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# A Bibliometric Analysis Operations Management in the Internet of Things

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**Abstract:**

The integration of the Internet of Things is affecting operation management in multiple industries. A literature review is completed to investigate the impact assessment of the Internet of Things on the following critical issues in operations management such as supply chain, logistics, manufacturing, and enterprise optimization. This paper follows the bibliometric analysis methodology to reveal patterns in publication, influential authors, cooperation networks, and research themes. The analysis of 2500 academic articles during a five-year period showed an increasing number of studies on IoT operations with a focus on systems, supply chain applications as well as strategic applications. At the same time, it can be stated that research can be further developed by the implications of the Internet of Things in those fields that require more attention such as sustainability and policy areas as well as emerging fields. The top countries that actively contribute to the research process are India, China and the UK, and 62 countries are interconnected through cooperation. The results of the study bring empirical findings in the field of the development of expanding, cooperative environment, and probable patterns in the IoT operations' research. It is known that the Internet of Things brings an opportunity for radical change, concentrated attention and excellence are required to maximize technical potential and address zones of ignorance through multidisciplinary cooperation. The outcomes of the analysis could be well used by decision-makers to form policies and program research to facilitate the utilization of the Internet of Things for a better operation management.

Keywords: Internet of Things (IoT),Operations Management ,Bibliometric Analysis,Research Trends,Supply Chain Management

## Introduction

The revolution of operation management began with the Internet of Things IoT, and diverse sectors benefit in numerous ways through it . First, IoT enables the capture and processing of real-time data, thus driving dynamic decision making and cost-cutting in intralogical operations . In doing so, this ilead to a system that manages an energy consumption system in which devices are connected for monitoring and communication. This makes the system an efficient energy conservation one. Second, in the business-to-business e-commerce operation of SLM and OP on the other hand, IoT is a moderator; that is, it improves efficiency, quality in decision-making, and more information about customers . Besides, there are many other sectors beyond the traditional ones. When we apply that in emerging e-business models, IoT uses innovative ways to execute: for instance, in the intelligent vegetable greenhouses, optimization using IoT affects pricing, planting system, and monitoring system, and ordering system. Although we have different models, all of them validate the holocaust of operating across different sectors through their use of IoT. Recently, operation management had been taking a new stride for the last decade and above by incorporating an IoT-based technological approach. Essentially, it has created a new unique system across the different sectors. It revolves around enhancing efficiency, granting visibility, and boosting the authority system. At the crux of it, the IoT means integrating our physical appliances with the online system. Therefore, these devices connect, creating an integrated sector, thus allowing continuous data flow. It offers optimum performance and annuls costs and enhances the decision-making sector. Traditionally, operation management involves designing, implementation and execution of a system that ensures the use of energy effectively to produce products . However, medicine, information, data, and other elements have been barriers including silo database information, nonreal-time insights, and inefficient resource consumption. However, the IoT has counteracted and filled the gaps . Of those that are solved are counteracted by the online network. Perhaps most significantly, our IoT-based sector stirs up real-time data and makes every probe reboot into one system online . Sensors and machines farm other devices, generate real data, and provide data to predict slack. In the 4 th revolution, in the era of smart factories, smart systems, and online-offline supply chain, the IoT multifuel plants are present in all sectors . IoT integrated with analysis and artificial intelligence gives intelligence to the combination of automation and other systematic organizations for businesses . The entire chain of connected vehicles to supply chain managements is dynamic and automated. As our sector gets dynamic, the IoT fuels the processing power

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growth, introducing a revolution in integrating the physical and the digital intelligence; therefore, in conclusion:

In the next sections, this exploratory endeavor aims to achieve the following scholarly goals: Find similar AM Objects 1. Identify and analyze the leading countries, institutions, and authors contributing to IoT-enabled operations management research. This requires conducting a bibliometric analysis to examine publication volume, as well as key factors, such as citations, the h-index, and centrality measures. 2. Investigate the evolution of collaborative research networks in IoT operations management. This also necessitates using bibliometric means and additional visualization tools to explore author, organizational, and country connections. 2. Literature Review presents a concise review of literature relevant to IoT-based technologies and their applications in operational management. Section 3 materials & methods outline the bibliometric and analytical methods utilized in this study. Section 4 provides a detailed overview of the results of the bibliometric analysis with support from qualitative visualizations. It is followed by a discussion of the implications and key findings of this study, including publication patterns and distribution, major contributors, networks and collaborations, and received patterns. Finally, Section 5 presents a brief summary of the conclusions derived from the bibliometric analysis.

In the assignment, the extensive available research on the role of the Internet of Things in the field of operations management which includes supply chain management, logistics, and manufacturing. For example, Heinis et al. conducted an empirical study to identify the motivators and inhibitors of IoT applications among the firms engaged in industrial manufacturing. Sharma et al. ; on the other hand, one of the research used in this assignment brought into limelight the significant contribution of IoT in the pharmaceutical production, warehouse management and the supply chain of drugs. According to Sharma et al. , “Integration of IoT brings forth various possibilities in increasing product quality, productivity and reduction in pharmaceutical errors ” , several other studies such as by Farquharson et al. have been conducted in this era of Internet and other related technologies, a study was conducted in South Africa to examine the impact of the Internet of Things in road freight business. With a clear study of IoT practices and the consequences of using such technologies in roads management helps the readers understand more of IoT practices applied in logistics management . There is sufficient literature on the various role of IoT in the food industry, Maulana et al. an earlier study on the uses of IoT in food supply chain, “A study to investigate the uses of the Internet of things within food supply ”. A more recent study of the role of IOT in possible supply chain has been successfully conducted, where Hasan and Habib presented a study to identify the potential use of IOT in supply chain for possible transformation, “the aim of this study is to investigate how IOT can be used to transform a cost-effective, highly visible and more open supply chain”. Thus, it is evident; from the literature analysis; of applications of the Internet of things in operations management that various up to date applications of the IoT exists . The papers further draw attention to the importance of the drivers and inhibitors into the application of the technology since it has the capability of transforming operation effectiveness, risk, and visibility, there is a clear difference in the studies that have been published on service operation and others on manufacturing, supply chain and logistics operation. Bibliometric analysis can enable us to explore more on the research trends and possibility of applications that can take the service operation to another new level.There is potential for more comparative bibliometric research examining the integration methods, difficulties, and results of IoT across various industry sectors. This can ascertain the optimal methodologies and customized resolutions for the implementation of the IoT. A longitudinal bibliometric analysis can provide deep insights into how IoT operations research has evolved over many years, for example, more than ten years. Through the research, one would be able to understand the technology advancement, research areas and areas of technology that have not been researchedThe research questions that can be developed in the area of operation management using the IoT includes:

RQ 1:Which countries, institutions, and authors have made the most significant contributions to research on IoT-enabled operations management based on bibliometric indicators?

RQ2:How has the research collaboration changed over time? What collaborative links exist between authors, organizations, and countries in this research domain?

RQ3:What are the directions suggested in the current scholarly literature for future research on the IoT in operations management?

**Methodology**

Bibliometric analysis is a valuable method to identify the most outstanding authors, institutions, and countries that made the most significant contributions to the literature on a particular topic. This is achieved through a broad-based search of available academic sources and a multidisciplinary overview of how the topic’s research field has been developed and evolved . Bibliometric analysis was initially introduced by Pritchard “as an effective instrument for examining the development of science” and has since become a widespread and established scientific method. Therefore, it comes as no surprise that the methodology of this bibliometric research bears similarities to the one completed by Vilutiene and colleagues at an earlier date. To ensure the meticulous search of relevant published papers, we used specific search strings in the Dimensions database

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that we developed based on an extensive review of the available literature and precedent studies. The search strings are “Internet of Thingss (IoT)” and key parts of “Operations Managements (OM).” They include the following: Supply Chain, Value Chain, Lean, Logistics, Productivity, Production, Manufacturing/Manufacture, Operations, Quality, and Agility, Just in Time. The bibliometric data was retrieved from the Dimensions database.Important to note, the search query conducted specifically excluded 2024 since it had not been finished at the moment of paper writing. Additionally, our analysis focused on articles published in academic peer-reviewed professional journals. The search, performed on August 29, 2021, was also refined to obtain the most relevant results, as the search query initially revealed a large number of papers. For the purpose of the bibliometric analysis, VOSviewer software was applied . The software creates a network of the studied topic in form of Nodes and Links. Nodes can represent documents, sources, authors, organizations, countries or key phrases, and the Links symbolize the relations among them. Size of the Nodes means the amount of occurrences, whereas, the size of Links represents connection strength. Based on the closeness grade of Nodes, the software shapes the clusters in a graph with a special algorithm ..

**Findings**

In this section, we present a summary of the outcomes derived from a bibliometric analysis of the articles described.

**Publication Trends over time**

A statistical summary of publication trends was developed to identify valuable patterns present in the dataset. The dataset covers the publication counts in five separate years, as depicted in Fig. 1. The average annual publication count is approximately 500, with a standard deviation of around 410. This implies that the publication volumes in a given year vary significantly. In other words, the research output fluctuates throughout the years, with the minimum annual publication count of 36, which was in 2018. Noteworthy, 2022 has the maximum annual publication count of 982. This is a relatively recent year that necessarily comprises a considerable increase in academic activity, i.e., research that has been initiated in this year. The visual representation of temporal distribution allows an empirical summary of the scholarly publication patterns, revealing changes in research performance rates over a certain period . This diagram is the basis for analyzing the dynamics of academic interest and activity in certain subject areas covered by the dataset.

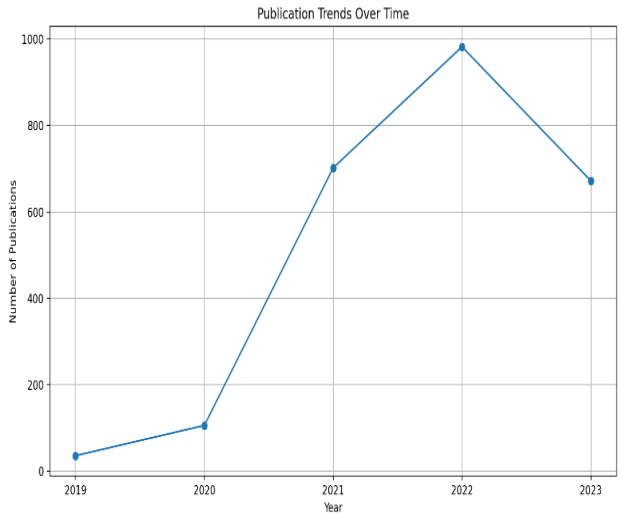


Figure 1: Publication from 2019-2023

**Keyword Analysis in the titles and abstracts**

The keyword co-occurrence analysis provides an overview of the particular distribution of keywords or terms within each cluster within the abstracts of all articles . It is a wholly free analytical technique used by scholars to evaluate particular similarities in the context of the set clusters. In the present article, keyword clustering allowed investigation of primary research streams discussed by scholars within the abstracts of the selected articles. The unsupervised clustering analysis of the titles and abstracts of all articles within the dataset led to the identification of the following five groups of keywords as presented in Figure 2. Cluster 0 explores the main issues related to supply chain resilience, management, risk, and performance, highlighting the explanation of blockchain technology applications. Cluster 1 presents the research topics on food supply chain highlighted through traceability, security, and safety, and the consequences of COVID-19 for agri-food systems. Cluster 2 addresses the area of the Internet of Things , smart devices, data security, and implementations of blockchain. Cluster 3 includes the research foci on the industry and digital transformation through the examination of manufacturing, management, production, and green logistics. Cluster 4 contains the research themes considering the impact of Covid-19 on the supply chain resilience, global crisis management, and strategic responses. The five clusters supported guided analysis of the dataset to identify the primary themes and research focus presented within the selected articles. The visualization represented in the computer-based form allows understanding how the articles are distributed across selected clusters . The bar chart is employed to represent the distribution of articles within selected clusters, and the height of the bar is aligned with the number of articles classified into the specific thematic research. It is used to understand the distribution of research attention and research activity across five main topic clusters.

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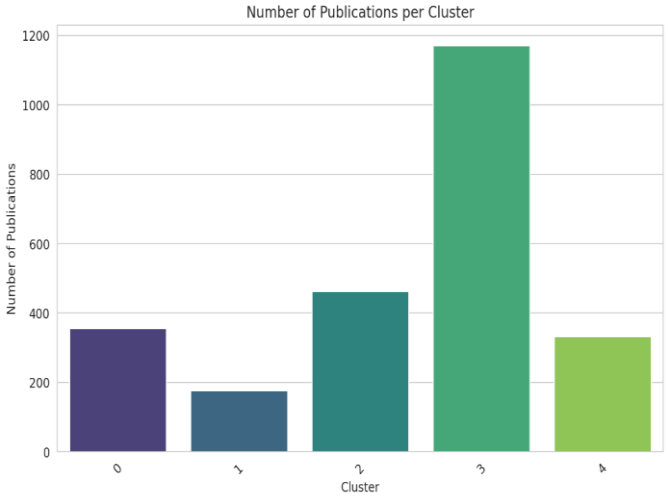


Figure 2: Publications per clusters

**Heatmap**

Figure 3 shows a heatmap of the number of publications per cluster that have been cited and are stratified according to publication year . The color intensity was based on the citation frequency; thus, more citations were represented by darker shades. This figure showed trends and patterns such as the growth and decline in research impact in each study area over time.

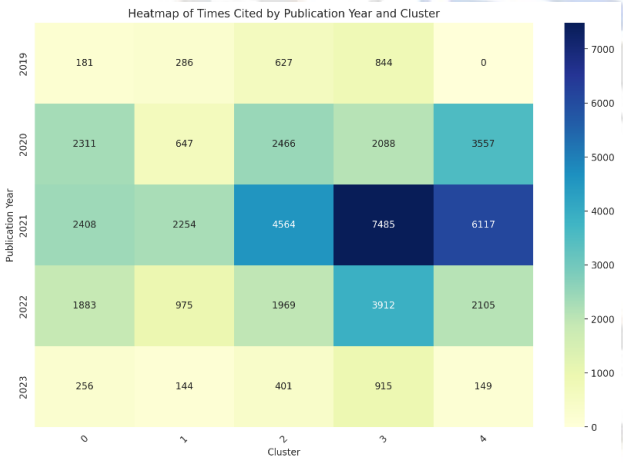


Figure 3: Heatmap

**Sentimental Analysis of Abstracts**

The software allowed the researcher to conduct sentiment analysis on all the abstracts of the selected articles. As Fischer et al. write, “sentiment analysis, also known as emotion arti cial intelligence or opinion mining, helps researchers to perceive, collect, assess, and explore the chic dimension of information” . The output of the sentiment analysis is shown in Figure 4. Sentiment analysis was performed on the abstracts, and the average sentiment polarity was . obviously shows that most abstracts slightly positive sentiment. Most of the histograms of the abstracts are grouped just above the zero scale to slightly positive scale. That is why most of the abstracts are almost balanced. The language used in the abstracts is mostly factual and neutral, which is reasonable as these are academic writings and general writings. This is because the language in academic writings is quite reserved and objective by nature.

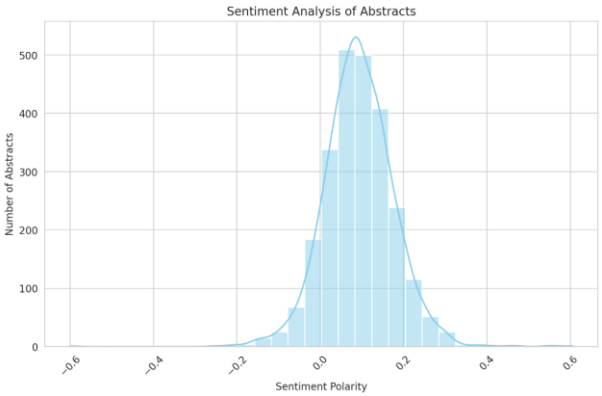


Figure 4: Sentiment analysis results.

**Word Cloud**

Figure 5: Word Cloud Visualization The word cloud visualization in Figure 5 presents an overall view of the most common terms appearing in the abstracts of the reports. The analysis is a guide to the common themes developed in this study by the key aspects of the abstract. The word cloud display reveals the core common concepts displayed in the abstract, therefore illuminating the collective themes from the final dataset . Primarily, the word cloud visualization offers the most prevalent word by size which further translates to the common theme. The visualization is critical since it forms the basis of understanding the common trends or themes in the area of a study based on the collective report.


Figure 5: Word cloud of most frequent terms

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**Author Citations**

Citation analysis is a quantitative measure to asses' how far a publication is accepted, as it measures how many times the publication is being cited by other already published studies. The citation analysis helps to measure the influence and popularity of an article. It also gives a broader view of a collaborative citation network of different articles that cited the publication. Vosviewer was used to perform citation analysis. The approach helped me to get a clear picture of research that has been performed so far on "IoT in Operations Management". I was able to find various outstanding authors, organizations, and countries involved, as described in Table 1. Figure 6 illustrates a network visualization of the top 20 strongest authors. We can see three clusters. link 23, Total link strength 99; In the author analysis, the VOSviewer threshold-based approach was used with a threshold of 7 documents per author configured initially. This way 9, 180 authors were set as primary authors. Only 13 authors had a minimum of 7 documents, and the total strength of citation links was calculated for them with other authors. Cluster 1 was made with 5 authors: Ivanov, Dmitry; Khan, Syedabdulrehman; Tirkolaee, Erfanbabaee; Waqas, Muhammad; Yu, Zhang. Cluster 2 contained 3 authors: Hassoun, Abdo; Jagtap, Sandeep; Zhang, Xin, and Cluster 3 was made by three authors: Kumar, Anil; Luthra, Sunil; Paul, Sanjoy Kumar.Sanjoy Kumar Paul found to have the highest academic impact with an average of 100.5 citations per document and 45 total link strength. It means he has a large collaborative engagement within the academic community. Dmitry Ivanov was got to be the highly cited author. His average citations per document was 204.8 over 10 publications. His total link strength is 38, which represents his academic collaboration within the community. Syed Abdul Rehman Khan has the significant academic impact and collaboration within the academic community. His average citation per document is 33.21, and his total link strength is 21 from his 14 publications. Kumar displays well-balanced academic efforts on a total of 11 publications where his average citation per document is 18.18, and he has 21 total link strength. Sunil Luthra holds a good academic position with an average 28.5 citations per document of his 12 publications. His total link strength is 17 which shows his balanced engagement into the academic activities. Zhang Yu has only gotten relatively moderate citation; an average of 20 per document from his 9 publications. His linear strength is 14, which shows his level of engagement in collaboration with other scholars. Muhammad Waqas holds a very good record of average citation of 28 of his seven publications. His total link strength of 13 from his seven publications shows a very good form of academic linkage with other scholars. Abdo Hassoun seems one of the high-impact authors. He has an average citation of 36.71 from his 7 publications. His total link strength is 12, which shows his already a well established one. Sandeep Jagtap has underlined a moderate academic implication with his average of 26.57 citations from his 7 publications. 11 total strength of Ha shows a well-established networking level in the academics. This all describes the individual academic standing of each author.

Table: Top Authors with Greatest Documents And Link Strength

| Sl No | Author | Documents | Citations | Total Link Strength | Average Citations |
|---|---|---|---|---|---|
| 1 | Paul, Sanjoykumar | 12 | 1206 | 45 | 100.5 |
| 2 | Ivanov, Dmitry | 10 | 2048 | 38 | 204.8 |
| 3 | Khan, Syedabdulrehman | 14 | 465 | 21 | 33.21 |
| 4 | Kumar, Anil | 11 | 200 | 21 | 18.18 |
| 5 | Luthra, Sunil | 12 | 342 | 17 | 28.5 |
| 6 | Yu, Zhang | 9 | 180 | 14 | 20 |
| 7 | Waqas, Muhammad | 7 | 196 | 13 | 28 |
| 8 | Hassoun, Abdo | 7 | 257 | 12 | 36.71 |
| 9 | Jagtap, Sandeep | 7 | 186 | 11 | 26.57 |
| 10 | Chew, Kit Wayne | 7 | 198 | 7 | 28.29 |
| 11 | Show, Pau Loke | 8 | 245 | 7 | 30.63 |
| 12 | Tirkolaee, Erfanbabaee | 8 | 98 | 5 | 12.25 |
| 13 | Zhang, Xin | 7 | 52 | 1 | 7.43 |

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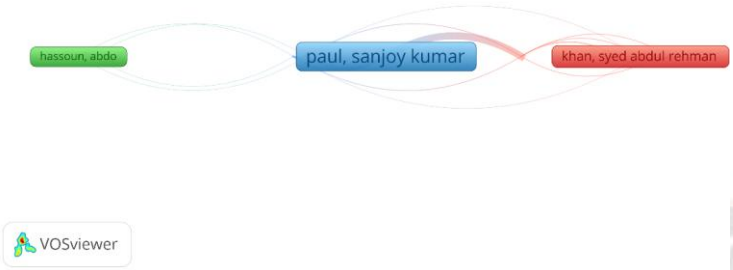


Figure 6: Network visualization of top authors with three clusters. link 23, Total link strength is 99

**Organizations citations**

VOSviewer was used for analysis of organizational citations, and minimum thresholds were applied,in where only organizations with at least 10 documents were included . Therefore, from the 3, 589 organizations, only 54 met the threshold of requirement. The sum total of the strength of citation links with other organizations was calculated for each of the 54 qualifying organizations. This analysis of inter-organizational citation patterns and collaborations was achieved by the minimum document threshold, thus only ensuring that the most productive organizations were included, thus improving the strength and relevance of the analysis. Relationship of the strength of the citation linkages between the organizations are a key indicator of the flows of knowledge and inter-organizational relationships that are present in the scholarly communication system. The combination of the 54 organizations meeting minimum threshold requirements represent on average the most academically productive and collaborative. As seen in Figure 7, 54 organizations were identified across seven discrete clusters, connected by 378 links with a cumulative link strength of 928. The table 2 is illustrativeof the best five organizations for clustering and forming cohesive units. Cluster 1 20 organizations, this is an organization that is mainly from Asian universities namely: Anna University Chennai, Beijing Technology and Business University, Cranfield University, Hong Kong Polytechnic University, King Abdulaziz University, King Saud University, Monash University, Nanyang Technological University, National University of Singapore, Shenzhen University, University of Aveiro, University of Johannesburg, University of Nottingham Malaysia Campus, University of Salento, University of Technology Malaysia, University of Tehran, Vellore Institute of Technology University, Wageningen University and Research, Wuhan university, Xiamen University. Cluster 2 11 organizations, this cluster is created by universities from different countries namely: Dalian University of Technology, Deakin University, Imperial College London, Lancaster University, Montpellier Business School, Qatar University, The University of Sydney, Tsinghua University, Universidade de São Paulo, University College London, University of Oxford. Cluster 3 3 organizations three universities, all of them are universities from Europe: Asian university, Indian Institute of Technology Delhi, Universitat Politècnica de València. Cluster 4 6 universities, 3 universities are from China, and three from India and one university is from Poland: Beijing Institute of Technology, Northwestern Polytechnical University, O.P. Jindal Global University, Silesian University of Technology, Tianjin University. Cluster 5 4 organizations, two universities from Brazil; UK and Australia: the Federal University of Rio Grande do Sul, Universidade Federal de Santa Catarina, University of Cambridge, University of Melbourne. Cluster 6 4 entities, all forms of organization African organization; Mexican organization and two Asian universities: Chang'an University , Ilma university, Monterrey Institute of Technology and Higher Education, National University of Malaysia. Cluster 7 3 organizations, institutions from US, Germany, and Australia:Berlin School of Economics and Law, Michigan State University, RMIT University. These clusters illustrate cohesive organization groupings based on shared attributes or thematic areas for which some organizations have been connected to form a matrix of inter-organizational relationships. The high average of 14.67 citations per document indicates the praiseworthy scholarly influence earned by Anna university Chennai. Further, a substantial total link strength of 234, at the third rank, indicates that it has actively engaged in influencing academic networks.The impact of Asian universities has been phenomenal with a very high average of 28.15 citations per document. A high total link strength of 160 indicates that the organization has been actively supportive of academic contributions. Beijing Institute of Technology has been a great holder of research influence with a good average of 46.27 citations per document which justifies a total link strength of 157. Beijing Technology and Business University many not have high average with only 9.64 citations per document, but a total link strength of 153 means that authorities have actively participated in academic networks.The Berlin School of Economics has generated a significant flow of academic impact as reflected by an explosion of 204.8 citations per document. The total link strength of 65 at the seventh highest position indicates that the institution has been actively engaged in the sharing and production of academic knowledge.

Chang'an University has a strong academic impact of 17.33 citations per document and a total link strength of 64, which implies a high degree of participation in contributing to scholarly discourse. Cranfield University demonstrates a strong impact through 22.25 citations per document and a total link strength of 55, which means a relatively high participation rate in collaborative academic work, contributing to the organizations' strong academic reputation. The Dalian University of Technology reports a more modest impact of 14.43 citations per document and a

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total link strength of 48, as part of a balanced engagement in academic networks due to the contribution to collaborative academic work. Based on these inferences, it was possible to formulate a differentiated understanding of each organization's academic impact and collaborative work. The use of the selected metrics ensured a comprehensive consideration of their contribution to the academic sphere based on the total link and average citations.

Table 2: Top organizations with highest citations and total link strength

| sl no | Organization | Documents | Citations | Total Link Strength | Average Citations |
|---|---|---|---|---|---|
| 1 | Anna University, Chennai | 15 | 220 | 234 | 14.67 |
| 2 | Asian University | 13 | 366 | 160 | 28.15 |
| 3 | Beijing Institute Of Technology | 11 | 509 | 157 | 46.27 |
| 4 | Beijing Technology And Business University | 14 | 135 | 153 | 9.64 |
| 5 | Berlin School Of Economics And Law | 10 | 2048 | 65 | 204.8 |
| 6 | Chang'an University | 15 | 260 | 64 | 17.33 |
| 7 | Cranfield University | 20 | 445 | 55 | 22.25 |
| 8 | Dalian University Of Technology | 14 | 202 | 48 | 14.43 |
| 9 | Deakin University | 10 | 253 | 46 | 25.3 |
| 10 | federal university of riogrande do sul | 11 | 214 | 43 | 19.45 |

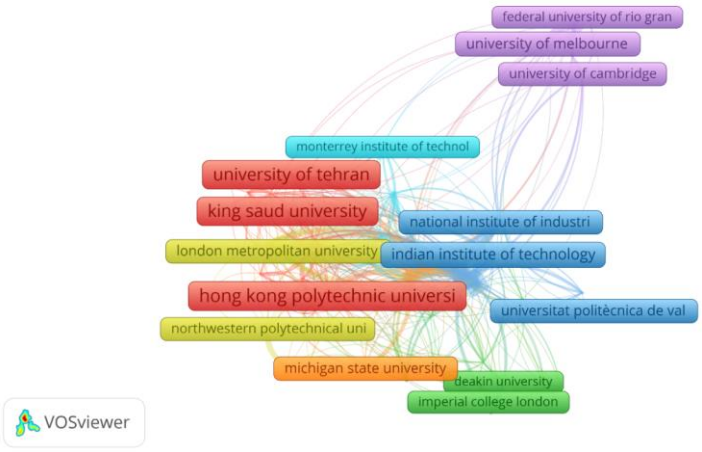


Figure 7: Network visualization of 54 organizations consisting of 7clusters,Total link strength 928

**Country citations**

For analysis of country citations, in VOSviewer, minimum thresholds were set at a level of at least ten documents per country. Out of 112 countries in the current research, 61 met the minimum criteria to be included in the citation study. The CS for the 61 qualifying country with the other country CL was calculated out for each of the 61 qualifying countries. Figure 8 shows seven clusters among 61 countries including 1215 linkages amongst, with a CLS of 9111. Table 3 represented the top ten countries based on the highest citation and link strengths. Cluster 1 has 20 countries, Belgium, Egypt, Ethiopia, France, Germany, Greece, Italy, Kenya, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and Switzerland. Cluster 2 had 19 countries, Austria, China, Czechia, Hungary, India, Ireland, Japan, Malaysia, Nigeria, Pakistan, the Philippines, Saudi Arabia, Singapore, South Africa, South Korea, Taiwan, Tunisia, the United Arab Emirates, and Vietnam. Cluster 3 has nine countries: Argentina, Australia, Brazil, Chile, Denmark, Finland, Israel, the United Kingdom, and the United States. Cluster 5 includes four countries, Bangladesh, Canada, Colombia, and Indonesia. Cluster 6 comprises 2 countries, Morocco and Qatar while Cluster 7 has a single country, Jordan. As these countries represent the same characteristics or association patterns, depicted the structured networked relationship among them in the dataset . India is a country with praise-worthy scholarly impact with an average of 23.75 citation per document. The total LS of 1424 represents the collaborative impact on the academic networks. The United Kingdom is well identified in academic network with strength of 28.17 citation per document. The substantial LS of 1373 indicates the country influences in the network. Whereas China is simply strong with the impact score of 15.84 citation per document. The extensive LS of 1299 indicates the country performance in academic community networks. It appears that the United State is the most high possible average citation per document of 27.48, indicating that it is pays more influence in academic networks. The high total LS of 1213 highlight the effort done by the United state in the academic field. The Australia is highly influencing in academic field which is shows an average of 38.89 LS per document. The appreciable LS value of 1174

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highlights the influence of the country. Germany is a country that influence on the academic field, with an average of 32.95 LS per document. A total LS of 781 highlights the nation engaging in the collaborative field on the academic work. Italy is high influencing in LS fields as viewed in an average LS 24.74 per document. A country with an LS of total 771 indicates that the country tightens. France has showing a high LS of 37.38 rate indicating it is high influencing in academic work. The total LS of 764 influence the nations impact. Brazil indicates the LS of 27.81 influence indicating major influence. The total LS value of 568 highlight nation that is very engaging on LS relation. Malaysia is influence with LS of 26.07 indicating the ability of high influencing in academic work . The LS total of 567 indicates the deploying would have a strong engaged on the work. These included created the academic leaning of the nations and counting based on the average citations presents as well as their cooperation influencing the academic network.

Table 3: top ten country with highest citations and link strength

| Sl No | Country | Documents | Citations | Total Link Strength | Average Citations |
|---|---|---|---|---|---|
| 1 | India | 327 | 7771 | 1424 | 23.75 |
| 2 | United Kingdom | 278 | 7828 | 1373 | 28.17 |
| 3 | China | 548 | 8683 | 1299 | 15.84 |
| 4 | United States | 303 | 8321 | 1213 | 27.48 |
| 5 | Australia | 170 | 6611 | 1174 | 38.89 |
| 6 | Germany | 112 | 3685 | 781 | 32.95 |
| 7 | Italy | 159 | 3937 | 771 | 24.74 |
| 8 | France | 81 | 3026 | 764 | 37.38 |
| 9 | Brazil | 80 | 2225 | 568 | 27.81 |
| 10 | Malaysia | 103 | 2690 | 567 | 26.07 |

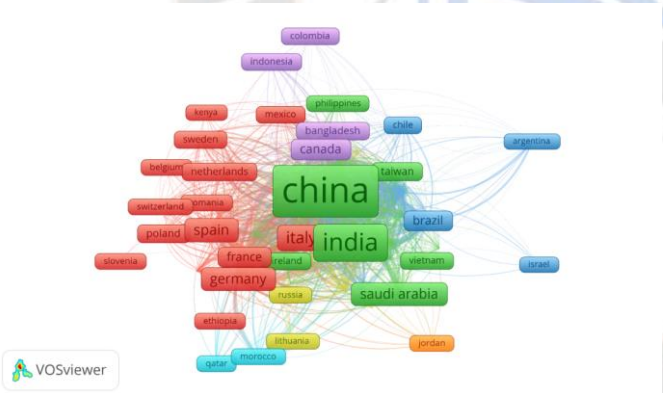


Figure 8: Network visualization of 7 clusters with 61countries,link 1215 and total link strength as 9111.

Keyword analysis

Keyword co-occurrence analysis presents how keywords or terms are distributed in each cluster based on the abstracts of all previously identified keywords. Figure 9 shows the density visualization map of keywords in articles about Iot in Operations Management,whereas Table 4 shows the top ten relevant keywords. Figure 9 presents the density visualization map of keywords in articles about IoT in Operations managementA minimum of 50 out of 47,588 terms were necessary to meet the threshold. Among these, 271 terms were identified as relevant and were scored accordingly. A selection process was implemented based on these scores and 60% of the terms were selected. Ultimately, 163 terms were selected and organized into three clusters: Cluster 1 contained 81 items, Cluster 2 comprised 59 items, and Cluster 3 included 23 items.Ultimately, a keyword co-occurrence map was formed by 163items grouped into three clusters with 12831 link and a total link strength of 194443.They form a network visualization map, as shown in Figure 9. The map featured larger circles and labels, indicating a higher weight, whereas smaller circles indicated a lower weight. Smaller circles may be omitted to prevent overlap and to maintain map clarity. Items are organized into clusters based on their proximity and relevance to a particular topic, distinguished by distinct colors on the map (Van Eck et al.,2010. Links, represented by lines, connect these items with shorter distances, and deeper lines denote stronger relationships between terms (Van Eck et al.,2010).This analysis examined the frequency and relevance scores of 162 terms in a text corpus. The most prevalent terms are systems, technologies, impacts, supply chains, strategies, and reviews. "System" was the most common term with 961 occurrences and a relevance score of 0.2943. Other top terms included "technology" (945 occurrences, 0.2875 score), "impact" (626 occurrences, 0.8447 score), and "supply chain" (629 occurrences, 0.3237 score). The data suggest an emphasis on researching

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technological systems, their strategic implementation, and the resultant impacts, particularly in supply chain contexts. There is also an interest in literature reviews, as indicated by terms like "review," "literature," and "systematic review." Additionally, frequent terms such as "covid," "pandemic," "crisis," and "disruption" potentially reflect rising scholarly attention to global disruptions and health crises.

This analysis also provides opportunities for future research directions as well. The terms' future research" and "future research direction" appear with moderate frequency and relevance scores, highlighting academics' interest in expanding knowledge gaps. Furthermore, high-scoring terms like "innovation," "sustainability," "policy," and "integration" suggest promising research avenues in these domains.This analysis provides insights into prevailing research themes and potential growth areas within the examined scholarly community. The prominent terminology centers on technological systems and their strategic management while also responding to contemporary societal challenges

Table 4: Top Ten Relevance Keywords

| SlNo | Term | Occurrences | Relevance Score |
|---|---|---|---|
| 1 | Accuracy | 132 | 6.0491 |
| 2 | Activity | 233 | 4.2558 |
| 3 | Agriculture | 142 | 3.7926 |
| 4 | Algorithm | 211 | 3.6951 |
| 5 | Application | 554 | 3.5014 |
| 6 | Architecture | 124 | 3.3875 |
| 7 | Artificial Intelligence | 217 | 3.2245 |
| 8 | Author | 89 | 2.98 |
| 9 | Automation | 100 | 2.9287 |
| 10 | Barrier | 100 | 2.8418 |

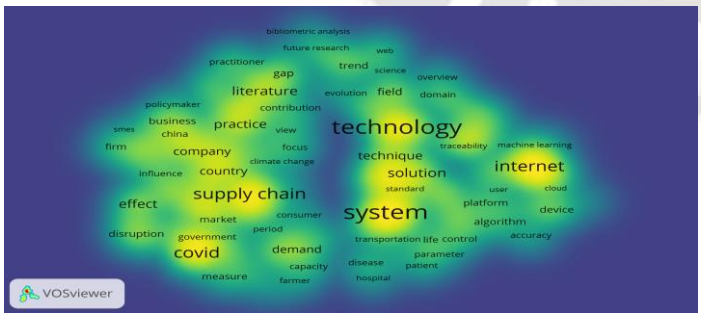


Figure 9: Density visualization map of keywords in articles about IoT in Operations management

## Conclusion

This study has conducted an extensive analysis of the existing body of knowledge to offer an overview of the use of the Internet of Things technology in operations management in various industries. The revolutionary potential of IoT comes from its data capture in real time, use of advanced analytics, enhanced visibility, and ability to provide predictive insights that help decision-making, efficiency, and agility. However, cases of low level of adoption call for concerted effort as the usage increases to address remaining challenges such as interoperability, data security, lack of established standards, and the high cost of investment. The bibliometric analysis has offered empirical evidence about the trends and patterns of research in IoT operations over the past five years. Key findings include increasing number of published works, the development of collaborative relationships between 62 nations, and the tendency to focus on Internet of Things applications in supply chain management, logistics, and manufacturing. However, the consequences of sustainability, policy design, and up-to-date technology incorporation were identified as areas calling for more research. By doing so, this study has outlined the vast potential of IoT-enable operation for use in various areas and pinpointed research areas where knowledge gaps exist. This summarizes the state of knowledge in a sub-field and offers a basis for guiding further research, which will be vital given the rapid pace of technology development. Constraints and columns for further research. Just like any other study, this one has several limitations that present opportunities for further research. Firstly, only a single database was used to retrieve papers for review. Additional databases may yield more comprehensive results. Second, only scholarly work published in journals was included in the analysis, while conference papers and grey literature were discarded. The inclusion of other publication types can provide additional insights. Furthermore, the timeframe used is limited to five years, meaning that long-term trends cannot be observed. A future study could use a longitudinal design spanning several decades to analyze changes and developments more effectively. Additionally, more focused bibliometric research could be conducted focusing on particular countries, topics, or industries. Furthermore, qualitative views on barriers, drivers of adoption, and outlooks can be obtained by conducting expert surveys or interviews in addition to quantitative analysis. This study can be a starting point for more exploration of the overlap between IoT and operation management. In the era of sophisticated technology, big data insight will help in seizing the opportunities of transformation IoT brings while minimizing the risk..

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

**Data availability**

Data will be made available on request.

**List of abbreviations**

IoT: The Internet of Things
SLM: strategic logistics management
BA:Bibliometrix Analysis

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