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Mapping Research on the Use of Algorithms in Commerce: A Bibliometric Analysis Based on Scopus

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abstract

Algorithms had garnered widespread attention across various scientific disciplines, including the commercial sector. According to data from Scopus, over 600 documents exploring the application of algorithms in commerce were identified. However, no comprehensive bibliometric analysis had been conducted to deeply examine the implementation of algorithms within this sector. This research aimed to fill this gap by analyzing the contributions of authors, affiliations, countries, and journals within the literature on commercial algorithms. Employing bibliometric methods on 645 Scopus-indexed documents, this study revealed that 2022 marked the peak of publications with 112 documents, indicating significant growth in this area. Li, Y. from Wuhan College, China, was recognized as the most productive author. Additionally, several universities in China were noted as the most productive affiliations. The ACM International Conference Proceeding Series was the most prolific source on this topic. The study also identified Computer Science, Engineering, and Mathematics as the most popular subject areas. These results indicate a need for further research into aspects such as data privacy, User Experience (UX), Dynamic Pricing Algorithms, and blockchain technology to enhance efficiency and security in commercial applications. This research paves the way for a broader understanding of algorithm utilization in commerce and provides recommendations for future studies.

abstrak

Algoritma telah menarik perhatian luas di berbagai disiplin ilmu, termasuk sektor komersial. Menurut data dari Scopus, lebih dari 600 dokumen yang mengeksplorasi penerapan algoritma dalam perdagangan telah diidentifikasi. Namun, tidak ada analisis bibliometrik komprehensif yang telah dilakukan untuk memeriksa secara mendalam penerapan algoritma dalam sektor ini. Penelitian ini bertujuan untuk mengisi kesenjangan ini dengan menganalisis kontribusi penulis, afiliasi, negara, dan jurnal dalam literatur tentang algoritma komersial. Dengan menggunakan metode bibliometrik pada 645 dokumen yang diindeks Scopus, studi ini mengungkapkan bahwa tahun 2022 menandai puncak publikasi dengan 112 dokumen, yang menunjukkan pertumbuhan signifikan di bidang ini. Li, Y. dari Wuhan College, Tiongkok, diakui sebagai penulis paling produktif. Selain itu, beberapa universitas di Tiongkok tercatat sebagai afiliasi paling produktif. ACM International Conference Proceeding Series adalah sumber paling produktif tentang topik ini. Studi ini juga mengidentifikasi Ilmu Komputer, Teknik, dan Matematika sebagai bidang subjek paling populer. Hasil ini menunjukkan perlunya penelitian lebih lanjut mengenai berbagai aspek seperti privasi data, Pengalaman Pengguna (UX), Algoritma Penetapan Harga Dinamis, dan teknologi blockchain untuk meningkatkan efisiensi dan keamanan dalam aplikasi komersial. Penelitian ini membuka jalan bagi pemahaman yang lebih luas tentang pemanfaatan algoritma dalam perdagangan dan memberikan rekomendasi untuk penelitian di masa mendatang.

Kata Kunci:

Algoritma; Perdagangan;

Analisis Bibliometrik; Scopus;

VOSviewer.

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ACM Computing Classification System (CCS)

EBSCOhost

Communication and Mass Media Complete (CMC)

1. Introduction

Algorithms have become pivotal in driving innovations across various aspects of commerce, enhancing e-commerce security, sentiment analysis, product recommendations, and behavioral analytics. For instance, P., Dijesh *et al.* (2020) enhanced e-commerce security using asymmetric key algorithms. Chen & Lai (2023) developed a blockchain-based cross-border e-commerce traceability security system, integrating genetic algorithms to ensure reliability and transparency. Ji & Wang (2022) implemented RSA algorithm-based signature technology to enhance security in e-commerce. Also Zhang *et al.* (2022) designed a network security design for an e-commerce sales management system using neural network algorithms, which significantly improved online data and transaction protection. Alzahrani *et al.* (2022) deployed deep learning algorithms for sentiment analysis of e-commerce product reviews, while Malik *et al.* (2022) combined NLP and machine learning for product recommendations. Also, in recommendation systems, Gulzar *et al.* (2023) introduced a cluster-based algorithm, and Kumar *et al.* (2023) used association rule mining for analyzing e-commerce site usability.

Numerous bibliometric analyses have investigated the utilization of algorithms across different research fields. These studies include genetic algorithms in supply chain flexibility by Lam *et al.* (2024), and machine learning for cancer prediction by Ampofo *et al.* (2024). Additionally, Bhosale *et al.* (2021) focused on leukemia diagnosis using machine learning and text mining, while Lai *et al.* (2023) used clustering algorithms to visualize collaborations and themes in skin cancer research. Previous bibliometric research by Daza *et al.* (2024) centered on sentiment analysis in e-commerce product reviews using advanced algorithms. To date, no comprehensive bibliometric analysis has been performed on algorithm use in the commercial sector indexed by Scopus. This study aims to fill this gap by conducting a bibliometric investigation into the contributors, affiliations, countries, and key journals involved in algorithm research in commerce. This will also identify both well-covered and lesser-explored topics, providing guidance for future research.

2. Research Method

This research conducts a bibliometric analysis of 645 documents indexed in the Scopus database as of October 24, 2024, using the keywords 'TITLE (algorithm AND commerce)'. The study included all matching documents to ensure comprehensive and accurate data representation and utilized VOSviewer software for data visualization, analyzing citation networks and keywords. Three types of bibliometric analysis were performed:

- 1) *Descriptive Analysis* - This evaluated research productivity by counting publications and their annual growth, identifying leading authors, affiliations, countries, journals, document types, and subject areas, providing insights into the dynamics and knowledge distribution of the topic.
- 2) *Citation Analysis* - This assessed the impact of the most cited publications, authors, years, and sources, highlighting significant contributions and their academic interactions.
- 3) *Keyword Analysis* - This identified frequently used keywords, offering insights into research trends, focuses, and gaps, crucial for understanding the theoretical and methodological underpinnings in the field.

This systematic approach is expected to significantly contribute to the literature on algorithms in commerce and suggest directions for future research.

3. Results and Discussion

Results

Descriptive Analysis

A total of 645 Scopus-indexed documents reveal diverse algorithmic developments in e-commerce. Kawazoe *et al.* (1999) developed an optimal algorithm for money distribution in electronic trading systems. In the same year, Ketchpel & Garcia-Molina (1999) introduced a reliable algorithm for distributed trade transactions. Sarwar *et al.* (2000) analyzed recommendation algorithms significantly impacting user experience in e-commerce. Kounchev *et al.* (2001) created a multi-layer image compression algorithm for e-commerce, while Li *et al.* (2001) designed a model for clustering e-commerce

characteristics based on artistic algorithms. Qin *et al.* (2001) developed a security algorithm for communicating non-alphabetical character information in e-commerce. Ye & Papavassiliou (2001) utilized a genetic algorithm for dynamic network resource allocation oriented towards market needs in e-commerce. Changqing & Min (2002) proposed a personalization algorithm for e-commerce services.

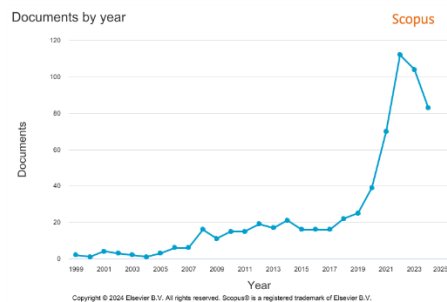


Figure 1. Annual growth of papers published related to the field

Figure 1 illustrates the trend in the number of publications concerning the use of algorithms in the commercial sector from 1999 to 2024. Initially, annual publications were minimal, with only a few papers published each year until around 2007. However, from 2008 onward, there was a gradual increase in the number of publications. This trend accelerated significantly after 2017, peaking in 2022 with 112 documents before experiencing a slight decline in 2023 and 2024. The exponential growth over the last decade highlights the growing interest and rapid development in the commercial field where algorithms are increasingly utilized for various applications. The sharp increase in publications underscores the critical role played by advanced algorithms in enhancing the efficiency, accuracy, and profitability of commercial enterprises.

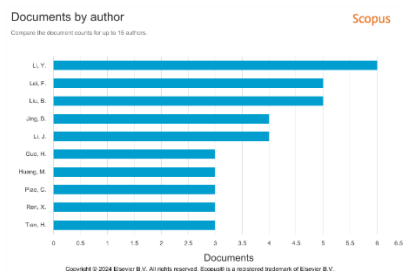


Figure 2. The most productive authors related to the field

Figure 2 displays the significant contributions of several authors regarding the use of algorithms in commerce. Li, Y. leads with 6 publications, followed by Lei, F. and Liu, B., each with 5 publications. Jing, B. and Li, J. also made substantial contributions with 4 publications each. Other authors such as Guo, H., Huang, M., Piao, C., Ren, X., and Tian, H. have each produced 3 publications. This productivity profile indicates an active group of researchers in the field of commercial application algorithms, making significant contributions to both theoretical development and practical implementation. This activity reflects the rapid progress and growing interest in utilizing advanced technologies to solve problems in the commercial world.

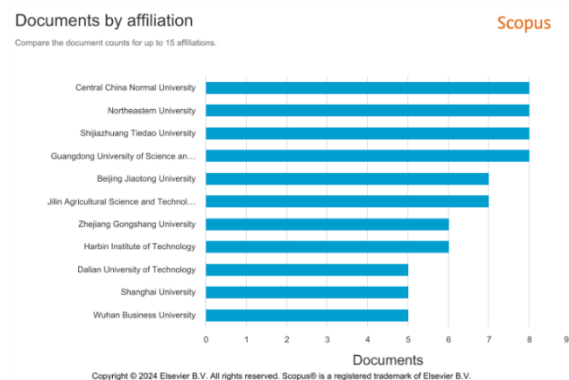


Figure 3. Top affiliations published related to the field

Figure 3 illustrates the distribution of publication numbers by affiliations actively publishing scholarly works on the use of algorithms in commerce. Central China Normal University, Northeastern University, Shijiazhuang Tiedao University, and Guangdong University of Science and Technology each lead with 8 publications. Beijing Jiaotong University and Jilin Agricultural Science and Technology University each have 7 publications. Meanwhile, Zhejiang Gongshang University and Harbin Institute of Technology each recorded 6 publications. Dalian University of Technology, Shanghai University, and Wuhan Business University each contributed 5 publications. This activity reflects the significant contributions of these institutions to the development of research on algorithms applied in the commercial sector, demonstrating their focus on innovation and the application of advanced technologies in business and commerce.

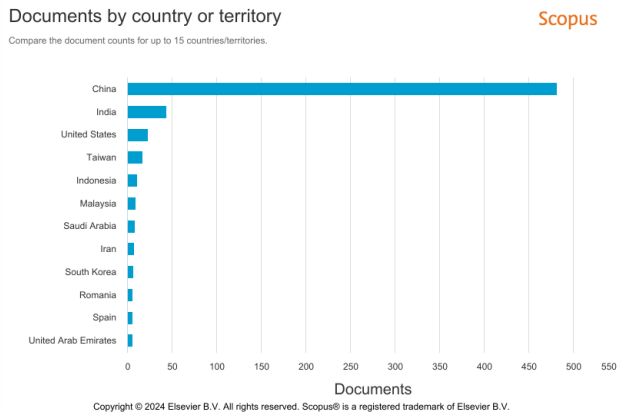


Figure 4. The most productive countries published related to the field

Figure 4 displays the number of documents by country with the most productive publication of algorithm usage in commerce. China dominates with 481 publications, demonstrating the country's significant role in the research and development of algorithmic technology in the commercial sector. India follows at a distance with 43 publications, holding the second position, while the United States is in third place with 22 publications. Other countries such as Taiwan, Indonesia, Malaysia, Saudi Arabia, Iran, South Korea, Romania, Spain, and the United Arab Emirates also contribute, but with much lower numbers compared to China. This disparity in publication numbers reflects the varied focus and research capacity of different countries in applying algorithmic technology to solve problems in the commercial sector.

Table 1. The most productive sources in the field

Source	Documents
ACM International Conference Proceeding Series	30
Lecture Notes On Data Engineering And Communications Technologies	17
Lecture Notes In Electrical Engineering	14
Advances In Intelligent Systems And Computing	11
Mathematical Problems In Engineering	10

Table 1 contains several sources that have made significant contributions to the publication of documents about the use of algorithms in commerce. The ACM International Conference Proceeding Series stands out as the most productive source with a total of 30 documents. This is followed by the Lecture Notes on Data Engineering and Communications Technologies, which has published 17 documents, and Lecture Notes in Electrical Engineering with 14 documents. Other sources such as Advances in Intelligent Systems and Computing and Mathematical Problems in Engineering also make substantial contributions, each publishing 11 and 10 documents respectively. Overall, these sources demonstrate a strong focus on the integration of algorithms in commercial applications, reflecting the importance of advanced technologies in optimizing business operations and enhancing innovation in the commerce sector.

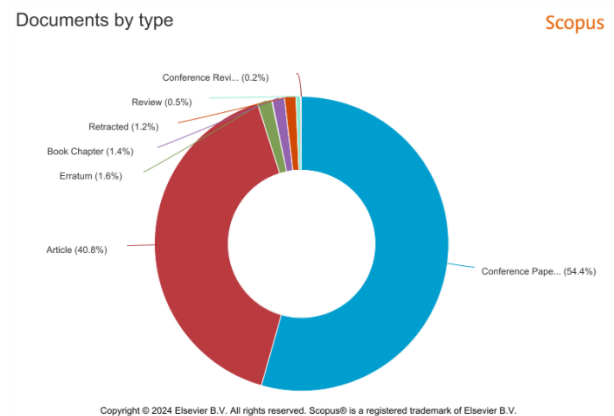


Figure 5. Document Types published related to the field

Figure 5 illustrates the distribution of various document types related to the use of algorithms in commerce. Conference papers dominate with a percentage of 54.4%, indicating that discussions regarding algorithms in commerce frequently occur within international conference forums. Journal articles also make a significant contribution with 40.8%, demonstrating in-depth research and rigorous peer-review on the topic. Other document types such as errata, book chapters, and reviews contribute to a lesser extent. The presence of document types like retracted and conference reviews, although minimal in number, indicates dynamics within scholarly publishing where errors and revisions are part of the

scientific process. Overall, this data portrays a solid foundation of research conducted in the field of algorithms applied in commerce, with a tendency for publication through conferences and journals as the primary mediums.

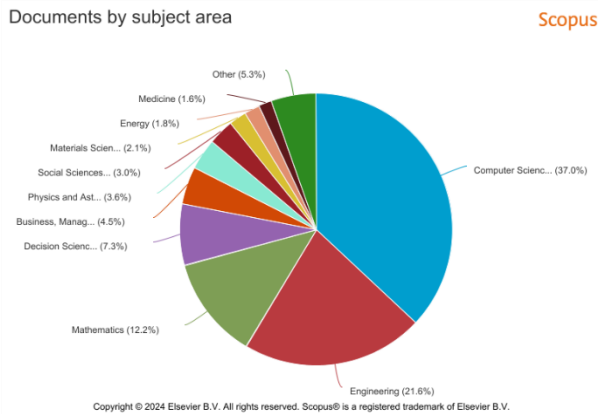


Figure 6. Top documents by subject areas

Figure 6 shows that in the publications related to algorithms in commerce, the three most popular fields are Computer Science, Engineering, and Mathematics. Computer Science dominates with a share of 37%, indicating that much of the research related to algorithms in commerce focuses on the development of software and computer applications. Engineering follows with 21.6%, highlighting the implementation of algorithms across various technical and engineering aspects that support commercial infrastructure and operations. Mathematics, accounting for 12.2% of the documents, illustrates the fundamental role of mathematics in developing efficient and effective algorithms for commercial solutions.

The citation analysis was conducted to assess the impact of the most frequently cited publications, authors, years, and sources. This approach allows for the identification of significant contributions and the academic relationships between key works in the field.

Table 2. The most cited papers in the field

No.	Article Details	Cited
1.	B. Sarwar, G. Karypis, J. Konstan, and J. Riedl, 2000, "Analysis of recommendation algorithms for e-commerce," in EC - Proc. ACM Conf. Electron. Commer. (Sarwar <i>et al.</i> , 2000)	1,393
2.	L. Jiang, Y. Cheng, L. Yang, J. Li, H. Yan, and X. Wang, 2019, "A trust-based collaborative filtering algorithm for E-commerce recommendation system," J. Ambient Intell. Humaniz. Comput. (Jiang <i>et al.</i> , 2019)	160
3.	Y. Guo, M. Wang, and X. Li, 2017, "Application of an improved Apriori algorithm in a mobile e-commerce recommendation system," Ind. Manag. Data Syst. (Guo <i>et al.</i> , 2017)	103
4.	X. Lin <i>et al.</i> , 2019, "A pareto-efficient algorithm for multiple objective optimization in e-commerce recommendation," in RecSys - ACM Conf. Recomm. Syst. (Lin <i>et al.</i> , 2019)	87
5.	R. J. Kuo, J. L. Liao, and C. Tu, 2005, "Integration of ART2 neural network and genetic K-means algorithm for analyzing Web browsing paths in electronic commerce," Decis. Support Syst. (Kuo <i>et al.</i> , 2005)	78
6.	R. J. Kuo and J. A. Chen, 2004, "A decision support system for order selection in electronic commerce based on fuzzy neural network supported by real-coded genetic algorithm," Expert Syst. Appl. (Kuo & Chen, 2004)	74
7.	B.-E. Shie, H.-F. Hsiao, and V. S. Tseng, 2013, "Efficient algorithms for discovering high utility user behavior patterns in mobile commerce environments," Knowl. Inf. Syst. (Shie <i>et al.</i> , 2013)	51
8.	Y. Cao, Y. Shao, and H. Zhang, 2022, "Study on early warning of E-commerce enterprise financial risk based on deep learning algorithm," Electron. Commer. Res. (Cao <i>et al.</i> , 2022)	44

Table 2 displays the 8 most cited papers in the context of algorithm use in commerce. It can be concluded that among the most influential authors is Kuo R.J. from the Department of Industrial Engineering and Management, National Taipei

University of Technology, Taiwan, whose 2 publications appear among the 8 most impactful publications. Both papers demonstrate the application of hybrid models combining neural networks and genetic algorithms to solve specific problems in

Consumer Analytics, derived from big data and machine learning, concentrates on analyzing consumer behavior to inform more effective marketing strategies and business decisions. Dynamic Pricing Algorithms are pertinent to optimization and e-commerce platforms, where prices are adjusted in real time based on demand and market fluctuations. Cybersecurity Measures are essential in safeguarding data and transactions within e-commerce, complementing the security cluster and focusing on preventing cyber-attacks. Supply Chain Optimization, related to optimization algorithms and machine learning, aims to enhance the efficiency of distribution and inventory management systems. Sustainability in E-commerce involves integrating sustainable practices within e-commerce business models, such as optimizing resource use and reducing waste, and is relevant to sustainability and corporate social responsibility themes. Finally, Privacy-Preserving Algorithms, crucial in the context of increasing privacy concerns, address the challenges of processing large-scale data while protecting consumer privacy. Incorporating these topics into future research could broaden the scope of studies on algorithm applications in the commercial sector, offering fresh perspectives on their practical implementations.

Discussion

This study presents a bibliometric analysis of algorithm applications in commerce, revealing significant trends and highlighting emerging research areas. By analyzing 645 documents indexed in the Scopus database, the study identifies the pivotal role of algorithms in shaping the commercial sector, especially in enhancing e-commerce security, personalization, and data analytics. One key observation from the citation analysis is the growing body of literature on algorithms that improve e-commerce security. Studies such as those by P., Dijesh *et al.* (2020) and Ji & Wang (2022) focus on the application of asymmetric key algorithms and RSA algorithm-based signature technology, respectively, to safeguard e-commerce transactions. Similarly, Zhang *et al.* (2022) proposed a neural network-based security design for e-commerce systems, demonstrating how algorithms are critical for the protection of online transactions and data. Blockchain technology, as explored by Chen & Lai

(2023), represents another significant contribution, especially in cross-border e-commerce where transaction transparency and reliability are paramount. Another area of importance highlighted in the bibliometric analysis is sentiment analysis in e-commerce product reviews. Alzahrani *et al.* (2022) utilized deep learning algorithms for sentiment analysis, improving customer service and marketing strategies by better understanding consumer opinions. Additionally, the work by Daza *et al.* (2024) examined the challenges and future prospects of sentiment analysis in e-commerce, using both machine learning and deep learning techniques. These contributions underscore the importance of sentiment analysis for enhancing customer experience and driving business decisions in e-commerce platforms. The study also reveals a growing interest in recommendation systems.

The use of algorithms such as Gulzar *et al.* (2023)'s cluster-based algorithm for product recommendations and Malik *et al.* (2022)'s combination of natural language processing (NLP) and machine learning demonstrates the increasing sophistication of e-commerce recommendation systems. These systems are designed to provide personalized experiences for users, which is a key factor in driving consumer engagement and sales. Kumar *et al.* (2023) applied association rule mining to analyze website usability, offering additional insights into how algorithms can optimize e-commerce site design for better user interaction. Further exploration of under-researched topics in algorithmic applications, as suggested in the study, reveals opportunities for future investigations. IoT, for instance, is increasingly being integrated with e-commerce platforms to enhance operational efficiency and customer experience by collecting data from a variety of interconnected devices (Cao *et al.*, 2022). Moreover, privacy-preserving algorithms, which are critical in safeguarding consumer data, are expected to gain importance as privacy concerns continue to grow. The need for algorithms that ensure secure data handling and compliance with privacy regulations is becoming more pressing, as highlighted by Qin *et al.* (2001). Sustainability in e-commerce, driven by algorithms designed to optimize resource usage and minimize waste, is another area that warrants more attention. As e-commerce continues to

grow, sustainable practices will play a crucial role in aligning business operations with environmental and social responsibility. Incorporating sustainability-focused algorithms will not only help businesses improve operational efficiency but also contribute to corporate social responsibility goals. Finally, while much of the research on machine learning and algorithms has focused on specific domains like healthcare and supply chain management (Ampofo *et al.*, 2024; Lam *et al.*, 2024), their integration into commerce offers new opportunities.

Algorithms such as dynamic pricing models and supply chain optimization are directly applicable to the commercial sector, where real-time adjustments to pricing and inventory management can result in significant competitive advantages. In conclusion, this bibliometric analysis provides a thorough overview of the current state of algorithm applications in commerce, identifies significant contributions, and points to future research opportunities. Emerging fields such as IoT, blockchain, and privacy-preserving algorithms offer exciting potential for further study, while topics like sustainability and consumer analytics are expected to grow in relevance. Future research should continue to explore these areas, aiming to bridge the gap between technological advancements and commercial applications to foster innovation in the e-commerce sector.

4. Conclusion

Research on algorithm use in commerce has significantly grown, peaking in 2022 with 112 publications, reflecting increasing interest and application in commercial processes. Li, Y. from Wuhan College, China, emerged as the most prolific author with six publications, underscoring his notable contributions. China's dominance in this field is further evidenced by the high output from institutions like Central China Normal University and Northeastern University, each with eight publications. Conferences, notably through the ACM International Conference Proceeding Series, which recorded 30 documents, have served as a primary dissemination medium, emphasizing the role of scientific meetings in this field's rapid development.

Nearly 54.4% of the documents are conference papers, with journal articles contributing 40.8%, highlighting the importance of knowledge exchange and collaborative research. Topically, Computer Science, Engineering, and Mathematics dominate, showcasing the strong technical foundation in algorithm development. Keyword analysis via VOSviewer identifies four main research clusters: optimization, digital platforms, recommendation technologies, and information management, vital for commercial technology advancement. For future research, it was highly recommended to delve deeper into the impact of algorithms on aspects such as User Experience (UX), Internet of Things (IoT), Blockchain, Augmented Reality (AR), Consumer Analytics, Dynamic Pricing Algorithms, Cybersecurity Measures, Supply Chain Optimization, Sustainability in E-commerce, and Privacy-Preserving Algorithms. This research would provide a more comprehensive understanding of how algorithms can be optimized to enhance efficiency, security, and user satisfaction in an increasingly digital commercial environment.

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