

Swarm Intelligence: A Quantitative Analysis of Research Publications and Trends

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Abstract

The research investigates the scholarly landscape of swarm intelligence by conducting a comprehensive bibliometric analysis of data sourced from the Scopus database. The search was performed with the help of keywords "swarm intelligence" on the date of 25 January 2024, and eventually, it was found that a total of 1374 articles with diversified sources up to 800 were identified and have been dated between 1996 to 2024. Related dimensions to be studied include annual scientific production, collaboration of publication and bibliographic coupling, leading authors, main sources and affiliations, and keyword co-occurrence. Visualizations used here include line graphs, bubble charts, network diagrams, and three-field plots to present key findings. One can observe from the results that the number of publications increases linearly, although a sharp increase is significantly noticed in 2024. Prolific and influential authors or sources in this area are identified. Moreover, keyword co-occurrence analysis brings out the central concepts or thematic areas cutting across the articles on research in swarm intelligence. A publication collaboration study, such as bibliographic coupling analysis, helps to unveil the international research linked network and the extent to which papers are interlinked. Overall, the understanding that this research has provided me is the tendency, dynamics, and change that has happened in the swarm intelligence research.

Keywords: Bibliometric analysis, Swarm Intelligence, VOSviewer, Biblioshiny.

1. Introduction

Swarm intelligence encapsulates striking capacities for entities as humble as social insects, or birds and fish that can achieve great results for complex tasks by coordination but without central guidance [1]. It all comes down to how these little creatures, following some simple rules, organize and solve problems. This is not because there is some kind of single entity in control, but a result of numerous interactions of them with their environment, which naturally leads to collective and adaptive behaviors [2,3].

So far, this natural phenomenon has inspired numerous technology advancements, particularly in such fields as robotics, optimization, and artificial intelligence. For example, Particle Swarm Optimization (PSO) and Ant Colony Optimization (ACO) are natural world-inspired algorithms [4,5]. How birds move in flocks, or how ants search for food, shows the coordination of a swarm that is beyond the reach of traditional methods in complexity. With each agent testing different possibilities and progressively zeroing in on the right solution, these algorithms have the power of many simple agents working in concert to accomplish a greater

task through a process that imitates natural self-organization. Swarm intelligence is of great utility, specifically in the field of robotics, regarding situations where an extremely high degree of autonomy and adaptability is required. In swarm robotics, many robots work together in order to do something individually, which none of them can do. And that's revolutionary across the board, from search and rescue to environmental monitoring, even in space exploration, with highly unpredictable conditions [6,7].

Bibliometric analysis is one of the quantitative methodologies used in the review of literatures on given subjects, the assessment of quality of research, identification of principal themes, and prediction of trends [8,9]. This methodology critically reviews academic literature and provides insights about the different metrics of research developments, including citation counts, keyword distributions, and h-index [10-12]. It also appraises publication volume and research funding over time [13, 14]. The VOS Viewer was designed by van Eck and Waltman [15] in 2010 and has ever since been rapidly applied to bibliometrics for making comprehensible maps representing the relationships and main themes of studies. The bibliometrix R-package helps to do these analyses quantitatively using tools like a friendly web interface—Biblioshiny—which allows the user to do studies with data from Scopus or Web of Science databases even if they have no coding skills [16].

2. Review of Literature

Swarm intelligence has its roots in thinking derived from nature and now finds its way into myriad real-life scenarios. Five areas are considered in this paper to cite growing space that it has a profound impact on.

Optimization Problems: At the heart of swarm intelligence is its ability to tackle optimization challenges—essentially finding the best solution among many possibilities. Particle Swarm Optimization (PSO) and Ant Colony Optimization (ACO) technique are nature-inspired approaches to optimization in processes such as routing, scheduling, and the allocation of resources. Thus, in logistics, such methods serve to reduce the distances traveled. In manufacturing, it helps in reducing the distances that will be traveled to optimize the production schedule for efficient use [17-19].

Robotics: The invention of swarm intelligence has initiated a new revolution in the invention of yet another new and unique field, i.e., "swarm robotics," in which groups of robots work together much like social insects to complete tasks that would be difficult or impossible for a single individual robot. Particularly, it is the most supportive in disaster situations where robots search for humans under dangerous conditions, agriculture where drones do field monitoring and farm management, and manufacturing where robots work collectively to produce some complicated items [20-22].

Network Design and Management: Another important application of swarm intelligence is in the field of telecommunications and computer networks. This type of application deals with the collective behavior of ants and other social organisms being taken as a model to improve data routes and bandwidth allocation. This is invaluable in highly dynamic environments due to the rapid change of network conditions, thus contributing to the maintenance of smooth and effective data flows [23-25].

Bioinformatics: In fact, bioinformatics also uses swarm intelligence in the hard area of bioinformatics, like with the case of solving complex problems in predicting protein structures, modeling biological systems, or gene expression analysis. Specifically, the considered methodologies, however, are particularly effective in the case of the multidimensional data that are typical of this field, as they give the possibility of finding patterns and relations usually hidden [26-28].

Data Mining and Analysis: If there is some domain where the exploratory power of swarm intelligence is really applied well, then it is surely data mining. In fact, the classification of information and the ability to predict the tendency of the same while pointing out outliers are the fields where it is vastly applied. Financial markets provide another scenario where

swarm-based systems would be able to process large quantities of data with the aim of finding investment opportunities together with potential threats, and with information from that, they would be able to inform guiding decisions [29-31]. These applications help understand how swarm intelligence applies the use of simple and small, nature-inspired concepts to develop solutions for some very high-level complex challenges in different domains.

Bibliometric Analysis: Swarm intelligence (SI) has seen significant growth in research and application over the past two decades, with bibliometric analyses shedding light on its evolution and trends. A study by Li et al. explored SI research between 2000 and 2015, identifying key research hotspots and trends through methods like keyword co-citation analysis and semantic clustering [32]. This analysis highlighted the widespread application of SI across various fields and provided insights into the leading countries, institutions, and research performances driving SI development. Similarly, Reong et al. conducted a bibliometric study focusing on particle swarm optimization (PSO) strategies for solving the vehicle routing problem (VRP) over the past 20 years [33]. This study used bibliographic coupling and co-citation analysis to map emerging trends and identify key thematic clusters, contributing to the ongoing development of PSO and VRP research. Both studies demonstrate how bibliometric analyses can uncover critical trends and guide future research in the rapidly evolving field of swarm intelligence.

3. Materials and Methods

The scientific studies for this research were sourced from the Scopus database's main collection. On January 25th, 2024, we conducted a search with "swarm intelligence" as the keyword. There were no restrictions based on language, and the search was narrowed to include only peer-reviewed journal articles, conference proceedings, and book chapters, while excluding meetings, editorials, notes, and books. This search yielded 1374 articles from 800 different sources, spanning from 1996 to 2024. We diligently checked the Scopus entries to eliminate any duplicates, ensuring the highest precision in our data set. The collected data were then saved in a CSV file format, and we conducted a bibliometric analysis using VOSviewer version 1.6.19 alongside Bibloshiny software. Key findings from this study are presented in Table 1.

Table 1. Essential aspects of the investigation.

Main Information about Data	
Timespan	1996:2024
Sources (Journals, Books, etc)	800
Documents	1374
Annual Growth Rate %	11.67
Document Average Age	6.92
Average citations per doc	20.67
References	43259
DOCUMENT CONTENTS	
Keywords Plus (ID)	8530
Author's Keywords (DE)	3611
AUTHORS	
Authors	3558
Authors of single-authored docs	86
AUTHORS COLLABORATION	
Single-authored docs	97
Co-Authors per Doc	3.39
International co-authorships %	21.11
DOCUMENT TYPES	

article	752
book chapter	49
conference paper	573

4. Results

a. Annual Scientific Production

Figure 1 illustrates the annual scientific production in swarm intelligence research from 1996 to 2024. The graph reveals a relatively low and stable number of publications from 1996 through the early 2000s, indicating minimal activity in the field during this period. However, from the mid-2000s onward, there is a noticeable upward trend, with a gradual increase in the number of publications. This growth becomes more pronounced after 2010, reflecting the growing interest and expansion of research in swarm intelligence. The most significant surge occurs between 2020 and 2023, with the number of publications peaking in 2023, reaching well over 150 articles. In 2024, the number of publications is 24, which may indicate either a shift in research focus or that data collection for this year is still incomplete. Overall, the trend shows a steady and substantial rise in swarm intelligence research output over the past two decades, underscoring the increasing importance of this field in the scientific community.

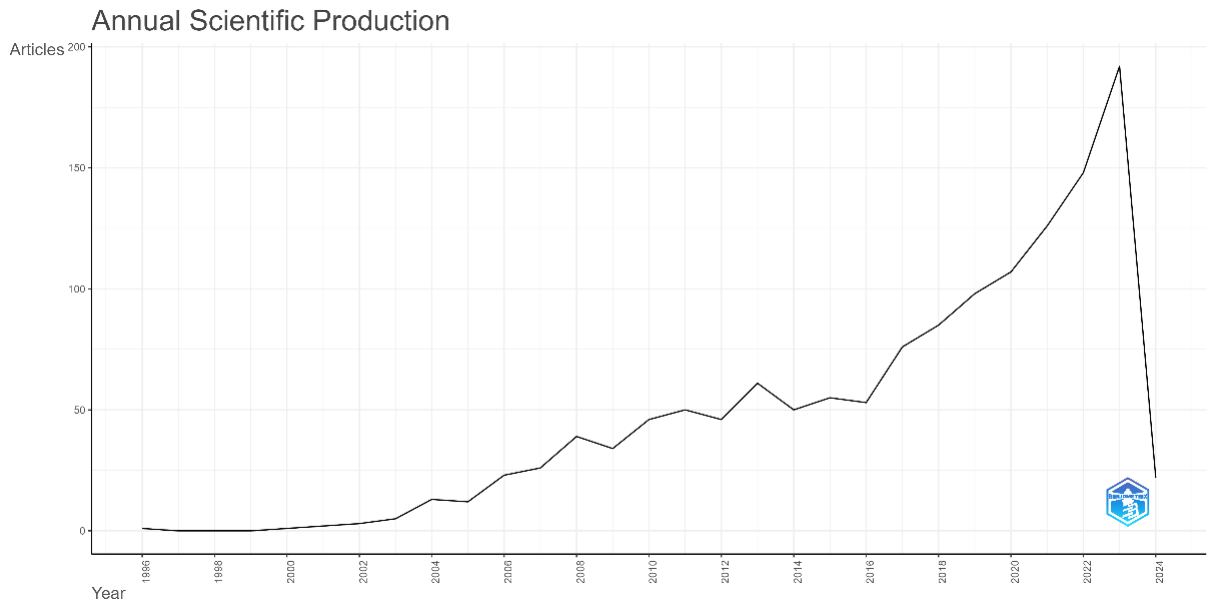


Figure 1. The annual scientific production

b. Most Significant Authors

Table 2 lists the most prolific authors in a specific field of study, along with the number of articles they have published. The table is organized with two columns: one for authors' names and one for the number of articles. At the top, "WANG J" leads the table with 17 articles, followed by "ZHANG Y" with 16 articles, which suggests these two authors are the most significant contributors to this field according to the table. They are followed by "WANG Y" and "ZHANG J," each with 13 articles. "LIU H" and "WANG X" have each contributed 12 articles. Four authors, "BACANIN N," "LI J," "TUBA M," and "ZHANG H," have each published 11 articles, rounding out the list of authors with double-digit article counts. The presence of multiple authors with the same surnames, particularly "WANG" and "ZHANG," may indicate commonality in names within the population from which these authors come, or it could point to a region where this field of study is particularly active. The number of articles per author reflects substantial contributions to the scholarly literature and indicates a consistent level of research output from these individuals over the time period considered.

Table 2. Most Significant Authors

Authors	Articles
WANG J	17
ZHANG Y	16
WANG Y	13
ZHANG J	13
LIU H	12
WANG X	12
BACANIN N	11
LI J	11
TUBA M	11
ZHANG H	11

c. Most relevant sources and affiliations

Figure 2 shows a bubble chart in the field of swarm intelligence, plotting various publication sources against the number of documents they have contributed. Each bubble represents a source, and its size correlates with the number of documents published by that source. The x-axis is labeled "N. of Documents" and shows a numerical scale indicating the volume of published work. On the y-axis, each row corresponds to a different publication source. The source with the most substantial contribution is "Lecture Notes in Computer Science (including subseries)," with 76 documents. This is followed by a cluster of sources with significantly fewer publications: "Advances in Intelligent Systems and Computing," "IEEE Access," and the "ACM International Conference Proceeding Series," each with 27 or 25 documents. A standalone entry titled "Swarm Intelligence" has 22 documents. Other notable sources such as "Lecture Notes in Electrical Engineering," "Communications in Computer and Information Science," "Expert Systems with Applications," and "Soft Computing" have contributions ranging from 10 to 16 documents. The smallest bubble, with 10 documents, corresponds to "Proceedings of SPIE - The International Society for Optical Engineering." This chart illustrates the distribution and concentration of research output across various reputable sources within the field of swarm intelligence, indicating which publications are most frequently associated with this area of study. The "Lecture Notes in Computer Science" series stands out as a key repository of knowledge in this domain.

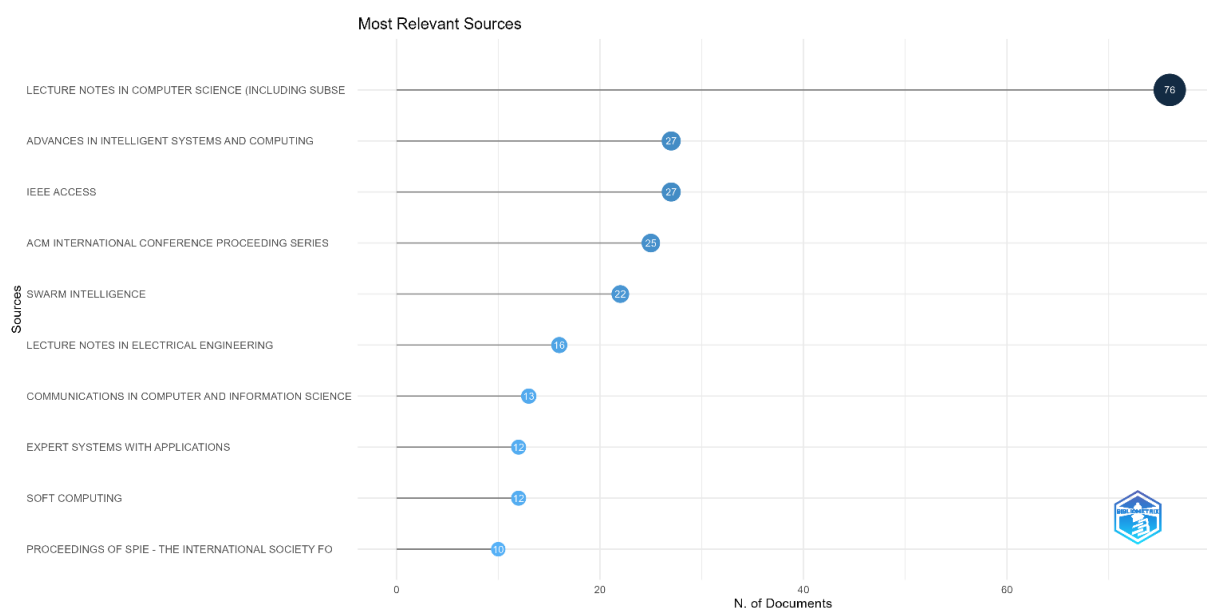


Figure 2. The most relevant sources

Figure 3 displays a bubble chart titled "Most Relevant Affiliations," which illustrates the affiliations associated with the highest number of articles published in the field of swarm intelligence. The horizontal axis is labeled "Articles" and shows a count of publications attributed to each affiliation, while the vertical axis lists the names of the affiliations. The Université Libre de Bruxelles tops the chart with 31 articles, closely followed by the National University of Defense Technology with 30 articles, indicating that these institutions are leading in terms of contribution to the field. Another entry is labeled as "Not Reported," which also has a significant number of articles (24) associated with it, suggesting that for many articles, the authors' affiliations were not specified. Other prominent institutions include Singidunum University, Wuhan University, Sichuan University, and Tongji University, each with 24 articles to their credit. Slightly fewer contributions come from South China University of Technology and Islamic Azad University, both with 17 articles, and Jilin University with 19 articles. This chart provides insight into which academic and research institutions are most actively publishing in the realm of swarm intelligence. The presence of several Chinese universities indicates a strong research interest and activity in this field within China.

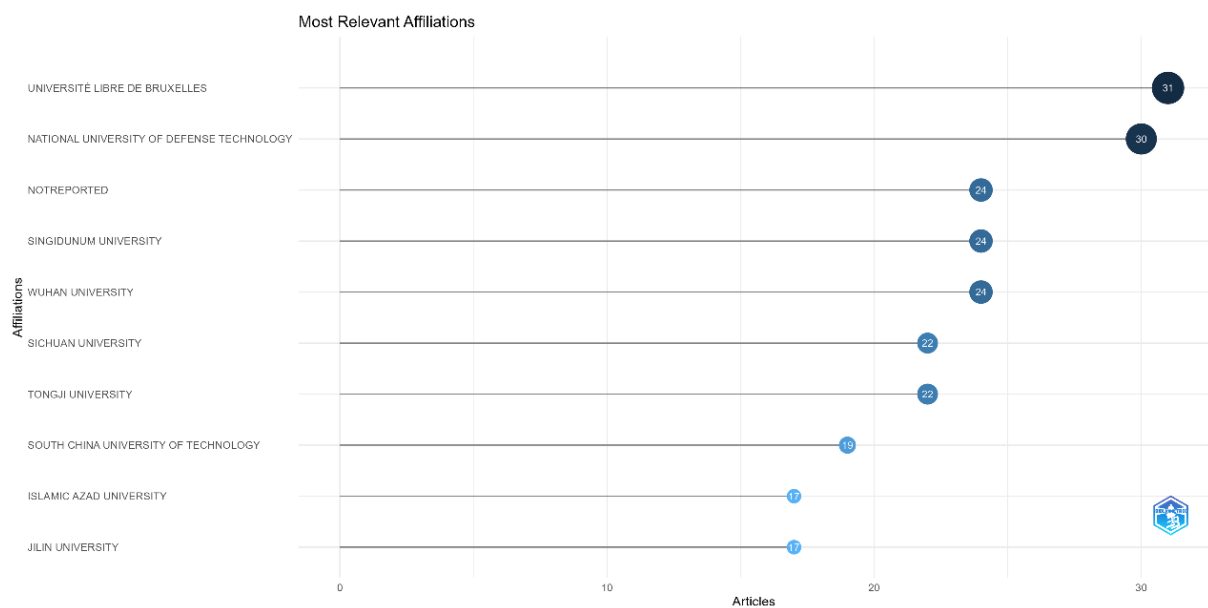


Figure 3. Most relevant affiliations

d. Three Field Plot of keyword, author and source

The figure 4, three-field plot is a kind of visual used in bibliometric analyses to describe how the input data dimensions relate to one another: authors' keywords (DE), authors (AU), and sources (SO) of the publication. In this visualization, a connection is made from items in one field to items in another, thus indicating the association or co-occurrence of items. In the left column (DE), there are keywords that authors usually used when referring to their paper. To the best of my knowledge, such keywords are: intelligence, swarm intelligence, optimization, and metaheuristics, etc. The lines are connecting such keywords with the middle column (AU), where it is found that it has author names like Tuba M, Zhang Y, and Liu H. It means that the mentioned authors have written papers related to the words written at the left. Lastly, sources of the publications fill the right column (SO), including "Lecture Notes in Computer Science," "IEEE Access," and "Expert Systems with Applications." Lines from the authors in the middle column extend to these sources, showing where their work has been published. The relationship strengths are often indicated by the density and concentration of the lines. For example, where a lot of lines are connecting a particular keyword to an author or a source, this is an indication of strong association or high activity in that area. This kind of visualization helps to understand between which authors, the most active domains of research, and which journals or conferences are publishing it. It also helps to understand the

thematic focus of individual researchers or groups of researchers within a broader research field.

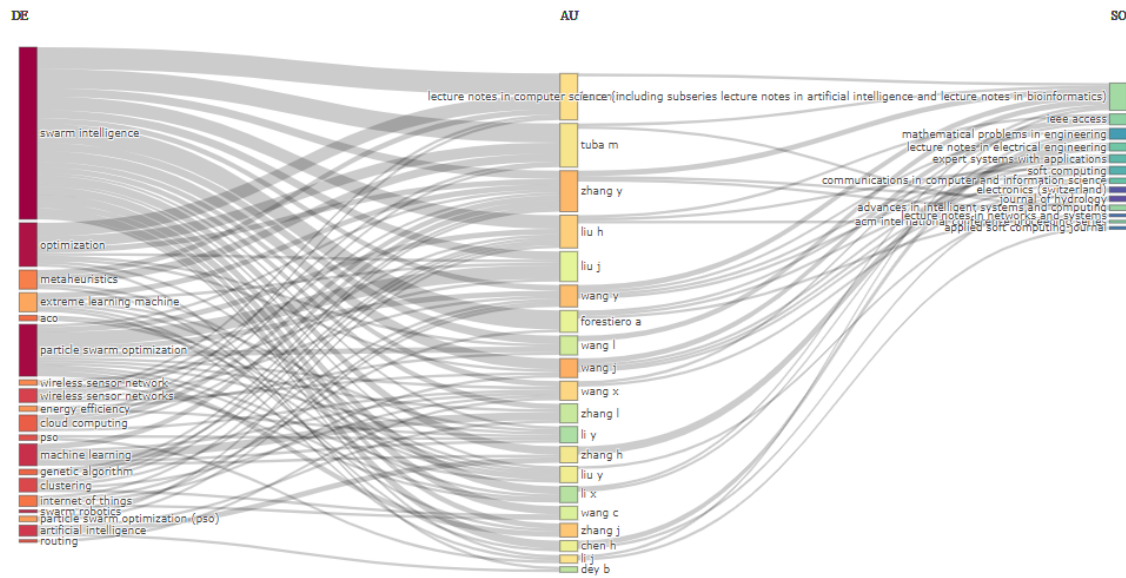


Figure 4. Three Field Plot representing the relationship between author keyword (DE), author (AU) and source (SO) using Biblioshiny.

e. Frequency and Co-Occurrence of Keywords

For the purpose of keyword co-occurrence analysis presented in Figure 5, a dedicated software tool named *SwarmIntelligence_PublicationsAnalysis* was developed. This software incorporates methods for analyzing the frequency of keywords and generating visual representations of their co-occurrences. The source code has been made publicly available on GitHub [35] to promote transparency, replicability, and further exploration of the results. Using this tool, a total of 3,620 keywords extracted from the selected research articles were evaluated. Keywords with a minimum occurrence of 15 across different documents were shortlisted and categorized into three distinct clusters. The most significant keyword, “Swarm intelligence,” with 495 occurrences, formed Cluster 1. An additional four keywords - “Optimization,” “Ant colony optimization,” “Particle swarm optimization,” and “Wireless sensor networks” - each with at least 50 related publications, were grouped into Cluster 2. The remaining 13 keywords were assigned to Cluster 3. Based on the assigned clusters, keywords are visually represented as nodes placed on three concentric rings in the network map, with each cluster distinguished by a specific color: light blue for Cluster 1, dark blue for Cluster 2, and violet for Cluster 3. The co-occurrence relationships between keywords are shown as edges connecting the nodes. These edges are colored according to the more prominent cluster involved and vary in thickness to reflect the frequency of co-occurrence. While the visual distinction between the cluster colors may appear subtle, the clusters remain easily interpretable due to their spatial distribution, ring-based arrangement, and the relative strength of the connecting edges. The overall structure effectively conveys the thematic proximity among keywords and the centrality of specific terms within the broader research domain. The resulting co-occurrence map is depicted in Figure 5.

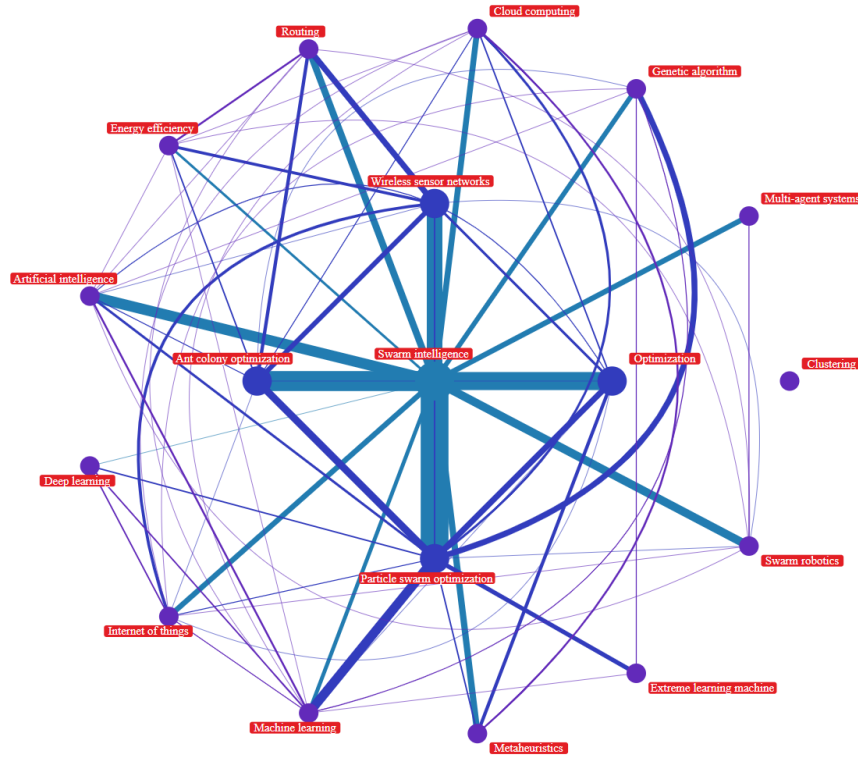


Figure 5. Keyword co-occurrence network with three clusters: light blue (Cluster 1), dark blue (Cluster 2), and violet (Cluster 3). Node size reflects keyword frequency, and edge thickness indicates co-occurrence strength.

f. Publication Collaboration in World-wide Community

Using the *SwarmIntelligence_PublicationsAnalysis* software for visualization [35], a collaboration network was generated based on publication data from 12 countries with more than 200 research contributions in swarm intelligence (Figure 6). The most productive countries—China and India, each with over 1,000 publications—are positioned at the center of the visualization. Each country is represented as an independent subgraph, where nodes denote individual authors and yellow-colored internal edges indicate domestic collaborations within that country. The density of these internal edges reflects the extent of intra-national research cooperation; for example, China and India display the densest internal collaboration networks, while countries such as Australia show sparser domestic co-authorship. Blue edges are used to represent international collaborations, linking authors from different countries. The thickness of these edges corresponds to the number of cross-border co-authored publications. Notably, the United Kingdom has the highest number of international collaborations (10 connections), while China, India, and the United States exhibit strong mutual collaborative ties—China and India most frequently collaborate with the United States, and vice versa. While the visualization employs similar tones (yellow for domestic and blue for international collaborations), the structural layout, edge placement, and thickness provide adequate visual clarity. This figure effectively highlights both the depth of internal research networks and the breadth of international cooperation in the swarm intelligence research community. The resulting country-level collaboration network is illustrated in Figure 6.

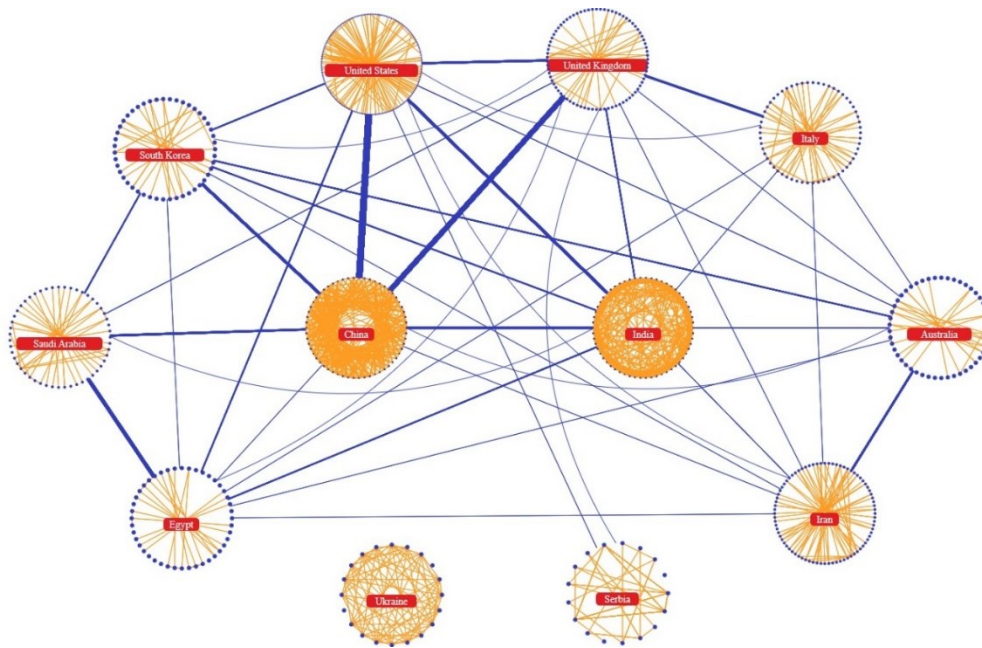


Figure 6. Country-wise collaboration network in swarm intelligence research. Orange nodes represent authors, yellow edges indicate intra-country collaborations, and blue edges show international collaborations. Edge thickness reflects collaboration intensity.

g. Bibliographic Coupling with Source

Figure 7 shows a bibliographic coupling visualization created using VOSviewer, a tool often used for bibliometric analysis. In this network, nodes represent different sources such as journals and conference proceedings, and the links between nodes indicate bibliographic couplings. A bibliographic coupling occurs when two sources cite the same article(s), suggesting a related thematic focus or research area. In the visualization, the sources are clustered and color-coded to represent different thematic groupings or subject areas. The size of each node reflects the strength of the coupling; larger nodes have more bibliographic couplings, indicating a higher degree of connection to other sources within the field of swarm intelligence. The lines connecting the nodes represent the coupling strength; thicker lines suggest stronger couplings. The node labeled "Lecture Notes in Computer Science" seems to be one of the larger ones and central in the network, which means it has strong bibliographic couplings with many other sources, signifying its prominence in the field. Other prominent sources, such as "IEEE Access," "Applied Soft Computing Journal," and "Artificial Intelligence Review," also have considerable node sizes and numerous connections. This kind of analysis is valuable for identifying the most influential sources in a field and understanding how different research areas are interconnected. By examining such a network, researchers can determine which publications are central to a particular research community and might therefore be important venues for publishing their work or for seeking out relevant literature in their field.

i. Most Influential Articles

Table 3 presents a list of the most influential articles in the field of swarm intelligence, ranked based on their global citation counts. The article "A powerful and efficient algorithm for numerical function optimization: artificial bee colony (ABC) algorithm" published in 2007 holds the top position with a staggering 6011 citations, underscoring its foundational impact on the research community. This paper introduced the ABC algorithm, which has become widely adopted in optimization tasks. The second and third entries, both surveys on the ABC algorithm and swarm robotics, reflect the growing academic interest in exploring and applying swarm-based algorithms across diverse applications, each accumulating over 1000 citations. Other notable contributions include studies on the "wisdom of the crowd" effect, bee swarm intelligence algorithms, and glowworm swarm optimization. These articles, with citation counts ranging from several hundred to thousands, indicate the broad adoption of swarm intelligence across fields such as numerical optimization, robotics, social behavior modeling, and even financial portfolio optimization. The high citation numbers reflect not only the academic interest but also the practical relevance of swarm intelligence in solving complex, real-world problems.

Table 3. Most Influential Articles in Swarm Intelligence Based on Global Citation Count

Document Title	DOI	Year	No. of Citations
A powerful and efficient algorithm for numerical function optimization: artificial bee colony (ABC) algorithm	10.1007/s10898-007-9149-x	2007	6011
A comprehensive survey: artificial bee colony (ABC) algorithm and applications	10.1007/s10462-012-9328-0	2014	1382
Swarm robotics: a review from the swarm engineering perspective	10.1007/s11721-012-0075-2	2013	1173
How social influence can undermine the wisdom of crowd effect	10.1073/pnas.1008636108	2011	646
A survey: algorithms simulating bee swarm intelligence	10.1007/s10462-009-9127-4	2009	543
Glowworm swarm optimization for simultaneous capture of multiple local optima of multimodal functions	10.1007/s11721-008-0021-5	2009	384
Multipurpose Reservoir Operation Using Particle Swarm Optimization	10.1061/(ASCE)0733-9496(2007)133:3(192)	2007	256
Particle Swarm Optimization (PSO) for the constrained portfolio optimization problem	10.1016/j.eswa.2011.02.075	2011	222

5. Discussion

From this comprehensive bibliometric analysis on research carried out in the field of swarm intelligence, some interesting insights about the evolution, contributors, and collaborative dynamics in this emerging field come forth. Swarm intelligence research would then appear to be an area of increasing interest and investment, highlighted by the huge uptick in 2024, of course, and the slow but steady rise in annual scientific production since the turn of the century. This increase in publication output may be indicative of either greater research activity or increased awareness of the possible applications and importance of swarm intelligence in a number of areas. However, great care is needed in the interpretation of this peak since it may as well be influenced by other factors such as incomplete data collection or different patterns of reporting. Regardless of that, the general tendency of the increase should point out and state the growing importance and relevancy of swarm intelligence as a subject for scholarly inquiry.

Identification of the prolific authors and their contribution lightens up on the individuals behind the research in this field. We observe an influential contribution, mainly from authors such range from WANG J to ZHANG Y, with consistent output in their record of publication. This presence may indicate common naming practices within the same geographic area or even cultural context—i.e., the commonality of WANG and ZHANG authors with the same or similar surname. It may indicate that the body of research in this specific area is originating from some sorts of clusters of activity in particular geographic areas.

In addition, average co-authors per document and international co-authorship are presented as a percentage of the total, which points towards the collaborative nature of swarm intelligence research involving a global pool of researchers for the advancement of knowledge in this domain. Source analysis and affiliation most relevant are to highlight those key publications and academic institutions at the frontier of swarm intelligence research. Such great importance attached to publications such as "Lecture Notes in Computer Science" and associations such as Université Libre de Bruxelles attests to the importance of the same publications in the diffusion and production of research within the area of specialty.

To some extent, the fact that multiple Chinese universities feature between the top affiliations points to a focus of research interest and activity from the country's side on swarm intelligence. That is, the concentration of this kind of research within China could very well be indicative of the global dispersion of scholarly research on this topic and mirror country-level distributions of expertise in this area. The visualizations of keyword co-occurrence, publication collaboration, and bibliographic coupling provide more insight into the thematic focus, collaborative networks, and influence within the context of swarm intelligence research. The strong association of central keywords, such as "swarm intelligence," with related concepts like "particle swarm optimization," reflects the interrelatedness of the research theme and shows light on the very high depth of inquiry in very focused specific topics within a broader subject area.

Further, the given network diagram for publication collaboration between countries clearly depicts that this has to be a global trend for research in the field of swarm intelligence, where China, the United States, and India become the central point for collaboration and research output. This bibliometric analysis offers valuable insights into the current state of research, identifying leading contributors and mapping collaboration patterns in the field of swarm intelligence. This contribution identified an increase in publication output, prolific authors, and influential sources, lending credence to the interdisciplinary and cross-continent nature of swarm intelligence research. Moreover, further exploration and analysis of related scholarly publications in the field will become imminent for developing our understanding of swarm intelligence and further derivation of its potential for problem-solving for a series of complex real-life applications.

The study confirms the extensive applicability of swarm intelligence across various domains, as highlighted in the literature review. The co-occurrence and clustering of keywords such as 'optimization,' 'particle swarm optimization,' and 'ant colony optimization' indicate that swarm intelligence techniques are frequently applied to complex optimization problems. The clustering analysis in the results section identifies three key thematic areas where swarm intelligence is extensively used: optimization problems, especially in routing and resource allocation; swarm robotics, which is critical in decentralized coordination tasks like search and rescue, agriculture, and manufacturing; and network design and bioinformatics, where it helps solve dynamic network challenges and analyze intricate biological data. The keyword co-occurrence and bibliographic coupling analyses confirm that swarm intelligence is not just a theoretical concept but is actively applied to practical challenges, reinforcing its significance in both industrial and academic settings.

The significance of the study lies in its ability to present a comprehensive overview of the current research landscape in swarm intelligence, highlighting key contributors, influential sources, and international collaboration networks. The sharp increase in research output reflects the growing importance of swarm intelligence, particularly in its applications to optimi-

zation, robotics, and artificial intelligence. By analyzing thematic focus and collaboration patterns, this study provides a basis for identifying focal research areas and guiding future scholarly efforts in swarm intelligence. The identification of prolific authors and leading sources helps researchers and practitioners focus on high-impact work, driving real-world advancements in areas such as disaster management, bioinformatics, and autonomous systems. This research holds substantial value for both academic researchers and industry practitioners. In academia, the insights can guide future studies and collaborations, while practitioners in fields like robotics, telecommunications, and optimization can apply swarm intelligence algorithms—such as Particle Swarm Optimization and Ant Colony Optimization—to solve complex real-world problems, including network design and autonomous decision-making. Understanding the global research landscape is crucial for stakeholders aiming to expand the applications of swarm intelligence in interdisciplinary areas such as artificial intelligence, machine learning, and complex systems. Therefore, this study offers a comprehensive overview of the field and its potential to drive innovation across various high-impact sectors.

Conclusion

This bibliometric analysis is very useful in giving light to the whole body of the scholarly landscape about the swarm intelligence research. The findings pointed at a marked increase in the publications over time, with 2024 as one of the prolific years. We also identified key contributors to the field's advancement, such as prolific authors and influential sources. Co-occurrence analysis indicates the central themes and foci in studies of Swarm Intelligence. Similarly, the publication collaboration analysis points to an expansive network of international collaborative research. Bibliographic coupling further demonstrates that there is some kind of cohesiveness between scientific works and the presence of certain sources in the field. Overall, the research makes a good contribution to in-depth study of trends, patterns, and dynamics of what shapes swarm intelligence research and, hence, gives a basis for future studies and developments.

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