Richard E.	7
	Robert M.	6
	Siegel	17
	Ward	5
Purple	Baker	5
	Beck	5
	Brown	14

	Campbell	12
	David M.	9
	E.	8
	J. R.	5
	James F.	16
	John G.	5
	Jonathan L.	6
	Kurtz	5
	Lynch	5
	Michael S.	7
	Peter A.	7
	Peter M.	5
	Robert L.	8
	S.	13
	Singh	6
	Stacy L.	6
	Steven M.	10
	Wagner	7
Sky bule	Andrew B.	5
	Andrew J.	7
	David A.	17
	David E.	7
	Eric H.	7
	Grosse	7
	Harris	7
	James T.	5
	John R.	8
	K. L.	8
	L.	8
	Li	6
	Paul A.	9
	Richard J.	10
	Richard L.	7
	Robert A.	7
	Robert J.	15
	Smith	14
	Williams	7
Orange	Anas M.	7
	Andreas	5
	Atieh	8
	D.	8
	Dimitris A.	8
	Etfa	15
	Ieee International Conference On Emerging Technologies And Factory Automation	15
	Jay K.	20
	Lee	33
	Michael E.	10

	Mourtzis	8
	Procedia Cirp	48
	Qin	5
	Taylor	5
Brown	Allen	6
	Chang	7
	Friedman	7
	Jennifer S.	5
	John H.	8
	Jonathan C.	6
	Khuri	6
	Klein	6
	Lin	8
	Ronald E.	5
	Shukri F.	6
Pink	Azuma	5
	De Koster	21
	Edwards H.	5
	Glaessgen	5
	J. M.	5
	Light	6
	Rene B.M.	21
	Richard W.	7
	Ronald T.	6
	T.	5
Light Pink	Antonio A.C.	6
	Christopher J.	6
	Clark	13
	Gue	5
	Kevin R.	5
	Lecture Notes In Computer Science	40
	Thomas	8
	Vieira	6
Light Green	David	7
	Fernandez-Carames	8
	Girshick	5
	Peter R.	8
	Ross B.	5
	Tiago M.	8
	Wurman	8
Light Bule	Ian R.H.	5
	Lara J.	5
	Liu	10
	Rockett	6
	Stephen J.	5
Light Yellow	Arthur	35
	Athanassiou	17
	B.	6

	C. G.	17
	Frank H.	35
Light Purple	Lecture Notes Of The Institute For Computer Sciences	5
	Lnicst	5
	Social-Informatics And Telecommunications Engineering	5
	Yan	6
	Zhang	7
Light Sky Bule	Aravindaraj	6
	Dorner	6
	Joe W.	5
	K.	15
Light Orange	Bell	12
	Christopher H.	11
Light Brown	Connie M.	6
	Rhee	7

This bar chart, titled "Document by author," in Figure (10) illustrates the number of documents published by a selection of authors. The y-axis represents the number of documents, while the x-axis lists the authors. The top 10 authors are led by a tie between Sangaralingham, Lindsey R. and Shah, Nilay D., both of whom have 21 documents. Following closely, McCoy, Rozalina Grubina holds the third rank with 18 documents, and van Houten, Holly K. is fourth with 17 documents. The remaining authors, from rank 5 to rank 10, have a slightly lower concentration of documents, with Clark, Reese H. having 12 documents, and the bottom five authors Ross, Joseph S., Herrin, Jeph S., Yao, Xiaoxi, Kattepur, Ajay K., and Kramer, Jennifer Rosenthal all tied with 10 documents each.

Fig. 10. Shows of highest document from authors' name

This Table 6 shows the author pair of the collaborations," lists the top 10 author pairs based on the number of collaborations they've had. The table has three columns: No. (ranking), Author Pair, and Collaborations (the number of joint publications). Based on the table, the summary of the top 10 author collaborations reveals a strong core of partnerships within the dataset, ranging from 6 to 10 collaborations. The most frequent author pair, ranked number one, is McCoy, Rozalina Grubina and Shah, Nilay D., with a total of 10 collaborations. The next six pairs (ranks 2 through 7) all share the same total number of collaborations, which is 7. Notably, the author Shah, Nilay D. appears in four of the top seven collaborations, indicating a central role in highly frequent partnerships. The

remaining top pairs (ranks 8, 9, and 10) have a collaboration count of 6, with the lowest-ranked pair being Kim, Jong-ho and Kwon, Young Suk.

Table 6
The author pair of the collaborations

No.	Author Pair	Collaborations
1.	Mccoy, Rozalina Grubina And Shah, Nilay D.	10
2.	Sangaralingham, Lindsey R. And Van Houten, Holly K.	7
3.	Ross, Joseph S. And Shah, Nilay D.	7
4.	Shah, Nilay D. And Van Houten, Holly K.	7
5.	Acharya, Nisha R. And Arnold, Benjamin F.	7
6.	Lipska, Kasia J. And Shah, Nilay D.	7
7.	Herrin, Jeph S. And Mccoy, Rozalina Grubina	7
8.	Motroni, Andrea And Nepa, Paolo	6
9.	Khan, Natalia And Solvang, Wei Deng	6
10.	Kim, Jong-Ho And Kwon, Young Suk	6

3.8 Co-occurrence analysis

Using "author keywords" is also used in co-occurrence analysis, another scientific mapping approach. Since the study is focused on the author's chosen research approach, it includes terms that the author has used as keywords. The process of co-word analysis, which "was also undertaken by Krishanmoorthi *et al*., [16]," sorts words into categories according to how often they appear together. Because we are only interested in those specific keywords, we restrict our research to those that occur in nine or more publications.

Many authors employ keywords to evaluate the state of a subject of research, and only strong terms are considered. The point where the limit is reached by 138 characters. 11 groups were formed by co-occurrence analysis using Figure (11) and Table (7). A keyword's effect increases with the size of the circle; Industry 4.0 and Warehouse were mentioned 271 and 51 times, respectively. The keywords Veterans andCovid-19 appeared 32 and 29 times, respectively, and the Mortality appeared 27 times in a cluster (1) of red highlight words. The terms "Industry 4.0" (272), " Warehouse Management" (23), and Sustainability (21) are included in cluster (2) of green. Keywords like "Logistics" (45) in a blue cluster (3), " Warehouse " (51), and " Machine Learning " (37), are highlighted. The gold-colored cluster (4) had terms like Logistics 4.0 (37), Digital Twin (29 times), and Simulation (21). Purple is cluster (5), and the terms are Internet Of Things (39), Artificial Intelligence (28), and Supply Chain (25). Sky bule is cluster (6), and the terms are Robotics (13), Deep Learning (9, and Edge Computing (6). Orange is cluster (7), and the terms are Iot (26), Automated Warehouse (11), and Intralogistics (9). Brown is cluster (8), and the terms are Digitalization (11), Industry 5.0 (5), and Technology (5). Pink is cluster (9), and the terms are Engineering Education (5). Light Pink is cluster (10), and the terms are Indoor Positioning (5). Light Green is cluster (11), and the terms are Warehouse 4.0 (8).

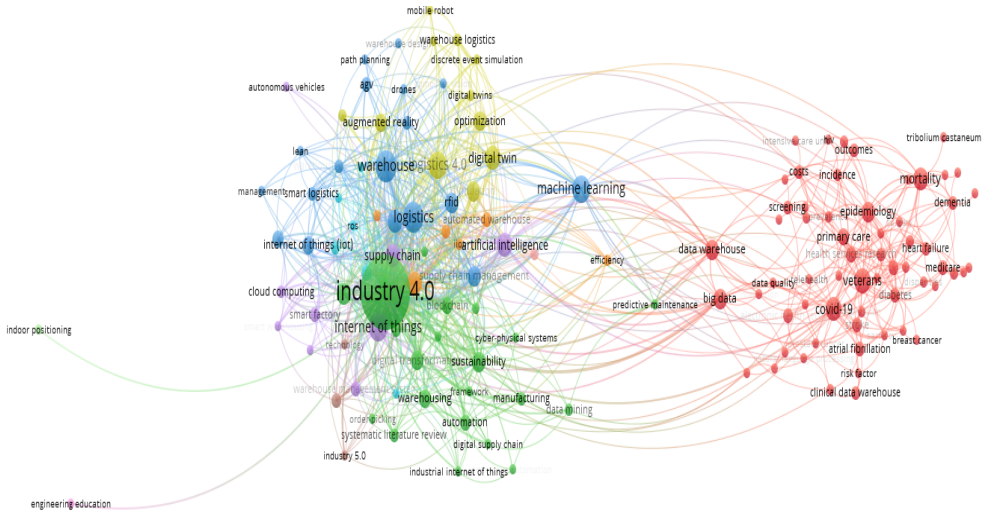

Fig. 11. A map of the co-occurrence of keywords

Table 7
Shows various keywords formulated through co-occurrence analysis

Colour of cluster	Keywords	Link	Total link strength	Times appeared
Red	Veterans	21	24	32
	Covid-19	24	37	29
	Mortality	13	22	27
Green	Industry 4.0	81	463	272
	Warehouse Management	27	38	23
	Sustainability	28	46	21
Blue	Logistics	43	103	45
	Warehouse	38	89	51
	Machine Learning	29	52	37
Gold	Logistics 4.0	36	71	37
	Digital Twin	22	52	29
	Simulation	14	38	21
Purple	Internet Of Things	36	92	39
	Artificial Intelligence	31	73	28
	Supply Chain	26	55	25
Sky Bule	Robotics	18	28	13
	Deep Learning	7	12	9
	Edge Computing	10	14	6
Orange	Iot	34	60	26
	Automated Warehouse	10	15	11
	Intralogistics	16	19	9
Brown	Digitalization	16	27	11
	Industry 5.0	9	13	5
	Technology	9	10	5
Pink	Engineering Education	1	3	5
Light Pink	Indoor Positioning	1	2	5
Light Green	Warehouse 4.0	10	14	8

3.8.1 Thematic analysis

The co-occurrence analysis was used to create thematic clusters, as seen in Figure (12). This "was also studied by *Krishnamoorth et al.,* [16]" Co-occurrence analysis is a science mapping approach

concentrating around terms to develop clusters of different themes by categorizing keywords the fact that come together regularly. In order to identify the many recurring motifs, each phrase was carefully selected. The rationale for this is because whether considering the abstract, title, or keywords, the overall picture that is provided by all of the keywords is more accurate. Phrases that appeared in publications at least ten times were selected for the theme analysis since the overall keyword coverage is higher than the author's keyword coverage. The frequency of phrase appearance in the papers was also taken into account. We need to give a keyword a weight of at least ten before it appears in papers, even if its relevance in a certain region increases if it occurs at least ten times in multiple articles. Two, different weights were tested using a hit-and-miss method; results were clear when the weight was ten times. In order to give weight to keyword occurrences, a minimum of 627 words were required. A total of six clusters were formed. Theme 1 talks about the red cluster, focuses heavily on specific diseases, patient characteristics, and medications, centred around terms like "diabetes mellitus," "non-insulin-dependent diabetes," "hypertension," "beta-adrenergic receptor antagonists," "risk factors," and "chronic kidney disease." This theme appears to be rooted in clinical epidemiology, focusing on specific health conditions, their risk associations, and therapeutic interventions. Theme 2 aims to yellow cluster, which is tightly integrated and central, represents a theme of population health and study design, focusing on demographics and research methodology with keywords such as "human," "aged," "very elderly," "cohort analysis," "follow-up," and "priority journal." This suggests a theme of studying outcomes and patterns in specific, often older, populations over time. Theme 3 is all about the blue cluster encompassing themes of healthcare systems, services, and locations, with keywords like "United States," "health services accessibility," "health maintenance organizations," and "cross-sectional studies," indicating a focus on the delivery, organization, and geographic context of healthcare. Theme 4 is all the purple cluster relates on data, technology, and health outcomes, featuring terms such as "data warehouse," "electronic health records," "mortality," and "length of stay," pointing to research leveraging large datasets and administrative records to study patient outcomes and resource utilization. Theme 5 is all the light green cluster is dedicated to advanced analytical methodologies like "data mining," "machine learning," "cost-benefit analysis," and "forecasting." Theme 6 is all the dark green cluster entirely on Industry 4.0 and its related concepts, which seems to be a very separate and emerging area of research, potentially looking at the intersection of modern industrial technology and healthcare or data analysis. Here, analysis follows the same principle as cooccurrence: the bigger the visible circle, the more weight a word is assigned.

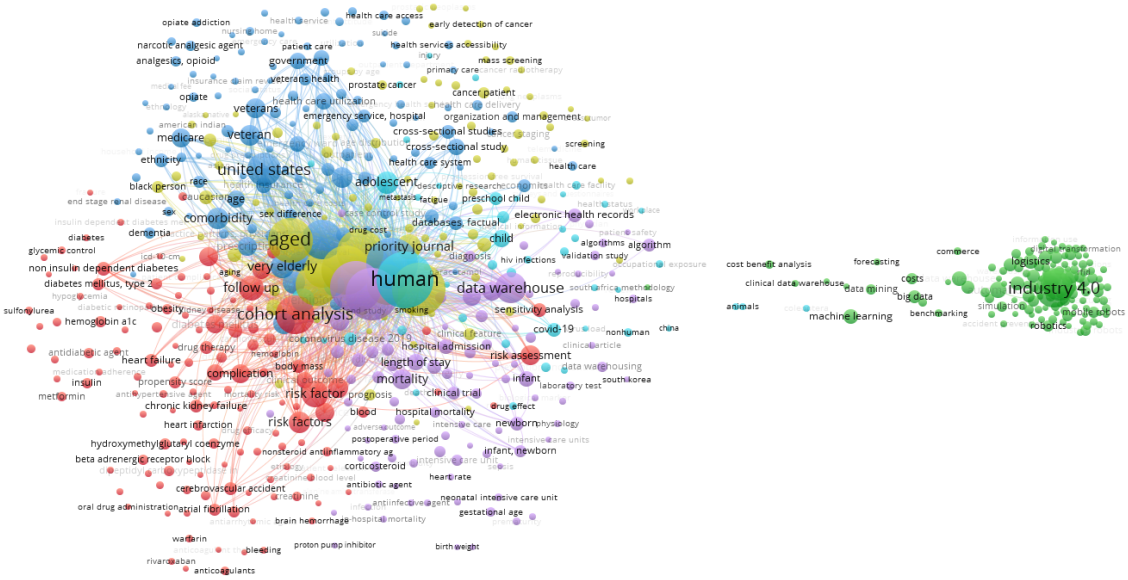

Fig. 12. Shows a map of co-occurrence analysis to form themes through all keywords

3.9 Thematic Evolution

Thematic evolution is used to determine the direction of the trend, through offering a thorough bibliometric analysis warehouse IOT research, which methodically maps the field's intellectual structure, publishing patterns, and thematic evolution, the current study has significant advantages for both academia and practice. Finding reputable sources, identifying research gaps, and forming partnerships with seasoned professionals are all made easier for researchers and practitioners by the identification of powerful nations, significant writers, and high-impact publications. Time is broken down into groups in theme progression in order to examine changes across time. Based on the Figure (13), analysis of publication trends and key research topics, the thematic evolution of warehouse IOT has progressed through distinct phases. Human subjects and demographic groupings are the main thematic emphasis of the underlying study, according to the visualization of the top 10 Index Keywords. The list is dominated by keywords like "human," "humans," "adult," "aged," "middle aged," "female," and "male," suggesting that the great majority of papers in the collection deal with research, illnesses, traits, or interventions pertaining to individuals of different ages and genders. This high frequency indicates that the corpus of literature is strongly biased toward disciplines where accurate study population identification is a fundamental indexing concept, such as biomedicine, clinical research, epidemiology, or health sciences. Methodological and study-specific descriptions, which provide light on the publications' character rather than just their content, constitute the second main focus. Prominent keywords include "article," "important clinical study," and "retrospective study." The prominence of particular study design phrases such as "major clinical study" and "retrospective study" suggests that organized, high-impact clinical investigation papers predominate in the collection, whereas the presence of "article" only indicates the kind of document. This implies that the theme progression encompasses not only the subject matter (people) but also the formal, frequently population-level research procedures used to study it. Overall, by compiling and mapping previous research, the study not only enhances scholarly discourse but also offers practitioners, institutions, and policymaker's practical recommendations for utilizing warehouse IOT for Malysia as a scalable and sustainable approach to enhancing academic and professional results in a society that is becoming more and more digital.

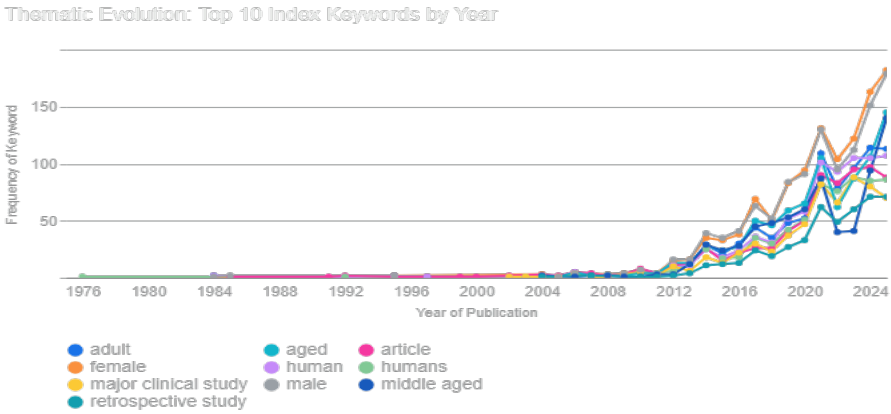

Fig. 13. Showcases thematic evolution

3.10 Discussion

Even while the total number of studies still shows a need for further study, the bibliometric analysis of warehouse IOT research suggests an area witnessing significant, yearly development, especially noticeable from 2012 and accelerating into 2022 and 2023. The top two countries in the field are the United States and Hong Kong, with the US having the most papers overall and Hong Kong having the most average article citations. According to Bradford's law, the most promising publishers are important journals like JAMA Network Open and Plos One. Industry 4.0 and warehouse are the most common keywords, according to the co-occurrence study, indicating a dual focus on broad technology frameworks and particular applications within logistics. Researchers and practitioners will be able to quickly locate reliable sources, discover research gaps, and collaborate with seasoned writers thanks to this study's rigorous mapping of the intellectual structure and publication trends. Furthermore, the study is positioned to provide a scalable and sustainable method to improving academic and professional achievements in an increasingly digital environment by concentrating on topics like Logistics 4.0 and offering useful advice for warehouse IOT.

4. Conclusions

In order to help readers have a better understanding of warehouse IOT, this research primarily aimed to conduct a bibliometric analysis of the collected data. The present research primarily focused on the study's trajectory, the growth and development of themes, network analysis, and patterns of warehouse IOT. Relevant data was gathered with the use of the bibliometric analysis about the warehouse IOT and to uncover the topic's various warehouse IOT, Logistics 4.0, IOT and more. The bibliometric analysis of warehouse Internet of Things (IoT) research offers a comprehensive mapping of the field's intellectual structure and thematic evolution. The study confirms that warehouse IoT research is experiencing significant, yearly growth, accelerating notably from 2012 onwards, with 255 articles published in 2023. The analysis identified the United States as the leading country in terms of document count (747), while Hong Kong showed the highest average article citations (45.19). Influential journals, determined by Bradford's law, include JAMA Network Open and Plos One. Keywords like Industry 4.0 and Warehouse dominated the co-occurrence analysis, reflecting a core focus on broad technological frameworks and their specific logistics applications. By systematically consolidating this fragmented literature, the study provides a valuable foundation for future research and practice, offering researchers and practitioners a guide to reputable sources, key authors, and thematic trends, ultimately supporting the digital transformation of warehouses and enhancing professional outcomes in a digital environment.

Having warehouse IOT is very vital for firms, especially those who plan to use current technology and expand into smart things. This bibliometric study on warehouse IoT provides significant benefits for both academics and practitioners by systematically mapping the field's intellectual structure, publication patterns, and thematic evolution. For researchers and practitioners, the study makes it easier to find reputable sources, identify research gaps, and establish partnerships with seasoned professionals by identifying powerful nations, influential authors, and high-impact publications. Furthermore, by concentrating on topics like Logistics 4.0 and offering practical recommendations for warehouse IOT, the study offers a scalable and sustainable approach to improving academic and professional achievements in an increasingly digital environment.

The main reason why this research couldn't generalise its findings to different settings is that it just looked at papers in the Scopus database. Consequently, future studies could benefit from using larger databases, like Google Scholar or the Web of Science, to uncover fascinating discoveries. This limitation narrows the scope of insights and may overlook influential contributions in the warehouse IOT of domain published outside Scopus. Therefore, future research can expand the bibliometric mapping by incorporating multiple databases, which would allow for more holistic coverage, stronger cross-validation of findings, and broader generalizability across disciplines. This study primarily concentrated on quantitative bibliometric indicators such as publication trends, co-occurrence, co-citation, and thematic evolution. While these methods provide valuable insights into structural patterns, they do not capture deeper qualitative aspects of consumer experiences and managerial practices. Future research can adopt a mixed-method approach, using more language combining bibliometric mapping with content analysis or systematic literature reviews to offer richer theoretical and practical insights. Insufficient Attention to New Technologies The study notes that the influence of emerging technologies, such as digital and smart warehouses, has not been sufficiently discussed in previous studies. Even if "Warehouse IOT" is the best term for the study, the more comprehensive and up-to-date ideas might not be well covered or thoroughly examined. Thus, future research should extend the bibliometric horizon by incorporating foresight analysis, trend forecasting, and scenario planning to anticipate emerging research avenues and practical challenges in the warehouse IOT in Malaysia ecosystem.

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