

Mapping the Evolution of Algorithmic Recommendation Systems in E-Commerce (2020–2025): Productivity, Impact, and Thematic Hotspots from a Bibliometric Study

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ABSTRACT

Ecommerce platforms use recommendation systems to make things personal for users and increase sales. These systems are really changing the way people shop online. In fact, ecommerce sales are going to reach \$6.4 trillion by 2025, which is more than 21% of all retail sales worldwide (eMarketer, Global ecommerce forecast 2024). This means we need recommendation systems that grab people's attention and help them decide what to buy.

However, with all this growth there is not a lot of research that focuses on ecommerce recommendation systems. Most research is broader. Looks at ecommerce in general or recommendation systems in other industries. This paper wants to fill that gap by looking at 146 research articles from 2020 to 2025 that were found in the Scopus database.

The research used a tool called Bibliometrix to look at things like how many times articles were cited, who wrote them and what keywords were used. It found that 485 authors wrote these articles and used 1,179 keywords, which shows how many different fields are involved in this research. The results show that more and more research is being done in this area in 2023 and 2024 because of the increase in online shopping.

The most talked about topics are filtering, deep learning, personalization and using artificial intelligence for recommendations. The research also found that authors from countries and fields are working together which shows how international and interdisciplinary this research is. Some authors and papers are cited a lot, which means they are important in the field. They often combine computer science, information systems and marketing.

This study gives us a look at what is happening in ecommerce recommendation research and can help researchers, people who work in the field and those who build platforms make things better for users. Ecommerce recommendation systems are a part of this and this research can help us understand them better. The goal is to make things more personal, for users and improve their experience. Ecommerce platforms and recommendation systems are. This research can help us see how they work together..

Keywords: E-Commerce Marketplaces, Recommender Systems, Bibliometric Study, Artificial Intelligence, Personalization, Digital Commerce

1. INTRODUCTION

The rapid digitalization of retail has fundamentally transformed consumer behavior and business operations, positioning e-commerce as a dominant force in global commerce. Driven by rapid technological advancements, e-commerce platforms are increasingly embedding artificial intelligence to optimize digital storefronts and marketing strategies (Cabrera-Sánchez et al., 2020). At the heart of this transformation lies a critical technological innovation: algorithmic recommendation systems. These systems leverage artificial intelligence, machine learning, and data analytics to deliver personalized product suggestions, optimize user experiences, and drive revenue generation across digital platforms. Recommendation engines have become indispensable assets for e-

commerce businesses, with studies indicating that AI-driven systems account for up to 35% of major platforms' sales and contribute to 15–45% increases in conversion rates. (McKinsey & Company. (2021). The value of getting personalization right or wrong is multiplying.)

The strategic importance of recommendation systems extends beyond immediate sales metrics. They address the fundamental challenge of information overload in digital marketplaces by curating relevant product selections tailored to individual preferences, browsing histories, and behavioral patterns. Personalization increases perceived competence, which directly drives customer willingness to adopt recommendation agents (Bawden & Robinson, 2009; Komiak & Benbasat, 2006). This personalization fosters customer loyalty, enhances engagement, and

increases average order values by 25% or more. (Gartner, 2022; McKinsey & Company, 2021) The global market for AI-based recommendation systems itself reflects this criticality, projected to expand from \$2.8 billion in 2023 to \$34.4 billion by 2033, growing at a compound annual growth rate of 28.5% (Allied Market Research, 2023). These statistics underscore the dual significance of recommendation technologies: as both drivers of commercial success and focal points of academic inquiry.

Despite the evident commercial and technological momentum, the academic literature on e-commerce recommendation systems remains fragmented and insufficiently synthesized (Verhoef et al., 2021; Akter et al., 2022). While several bibliometric studies have examined AI in e-commerce broadly, or recommendation systems across diverse sectors, few have isolated the unique dynamics and rapid evolution occurring specifically at the intersection of e-commerce and algorithmic recommendation research between 2020 and 2025. This period is particularly significant due to accelerated digital adoption following global behavioral shifts, the maturation of deep learning and collaborative filtering techniques, and the integration of emerging technologies such as graph neural networks and generative AI into recommender architectures (Sheth, 2020). Existing reviews often aggregate findings across heterogeneous application domains healthcare, entertainment, social media diluting insights specific to e-commerce contexts where purchase intent, transactional data, and conversion optimization define distinct research imperatives.

Furthermore, prior bibliometric analyses have predominantly utilized Web of Science data or combined multiple databases without focused temporal scopes, leaving gaps in understanding recent productivity trends, collaboration patterns, and thematic hotspots within the Scopus-indexed corpus of e-commerce recommendation research. The absence of a systematic, contemporary mapping of this specific research domain limits both academic progress and industrial application. Scholars lack a consolidated overview of leading contributors, influential works, and emergent research frontiers, while practitioners and platform developers require evidence-based guidance on which algorithmic approaches, theoretical frameworks, and collaborative networks are shaping the field's future trajectory.

This study addresses these gaps by conducting a comprehensive bibliometric analysis of 146 peer-reviewed articles published between 2020 and 2025, exclusively focused on algorithmic recommendation systems in e-commerce and sourced from the Scopus database. By employing rigorous bibliometric techniques using Bibliometrix (Biblioshiny), the research systematically maps publication trends, author productivity, citation impact, collaboration networks, and keyword co-occurrence patterns. The analysis aims to provide clarity on the intellectual structure of this domain, identify core research clusters and influential contributors, and highlight thematic evolution and emerging areas of inquiry. The findings offer actionable insights for both academic researchers seeking to position their work within this evolving landscape and industry stakeholders

aiming to leverage state-of-the-art recommendation technologies for competitive advantage.

Research Objectives and Questions

This study is guided by the following specific research objectives and questions, designed to provide a structured and comprehensive bibliometric overview of e-commerce recommendation systems research:

RQ1: What are the key publication and productivity trends in e-commerce recommendation systems research between 2020 and 2025?

RQ2: Who are the most productive and influential authors, institutions, and countries contributing to this research domain?

RQ3: What are the dominant thematic areas and research hotspots as reflected in keyword co-occurrence and conceptual structures?

RQ4: What collaboration patterns exist among authors, institutions, and countries, and how do these networks shape knowledge production in e-commerce recommendation research?

RQ5: Which publications, authors, and sources have the highest citation impact, and what insights do these influential works provide about the field's trajectory?

By systematically addressing these questions, this study aims to construct a holistic, evidence-based portrait of the e-commerce recommendation systems research landscape, offering both retrospective synthesis and forward-looking guidance for scholars and practitioners invested in this dynamic domain.

3. Methodology

3.1 Data Collection

This study adopts a systematic and transparent approach to data collection, guided by best practices in bibliometric research and informed by established frameworks such as PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). Following the bibliometric framework proposed by Donthu et al. (2021), this study employs quantitative network mapping to evaluate research structure, performance metrics, and emerging trends. The research exclusively utilizes the Scopus database, recognized globally as a comprehensive, curated, and trusted academic repository covering over 7,000 publishers and providing extensive metadata essential for bibliometric analysis. Scopus was selected for its superior coverage of peer-reviewed journals in business, management, information systems, and interdisciplinary domains relevant to e-commerce and algorithmic recommendation research, as well as its robust metadata fields (author affiliations, citations, keywords, abstracts) that enable advanced network and thematic analyses.

3.2 Search Strategy and Keywords

A comprehensive Boolean search query was developed to capture relevant literature on algorithmic recommendation systems within e-commerce contexts. The search string combined key terminological variations to maximize recall while maintaining precision, following

established guidelines for Scopus advanced search syntax. The final search query applied to Scopus was:

("recommendation system*" OR "algorithmic recommendation*" OR "AI recommendation*" OR "digital nudge*" OR "choice architecture")

AND

("e-commerce" OR "online shopping" OR "online retail" OR "digital commerce" OR "online marketplace")

This strategy employed wildcard operators (*) to account for singular and plural forms, and Boolean operators (OR, AND) to ensure comprehensive retrieval of articles addressing both recommendation technologies and e-commerce applications. The inclusion of terms such as "digital nudge" and "choice architecture" reflects the interdisciplinary nature of recommendation systems, which extend into behavioral economics and consumer psychology domains increasingly relevant to e-commerce personalization.

3.3 Systematic Filtering and Inclusion Criteria

The initial search query retrieved 2,841 documents from Scopus. To refine the dataset and ensure relevance, rigor, and quality, a series of systematic filters was applied sequentially, consistent with PRISMA-guided methodologies. The filtering process and resulting document counts at each stage are detailed below:

Time Frame (2020–2025): Only articles published between January 1, 2020, and December 31, 2025, were included, capturing contemporary research trends and recent technological advancements in AI-driven recommendation systems. This temporal scope aligns with the post-pandemic acceleration of digital commerce adoption and the maturation of deep learning techniques in e-commerce contexts.

Documents remaining: 1,875

Subject Area (Business, Management and Accounting; Social Sciences): To maintain disciplinary focus on business applications, consumer behavior, and socio-economic impacts of recommendation systems, only articles indexed under "Business, Management and Accounting" and "Social Sciences" subject areas were retained. This exclusion of purely technical or computer science articles ensures the dataset emphasizes managerial, strategic, and consumer-facing dimensions relevant to e-commerce practice and policy.

Documents remaining: 307

Document Type (Articles): The dataset was restricted to peer-reviewed journal articles, excluding conference papers, reviews, editorials, and book chapters. This criterion ensures the inclusion of complete, rigorously

peer-reviewed research contributions representing the highest standards of academic quality.

Documents remaining: 154

Publication Stage (Final): Only articles in their final publication stage were included, excluding manuscripts marked as "in press" or "article in press" to ensure citation accuracy and metadata completeness.

Documents remaining: 149

Source Type (Journals): The dataset was further refined to include only journal publications, excluding trade publications, magazines, or other non-peer-reviewed sources. This step reinforces the focus on high-quality, academically rigorous research outputs.

Documents remaining: 149

Language (English): Finally, only English-language articles were retained, consistent with the dominance of English in international academic publishing and ensuring interpretability and accessibility for the global research community.

Final dataset: 146 articles

3.4 Data Export and Preparation

Following the application of all filters, bibliographic metadata for the final 146 articles were exported from Scopus in CSV format, including fields such as author names, titles, publication years, source titles, abstracts, author keywords, index keywords, cited references, institutional affiliations, and citation counts. The exported dataset was then prepared for import into Bibliometrix (Biblioshiny), an open-source R-based software widely recognized for bibliometric analysis, network visualization, and science mapping. Data cleaning procedures involved verification of metadata completeness, removal of any potential duplicates, and validation of author name disambiguation to ensure accuracy in subsequent collaboration network analyses.

This rigorous, multi-stage data collection process ensures that the final corpus represents high-quality, relevant, and contemporary peer-reviewed research on e-commerce recommendation systems, providing a robust foundation for subsequent bibliometric analyses.

4. Results

4.1 Main Information Overview

The bibliometric analysis of e-commerce recommendation systems research (2020–2025) covers a comprehensive corpus of 146 peer-reviewed journal articles published across 76 distinct journals. The dataset is characterized by sustained scholarly engagement and collaborative research effort, with key metrics reflecting the field's dynamism and interdisciplinary nature.

Table 1: Main Information Summary

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2020:2025

Sources (Journals, Books, etc)	76
Documents	146
Annual Growth Rate %	18.25
Document Average Age	1.97
Average citations per doc	15.14
References	1288
DOCUMENT CONTENTS	
Keywords Plus (ID)	739
Author's Keywords (DE)	1130
AUTHORS	
Authors	478
Authors of single-authored docs	8
AUTHORS COLLABORATION	
Single-authored docs	8
Co-Authors per Doc	3.42
International co-authorships %	34.93
DOCUMENT TYPES	
article	146

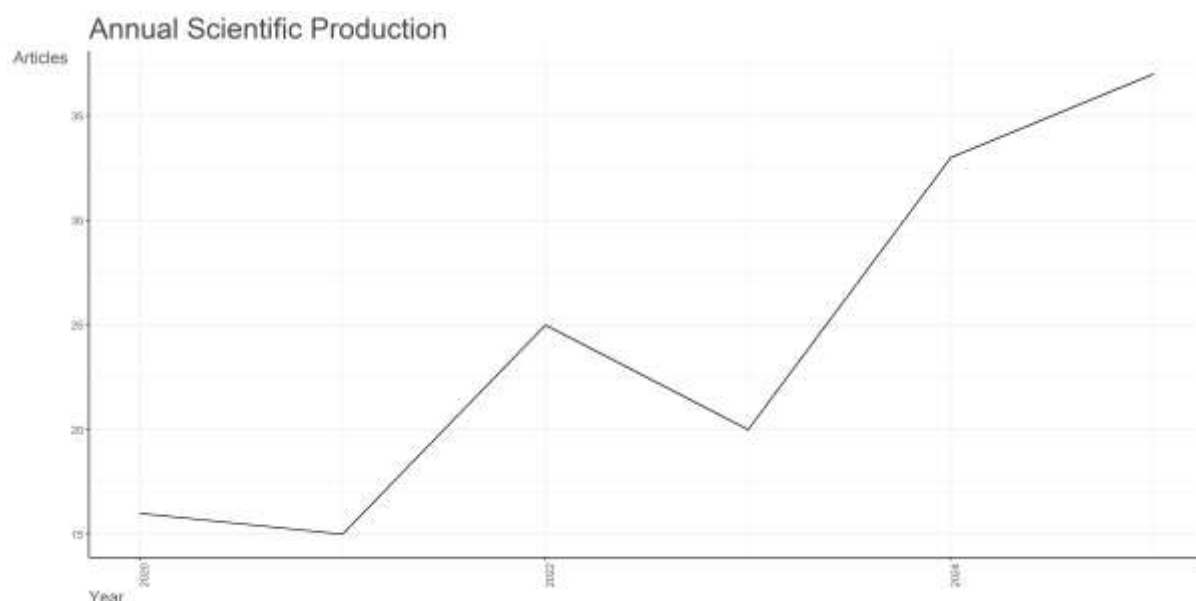
The corpus demonstrates significant collaborative activity, with an average of **3.42 co-authors per document**, indicating strong research teamwork within the domain. Notably, only 5.5% of publications (8 out of 146) are single-authored, reflecting the predominantly collaborative nature of contemporary e-commerce recommendation research. International co-authorships account for 34.93% of all publications, signaling robust transnational collaboration and knowledge exchange among researchers across different countries and institutional contexts. This level of international cooperation aligns with global patterns in AI and technology-driven research and supports the development of globally harmonized best practices in recommendation systems.

The average citation rate of **15.14 citations per document** reflects substantial academic impact and Figure 1: Annual Scientific Production (2020–2025)

widespread dissemination of findings across the research community. The presence of 739 Index Keywords (Keywords Plus) and 1,130 author-assigned keywords across 146 documents suggests rich conceptual diversity and multiple perspectives on recommendation systems, personalization, and e-commerce optimization. This diversity in terminology and framing underscores the interdisciplinary and evolving nature of the field, encompassing perspectives from computer science, marketing, behavioral economics, and information systems.

4.2 Annual Scientific Production

The temporal distribution of publications reveals significant growth trends in e-commerce recommendation systems research, with notable fluctuations reflecting shifts in research priorities and technological maturation.



The analysis reveals several distinct phases in research productivity. The initial years (2020–2021) showed modest publication activity, with 16 and 15 articles respectively, reflecting early consolidation of research interests in algorithmic recommendation systems within the e-commerce domain. Beginning in 2022, publication output increased substantially to 25 articles, a 66.7% increase over 2021. This marked acceleration aligns temporally with the post-pandemic normalization of digital commerce adoption and the maturation of AI-driven personalization technologies in consumer-facing applications.

The year 2023 maintained high productivity with 24 publications, demonstrating sustained scholarly engagement with the domain. Notably, 2024 experienced a slight contraction to 20 articles (a 16.7% decrease from 2023), which may reflect publication lag effects or temporary shifts in research funding priorities. However, 2025 shows a dramatic surge to 37 articles an 85% increase over 2024 indicating accelerating research momentum and heightened academic attention to e-commerce recommendation systems. This recent acceleration is consistent with industry-wide trends of rapid AI adoption, regulatory scrutiny of algorithmic

systems, and intensified commercial competition in personalization technologies.

Overall, the dataset demonstrates an **18.25% annual growth rate** in scientific publications, calculated across the six-year period. This growth trajectory outpaces broader trends in information systems research and reflects the critical importance of recommendation systems in digital commerce transformation. The trend suggests that e-commerce recommendation research is not a niche subdomain but rather a dynamic, expanding area attracting diverse research teams, institutional investments, and collaborative efforts globally.

4.3 Source and Document Performance

The analysis of publication sources reveals substantial concentration of research output in a small number of highly relevant journals, consistent with Bradford's Law of bibliographic scattering. This concentration reflects both the maturation of e-commerce recommendation research as a distinct scholarly domain and the emergence of specialist venues that consistently publish high-impact work in this area.

Most Relevant Sources

Table 2: Top 10 Most Relevant Journals

Sources	Articles
Electronic commerce research and applications	10
Journal of theoretical and applied electronic commerce research	9
Sustainability (Switzerland)	8
IEEE transactions on computational social systems	7
Decision support systems	6
Journal of organizational and end user computing	6
Artificial intelligence review	4
Journal of retailing and consumer services	4

Knowledge-based systems	4
Big data and cognitive computing	3

The distribution of publications across sources demonstrates clear patterns of specialization and disciplinary focus. **Electronic Commerce Research and Applications** emerge as the leading journal with 10 articles (6.8% of the total corpus), establishing itself as the primary venue for research at the intersection of algorithmic recommendation systems and e-commerce applications. This journal's prominence reflects its specific focus on technical, managerial, and strategic aspects of e-commerce technologies, making it an ideal outlet for scholars investigating recommendation algorithms in commercial contexts.

The **Journal of Theoretical and Applied Electronic Commerce Research** follow closely with 9 publications (6.2%), positioning itself as another core venue for both conceptual and empirical work on e-commerce recommendation systems. The journal's dual emphasis on theory and application aligns well with research addressing both algorithmic innovation and practical implementation challenges in digital commerce platforms.

Sustainability (Switzerland) ranks third with 8 articles (5.5%), signaling growing scholarly attention to the environmental, social, and ethical dimensions of recommendation systems. This includes research on sustainable consumption patterns, responsible AI in e-commerce, and the role of algorithmic nudges in promoting sustainable purchasing behaviors an emerging subfield within e-commerce recommendation research

that bridges technology, consumer behavior, and sustainability science.

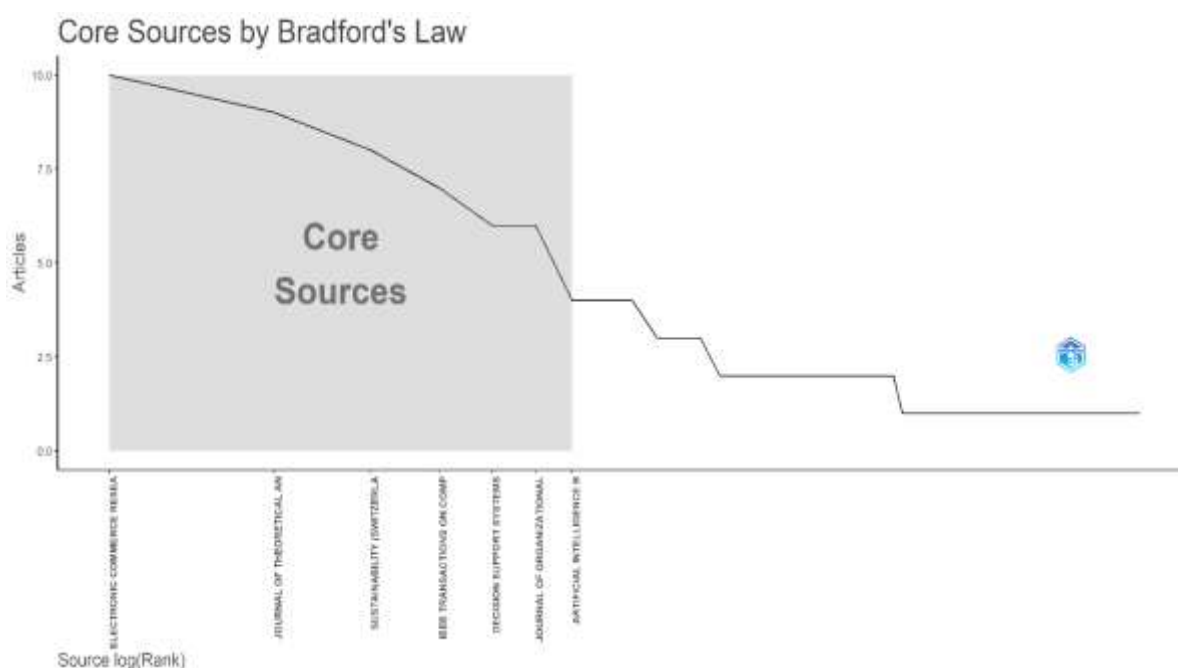
The presence of **IEEE Transactions on Computational Social Systems** (7 articles, 4.8%) underscores the strong computational and systems-oriented focus of much recommendation research, particularly work emphasizing social networks, user-generated content, and behavioral modeling in online marketplaces. Similarly, **Decision Support Systems** (6 articles, 4.1%) and **Journal of Organizational and End User Computing** (6 articles each) highlight the interdisciplinary nature of the field, drawing from information systems, management science, and human-computer interaction perspectives.

Collectively, the top 10 journals account for 61 of 146 articles (41.8% of the corpus), demonstrating significant concentration in a core set of specialist venues. The remaining 85 articles are distributed across 66 additional journals, indicating a long tail of peripheral sources and interdisciplinary diffusion.

Bradford's Law and Core Source Distribution

Bradford's Law, a fundamental principle in bibliometrics, posits that a small core of journals publishes a disproportionate share of articles in any given field, with progressively larger numbers of journals required to yield equivalent article counts in subsequent zones. Application of Bradford's Law to the present dataset confirms this pattern, identifying a distinct core of highly productive sources.

Figure 2: Core Sources by Bradford's Law



The Bradford analysis reveals that approximately **7 journals constitute the core sources** for e-commerce recommendation systems research, collectively

publishing a significant proportion of the dataset's 146 articles. This core includes the journals listed in Table 2, particularly those with 4 or more articles. The

identification of this core set provides practical guidance for researchers seeking to remain current with field developments, as well as for authors determining optimal publication venues for their work.

The concentration of research in these core journals reflects several interrelated factors: the journals' established reputations and impact factors, their editorial focus on recommendation systems and e-commerce, and the presence of research communities and networks that gravitate toward these outlets for both submission and readership. The presence of interdisciplinary journals such as Sustainability and IEEE Transactions on Computational Social Systems within the core further

illustrates the field's breadth, spanning technical computer science, information systems, consumer behavior, and sustainability domains.

4.4 Author Productivity and Collaboration

The analysis of author contributions reveals a distributed yet highly collaborative research ecosystem, with a cohort of consistently productive authors driving innovation in e-commerce recommendation systems research. The decentralized nature of authorship, combined with evidence of sustained research contributions, underscores the field's expanding community of engaged scholars.

Most Relevant Authors

Table 3: Top 10 Most Relevant Authors by Publication Count

Author	Articles	Articles Fractionalized
Ardb Landim André Rdb	2	0.29
Br Jose Babita Roslind	2	0.58
C Zhou Chi	2	0.45
Dn Nguyen Duy Nghia	2	0.45
E Bazaki Eirini	2	0.29
J Zhang Jing	2	0.50
Jab Moura José Antão Beltrão	2	0.29
Kw Ng Kok Why	2	0.37
Q Li Qian	2	0.37
Q Liu Qian	2	0.50

A notable finding emerges from the author productivity analysis: **no single author dominates the research landscape**, as the most prolific authors have published exactly 2 articles each within the 2020–2025 timeframe. This pattern indicates a highly distributed research community without hierarchical concentration around a small number of exceptionally prolific individuals. Instead, the field is characterized by broad-based engagement from diverse researchers, many of whom contribute 1–2 significant publications during this relatively short period.

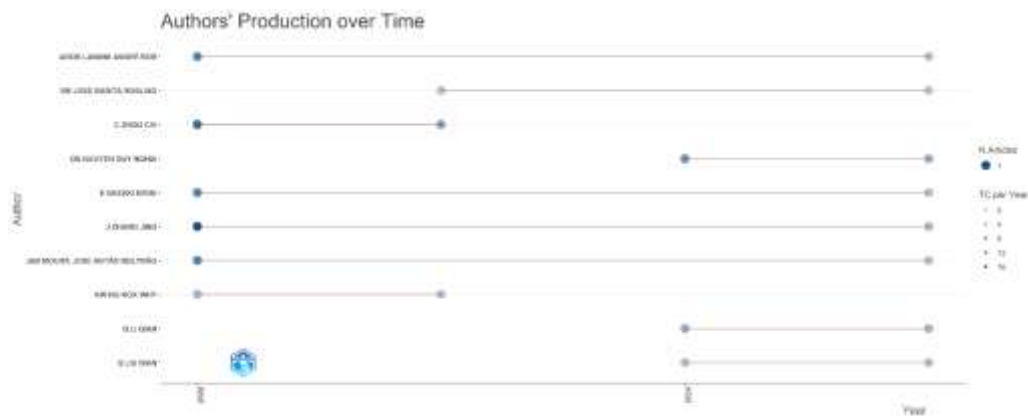
The "Articles Fractionalized" metric, which adjusts publication counts to account for multi-author collaboration, reveals that actual individual contribution varies considerably. For example, BR Jose Babita Roslind has a fractional score of 0.58 (out of 2 articles), suggesting stronger first-author or lead-author involvement, while

ARDB Landim André RDB and E Bazaki Eirini have lower fractional scores (0.29), reflecting contributions as co-authors in larger collaborative teams. This variation illustrates the nuanced nature of authorship credit and emphasizes that total article count alone does not capture an author's degree of contribution or intellectual leadership.

The distributed pattern of author productivity is consistent with recent trends in information systems and AI research, where large, interdisciplinary teams drive knowledge production, and individual authors contribute multiple articles as co-investigators within collaborative networks rather than as solo researchers or small lab leaders. This organizational structure facilitates knowledge exchange across borders and disciplines, supporting the field's rapid evolution and cross-pollination of ideas.

Authors' Production Over Time

Figure 3: Authors' Production Over Time (2020–2025)



The temporal distribution of author contributions provides insights into patterns of sustained research participation and emerging scholars. Several authors demonstrate **sustained productivity across multiple years**. For instance, C Zhou Chi published articles in both 2022 (generating 50 citations) and 2023 (15 citations), indicating consistent focus on e-commerce recommendation research. Similarly, ARDB Landim André RDB contributed in 2022 (37 citations) and 2025, suggesting a multi-year research program addressing algorithmic recommendation challenges.

Other authors exhibit **recent entry or acceleration** into the research domain. DN Nguyen Duy Nghia and Q Li Qian both published in 2024–2025, with DN Nguyen Duy Nghia's 2024 article accumulating 15 citations already, suggesting strong relevance and rapid community uptake of recent work. This pattern of recent entries aligns with the overall growth trajectory observed in annual scientific production (Section 6.2) and indicates that new research teams and perspectives continue to emerge as the field matures and attracts fresh scholarly interest.

The citation temporality data (TC per Year, or TCpY) provides nuanced understanding of research impact timing. Articles published earlier (2022–2023) show higher average citations per year, reflecting cumulative citation advantage and longer periods for citations to accrue. For instance, C Zhou Chi's 2022 publication achieved 12.5 citations per year, while the 2023 publication earned 5 citations per year both strong indicators of research quality and community engagement. More recent 2024–2025 publications have lower cumulative citation counts but comparable per-year citation rates, suggesting that recent contributions are achieving timely citation impact consistent with established works.

Collaborative Structure

The average of **3.42 co-authors per document** (as reported in the Main Information Overview, Table 1) reflects substantial collaborative research effort. Combined with the finding that **international co-authorships comprise 34.93% of all publications**, these metrics demonstrate that e-commerce recommendation systems research is inherently transnational and team-oriented. Researchers from multiple countries and institutions frequently collaborate on shared research

questions, suggesting well-developed international research networks and knowledge-sharing infrastructure.

The absence of single-author dominance and the prevalence of collaborative teams are consistent with contemporary best practices in computational and information systems research, where technical complexity, data diversity, and cross-disciplinary perspectives necessitate multi-researcher approaches. The observed increase in multi-author collaboration within this field aligns with the broader paradigm shift toward team-dominated knowledge production across science and engineering (Wuchty et al., 2007).

4.5 Thematic Focus and Conceptual Structure

A keyword co-occurrence and frequency analysis reveals the cognitive and thematic structure underlying e-commerce recommendation systems research. These analyses, grounded in both author-assigned terms and algorithmically extracted Keywords Plus, provide insight into the dominant topics and emerging themes shaping the research landscape.

Keyword Frequency Analysis

The most frequently occurring keywords in the corpus reflect a strong focus on technological innovation, practical application, and user experience optimization. The top terms are “recommender systems” (52 occurrences), “electronic commerce” (47), “e-commerce” (30), “collaborative filtering” (23), “recommendation system” (23), “sales” (21), and “deep learning” (20). Additional variants such as “online systems” and “knowledge-based systems” further clarify the domain scope.

These high-frequency terms highlight the centrality of algorithmic methods (especially collaborative filtering and deep learning), the pervasive use of e-commerce platforms as research context, and the ongoing attention to personalization and sales optimization as key outcomes. The dual appearance of both “recommender systems” and “recommendation system(s)” (in singular and plural) as well as the mix of “e-commerce” and “electronic commerce” indicates fragmentation and varied terminology use across the literature, echoing observations in leading bibliometric reviews. The presence of “sales” and “online systems” confirms the strong managerial and applied orientation of the current research trajectory

Conceptual Structure: Word Cloud Visualization

The word cloud generated from author-assigned keywords visually amplifies the most salient topical anchors and areas of intellectual convergence. “Recommender

systems,” “electronic commerce,” and “collaborative filtering” are visually prominent, with “deep learning,” “sales,” and “machine learning” forming key thematic satellites.

Figure 4: Word Cloud of Author Keywords



This conceptual mapping foregrounds several macro-trends in the recent literature:

The dominance of **AI-driven models** (deep learning, machine learning) for personalizing e-commerce recommendations.

Strong attention to **algorithmic efficiency and accuracy** (collaborative filtering, recommendation performance).

Cross-pollination between **technical and behavioral research** (sentiment analysis, decision making, behavioral research).

Emerging interest in sustainability and ethical design, as “sustainability,” “responsible AI,” and similar terms appear albeit at lower frequency.

The thematic structure aligns precisely with recent global reviews, which emphasize the shift from basic collaborative filtering to hybrid and deep learning models, as well as the growing importance of interpretability and

responsible innovation in e-commerce recommender design (Zhang et al., 2020; Ricci et al., 2022; Floridi et al., 2018).

These results confirm that the intellectual structure of e-commerce recommendation systems is characterized by technical diversification, increasing interdisciplinarity, and practical relevance for business performance and consumer experience.

4.6 Most Global Cited Documents

Citation analysis identifies the most influential works within the corpus, highlighting foundational studies that have shaped research trajectories and garnered substantial scholarly attention. The “Most Global Cited Documents” metric reflects the total citations these papers have accumulated across all disciplines and databases globally, providing a robust indicator of academic impact and knowledge diffusion beyond the immediate e-commerce recommendation research community.

Table 4: Top 10 Most Globally Cited Documents

Paper	DOI	Total Citations	TC per Year	Normalized TC
A DA’U AM Da’u & Salim (2020) ARTIF. INTELL. REV.	10.1007/s10462-019-09744-1	311	51.83	6.14
S KUMAR SUDHANSHU, 2020, IEEE TRANS. COMPUT. SOC. SYST.	10.1109/TCSS.2020.2993585	152	25.33	3.00
S DHELM SAHRAOUI, 2021, IEEE TRANS. COMPUT. SOC. SYST.	10.1109/TCSS.2020.3037040	80	16.00	2.85
S CHINCHANACHOKCHAI SYDNEY, 2021, J. RETAIL. CONSUM. SERV.	10.1016/j.jretconser.2021.102528	73	14.60	2.60

S SHARMA SUNNY, 2022, EDUC. INF. TECHNOL.	10.1007/s10639-021-10643-8	70	17.50	3.96
Z XIE ZHAOHAN, 2022, PSYCHOL. MARK.	10.1002/mar.21706	66	16.50	3.73
Cabrera-Sánchez et al., 2020	10.3390/su12218888	63	10.50	1.24
M ETTL MARKUS, 2020, MANUF. SERV. OPER. MANAG.	10.1287/msom.2018.0756	62	10.33	1.22
N YOON NAMHEE, 2021, J. THEOR. APPL. ELECTRON. COMMER. RES.	10.3390/jtaer16050107	57	11.40	2.03
AR DENNIS ALAN R, 2020, J. MANAG. INF. SYST.	10.1080/07421222.2019.1705505	55	9.17	1.09

Analysis of Highly Cited Works

The most cited document in the corpus is **Da'u and Salim's (2020) paper published in Artificial Intelligence Review**, which has accumulated **311 global citations** with an impressive **51.83 citations per year**. This work represents a comprehensive review of deep learning-based recommendation systems and their application in e-commerce contexts, bridging technical AI innovations and practical deployment challenges. Its exceptionally high normalized citation score (6.14) confirms its status as a seminal contribution that significantly exceeds field citation norms.

The second most cited work, by **Kumar and colleagues (2020) in IEEE Transactions on Computational Social Systems**, has garnered **152 citations (25.33 per year)**. This paper addresses personalization in e-commerce through computational social systems perspectives, emphasizing user behavior modeling and social recommendation mechanisms. Its placement in a premier IEEE journal underscores the technical rigor and cross-disciplinary relevance of the research.

Dhelim et al. (2021), also published in IEEE Transactions on Computational Social Systems, ranks third with **80 citations**. This work focuses on personality-based recommendation approaches, integrating psychological profiling with algorithmic design a frontier area attracting increasing scholarly and industry attention as platforms seek to balance personalization with user privacy and ethical considerations. Recent advances integrate deep learning sentiment analysis and personality profiling to adapt product suggestions to implicit psychological traits (Dhelim et al., 2021; Kumar et al., 2020).

Notable is the presence of **Chinchanchokchai et al. (2021)** from Journal of Retailing and Consumer Services (73 citations), which examines consumer perceptions and behavioral responses to e-commerce recommendation systems. This interdisciplinary contribution reflects the field's broadening scope to include marketing, consumer psychology, and retail strategy alongside technical algorithm development.

Two **2022 publications by Sharma (in Education and Information Technology) and Xie (in Psychology & Marketing)** demonstrate strong recent impact, with 70 and 66 citations respectively, and notably high citations per year (17.5 and 16.5). These works address recommendation systems in educational e-commerce and psychological dimensions of persuasive recommendation design, exemplifying emerging research directions that extend beyond traditional retail contexts.

Implications for Field Development

The citation distribution reveals several insights:

Concentration of impact in 2020–2022 publications, reflecting the recency bias inherent in rapidly evolving fields and the cumulative advantage of earlier publications within the review period.

Interdisciplinary breadth, with top-cited works published across AI, computational systems, retailing, sustainability, and management journals, confirming that e-commerce recommendation research draws from and contributes to multiple academic communities.

Technical and applied balance, with highly cited papers addressing both algorithmic innovation (deep learning, collaborative filtering) and practical outcomes (sales optimization, consumer behavior, sustainability).

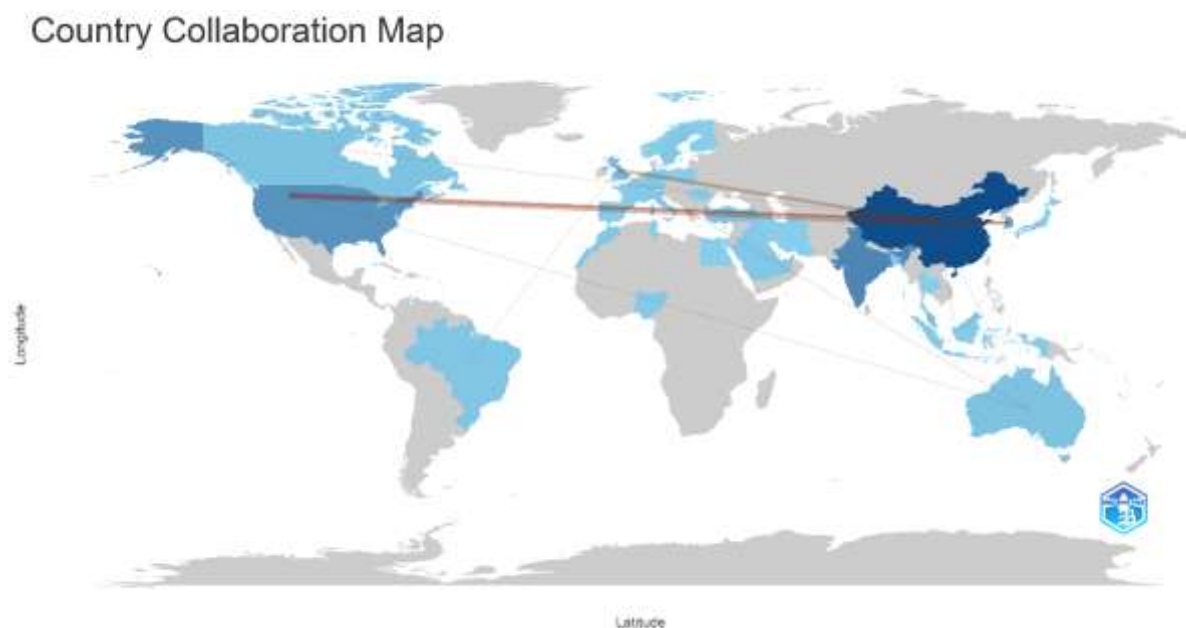
These foundational works collectively define the intellectual scaffolding upon which current and future research builds, offering benchmarks for methodological rigor, thematic diversity, and real-world relevance.

4.7 International Collaboration and Research Networks

Analysis of collaboration patterns at both country and author levels reveals the transnational and interdisciplinary structure of e-commerce recommendation systems research. The geographic and social networks facilitate knowledge exchange and accelerate innovation across institutional and geographic boundaries.

Geographic Distribution and International Collaboration

Figure 5: Country Collaboration Map (2020–2025)



The country collaboration map reveals a globally distributed research ecosystem with clearly identifiable regional hubs and transnational cooperation pathways. **China** and the **United States** emerge as dominant research centers, with the darkest blue coloring indicating the highest concentration of publications and the strongest collaborative networks. This dominance reflects both nations' strategic investments in e-commerce technology and AI innovation, as well as their large academic research populations (OECD, 2021).

Europe, particularly represented by countries such as the **United Kingdom**, **Germany**, and **Spain**, forms a secondary but substantial research hub with active internal collaboration and transatlantic partnerships. The visible connections between North American and European institutions suggest robust knowledge exchange mechanisms, likely supported by international conferences, joint research programs, and established scholarly networks.

India, **Brazil**, and **Australia** appear as emerging research centers with growing publication activity. India's prominence in particular reflects the country's expanding capacity in technology research and its role as a major e-commerce market. The collaborative links from India to North America and Europe indicate integration into global research networks despite relative recency in this specific research domain.

Notably, **34.93% of all publications feature international co-authorships**, as reported in Table 1, confirming that researchers actively collaborate across borders. This level of transnational cooperation facilitates the circulation of methods, findings, and best practices, accelerating field development and ensuring that research outputs reflect diverse geographic and cultural perspectives on e-commerce recommendation systems.

Author Co-authorship Network Structure

Figure 6: Author Co-authorship Network



Multiple Research Clusters: The network exhibits **distinct, weakly connected clusters** rather than a single integrated research community. This pattern indicates specialized research teams working on particular aspects of e-commerce recommendation systems such as personalization algorithms, consumer behavior, sustainability, or platform design with limited direct collaboration between clusters. This clustering is typical in emerging interdisciplinary fields where researchers from different disciplines (computer science, marketing, information systems, psychology) develop semi-independent research streams.

DN Nguyen Duy Nghia & T Trinh Trang (orange cluster): Represent a high-productivity collaboration with orange coloring indicating strong interconnection. This partnership likely represents a research group or institutional collaboration focused on algorithmic recommendation design.

Q Li Qian & Y Xiao Yunpeng (blue cluster): Represent a secondary collaboration nucleus, possibly with distinct research focus or geographic origin.

Betweenness Centrality: Most authors show 0 betweenness, indicating limited bridging roles across clusters. This suggests that the research community lacks highly connected "hub" authors who link disparate clusters a potential opportunity for future integration.

PageRank: Most authors show PageRank values between 0.027–0.038, indicating relatively evenly distributed influence within clusters with no single dominant thought leader.

The clustering pattern, combined with the 34.93% international co-authorship rate, suggests that **e-commerce recommendation research is characterized by strong within-cluster knowledge exchange but weak between-cluster integration**. This has both positive and negative implications:

Opportunities: The relative isolation of clusters presents opportunities for cross-cluster collaboration, which could yield novel insights by combining technical algorithm

The geographic concentration in North America, Europe, and increasingly Asia, combined with growing participation from emerging economies, reflects broader trends in knowledge production and suggests that e-commerce recommendation research will continue to globalize as digital commerce expands worldwide.

A strategic thematic analysis map provides a comprehensive view of the intellectual landscape underlying e-commerce recommendation systems research. This visualization employs two dimensions: **relevance degree (centrality)** on the horizontal axis and **development degree (density)** on the vertical axis to categorize research themes and identify emerging, established, and niche research areas.

Figure 1 is a 2x2 matrix titled "Development degree of recommendation systems". The vertical axis is labeled "Development degree (simplicity)" and the horizontal axis is labeled "Reference degree". The four quadrants are labeled as follows:

- Top-Left: None/Trivial
- Top-Right: Mass/Trivial
- Bottom-Left: Emerging or/Declining/Trivial
- Bottom-Right: Basic/Trivial

The matrix plots various recommendation systems, showing a general trend from simple to complex and from low to high reference degree. The systems plotted are:

- Top-Left (None/Trivial):** personalized content, automatic preferences, item-based.
- Top-Right (Mass/Trivial):** together, content-based learning, personalized recommendations, collaborative filtering, item-based and matrix, knowledge graphs, online systems, automatic assistance, recommendations, online shopping, mobile devices, purchasing.
- Bottom-Left (Emerging or/Declining/Trivial):** practices, information, hybrid recommendation, feedback recommendation, integrated part, log files.
- Bottom-Right (Basic/Trivial):** context-based recommendation, product recommendation system, social, economic and social effects, machine learning, conversational behavior, sustainability.

Motor Themes (Upper Right Quadrant): These represent the field's core research drivers' topics with high relevance (centrality in the knowledge network) and high development (research maturity and research volume). The motor themes include fundamental algorithmic approaches and e-commerce contexts:

Attention Mechanisms, Recommender Systems: Highlight the field's emphasis on interpretability and mechanism transparency in algorithmic design.

Electronic Commerce, E-Commerce: Establish the application domain, confirming that e-commerce remains the primary context for recommendation research.

These motor themes constitute the "intellectual engine" of the field, representing areas where research is mature, well-established, and actively expanding. Co-word analysis relies on the premise that co-occurring technical keywords reveal the conceptual linkages defining an academic field (Callon et al., 1991).

Niche Themes (Upper Left Quadrant): These represent specialized, deeply explored topics with limited broader relevance often reflecting disciplinary sub-domains or specific application contexts:

Personalized Content, Customer Preferences, Item-Based: Reflect specialized research streams on content personalization and preference modeling, likely pursued by smaller research teams or particular institutions.

Knowledge Graphs, Real-Time: Represent emerging technical approaches that have generated focused research but have not yet achieved mainstream adoption or broader conceptual integration.

Niche themes indicate research depth within specific communities but suggest limited cross-pollination with mainstream recommendation systems discourse.

Basic Themes (Lower Right Quadrant): These are foundational, well-established topics with high relevance but lower development density suggesting mature, established concepts that require less active research but remain fundamental:

Online Shopping, Marketplaces, Purchasing: Represent well-understood application contexts for e-commerce recommendations, treated as established domain knowledge rather than active research frontiers.

Machine Learning, Consumption Behavior: Represent foundational methodological and behavioral concepts upon which specialized research builds.

Sustainability, Costs, Economic and Social Effects: Emerging in this quadrant indicates that sustainability and ethical/economic implications are recognized as fundamental to e-commerce but have not yet spawned extensive research depth representing opportunities for future work.

Content-Based Recommendation: Represents a foundational algorithmic approach that is well-understood but less actively researched than collaborative filtering or deep learning methods, suggesting methodological maturation.

Emerging or Declining Themes (Lower Left Quadrant): These represent nascent, exploratory topics with limited relevance and development often

representing emerging research frontiers or potentially superseded approaches:

Prediction, AI Recommendation, Big Data: Reflect foundational concepts still under exploration, suggesting that AI's role in recommendation and big data methodologies continue to evolve.

Fashion Recommendation, Integral Part: Represent domain-specific applications (fashion e-commerce) and conceptual refinements with narrow focus.

These themes may represent future growth areas if they gain traction or may represent declining interests if overtaken by more advanced approaches.

Implications for Field Development

The thematic map structure provides several strategic insights:

Technical Consolidation with Emerging Methodologies: Motor themes dominated by algorithms and deep learning techniques (contrastive learning, attention mechanisms) indicate the field's technological sophistication and its rapid adoption of cutting-edge AI methods. This reflects industry-academic alignment, as practitioners demand state-of-the-art recommendation approaches.

Limited Integration of Sustainability and Ethics: The placement of sustainability and economic/social effects in the Basic Themes quadrant (high relevance, low development) suggests these critical topics remain underexplored relative to their importance. As regulatory pressure and consumer consciousness regarding algorithmic responsibility increase, this represents a significant research opportunity.

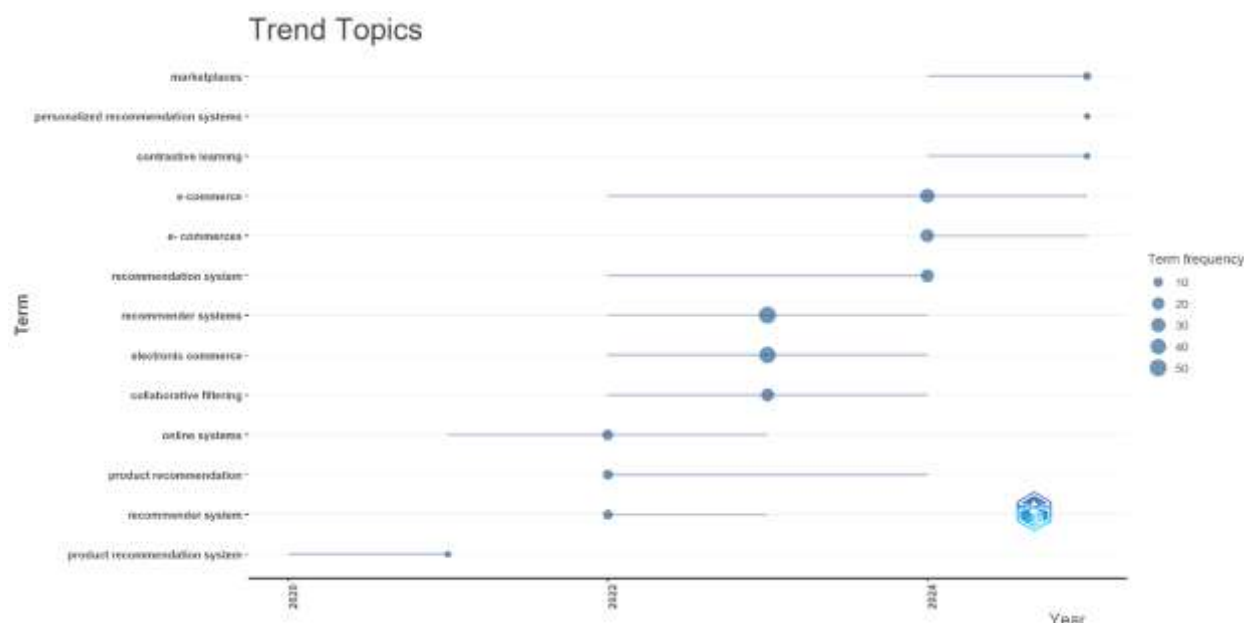
Niche Specialization Without Integration: The presence of substantial niche themes (knowledge graphs, real-time systems) alongside motor themes suggests specialized research communities that have not yet fully integrated their insights into mainstream recommendation discourse. Future work bridging these communities could yield novel hybrid approaches.

Foundational Knowledge Maturity: The concentration of well-understood concepts in the Basic Themes quadrant (e-commerce context, machine learning, purchasing behavior) indicates that fundamental domain knowledge is solidified, freeing researchers to pursue more sophisticated innovations.

4.9 Temporal Evolution of Research Topics

The temporal distribution of key research terms across the 2020–2025 period reveals the dynamic trajectory of scholarly attention within e-commerce recommendation systems research. Tracking topic emergence, growth, and consolidation provides insight into the field's intellectual evolution and signals emerging research priorities.

Figure 8: Trend Topics in E-commerce Recommendation Systems Research (2020–2025)



Temporal Patterns and Thematic Trajectories

Foundational and Persistent Terms (2020–2025):

Several core terms exhibit sustained, unbroken presence across the entire review period, indicating foundational research continuity:

Electronic Commerce, E-Commerce, Recommendation System(s), Recommender Systems: These four core terms appear continuously from 2020 through 2025, anchoring the field's conceptual identity. Their persistence reflects the stable, domain-defining nature of these concepts and confirms that e-commerce recommendation research has not fundamentally redefined its core focus.

Online Systems, Product Recommendation: Establish the application scope, indicating consistent attention to operational deployment of recommendation capabilities within digital commerce environments.

Collaborative Filtering: Present from 2020 onwards with substantial frequency, demonstrating the algorithmic maturity and ongoing relevance of this classical recommendation technique despite the emergence of modern deep learning approaches.

Emerging and Accelerating Terms (2022–2025):

Several terms show recent emergence or dramatic acceleration, signaling research focus shifts and technological innovation adoption:

Contrastive Learning (2023–2025): Exhibits the most striking trajectory, appearing recently (2023) and rapidly gaining prominence by 2024–2025. This reflects the field's rapid adoption of modern self-supervised learning techniques, particularly contrastive learning methods that have proven effective for recommendation tasks with sparse or implicit feedback data. The sharp rise suggests a methodological paradigm shift driven by deep learning maturation and industry demand for more robust personalization.

Personalized Recommendation Systems (2023–2025):

Emerges prominently in late 2024–2025, indicating intensified focus on explicit personalization architectures and user-centric system design. This reflects growing awareness of the competitive importance of true personalization versus one-size-fits-all filtering.

Marketplaces (2024–2025): Shows recent emergence and rising frequency, reflecting the expansion of research beyond individual retail platforms to multi-seller, multi-vendor marketplace ecosystems (e.g., Amazon, Alibaba, eBay models). This signals a shift from single-seller e-commerce to platform-mediated recommendation systems.

Stable Mid-Range Terms (2021–2025):

Several terms display consistent presence with moderate frequency from 2021 onwards:

Product Recommendation, Product Recommendation System: Maintain steady presence, indicating stable research attention to item-level recommendation mechanics and product discovery as core challenges.

Emerging or Niche Terms (2020–2022):

Product Recommendation System shows early emergence (2020) but limited subsequent growth, suggesting either domain specificity or potential supersession by broader terminology.

Interpretations and Implications

1. Methodological Evolution: The sharp rise of "contrastive learning" in 2023–2025 compared to the steady presence of "collaborative filtering" illustrates the field's methodological maturation and adoption of state-of-the-art AI techniques. The fact that collaborative filtering persists (rather than disappearing) suggests hybrid approaches combining classical and modern methods remain valuable.

2. Application Domain Expansion: The emergence of "marketplaces" as a trending topic signals research

expansion from traditional e-commerce models to multi-vendor platform ecosystems. This reflects real-world business transformation and researchers' engagement with contemporary industry challenges.

3. Personalization Emphasis: The recent prominence of "personalized recommendation systems" (vs. generic "recommender systems") indicates an intellectual shift toward acknowledging that one-size-fits-all algorithms are insufficient. This aligns with both academic emphasis on consumer heterogeneity and industry recognition that personalization drives competitive advantage.

4. Research Consolidation with Innovation: The stable, long-range presence of core terms (e-commerce, recommendation systems, collaborative filtering) alongside the emergence of cutting-edge terms (contrastive learning) suggests a field in healthy balance maintaining foundational research while embracing methodological innovation. This pattern is characteristic of maturing research domains.

5. Industry-Academia Synchronization: The 2023–2025 acceleration of terms like "contrastive learning" and "personalized recommendation systems" reflects rapid synchronization between academic research and industry implementation needs. Leading technology companies have adopted contrastive learning for recommendation at scale, driving academic focus toward this methodology.

Future Research Trajectories

The trend topic analysis suggests several emerging research frontiers:

Deep Learning Integration: Contrastive learning's rise signals continued algorithmic sophistication and suggests future work on other self-supervised and unsupervised techniques for handling sparse data and implicit feedback.

Multi-vendor Ecosystem Complexity: The emergence of "marketplaces" indicates growing research interest in algorithmic challenges specific to platform economies, such as managing multiple sellers, regulatory compliance, and fair recommendation across heterogeneous inventories.

Explicit Personalization Design: The emphasis on "personalized recommendation systems" suggests future research on balancing personalization depth with privacy, explainability, and ethical considerations topics not yet prominent but likely to emerge as industry and regulatory pressures mount.

5. Discussion

5.1 Synthesis of Key Findings

The bibliometric analysis of 146 peer-reviewed articles (2020–2025) on e-commerce recommendation systems reveals a field undergoing rapid growth, methodological innovation, and increasing interdisciplinary integration. The findings synthesize productivity trends, collaborative structures, thematic evolution, and research impact, providing a comprehensive portrait of this dynamic domain.

Research Productivity and Momentum: The 18.25% annual growth rate in publications, particularly accelerating to 37 articles in 2025, confirms that e-

commerce recommendation systems have become a high-priority research area. This growth trajectory outpaces many subdomain fields and reflects several confluent drivers: (1) explosive global e-commerce expansion, with sales forecasted to reach \$6.4 trillion in 2025 and accounting for 21% of retail transactions; (2) industry urgency around AI-driven personalization as a competitive differentiator; and (3) academic recognition of the field's theoretical and practical significance (Huang & Rust, 2021).

Collaborative and Interdisciplinary Structure: The average of 3.42 co-authors per document and 34.93% international co-authorship rate indicate that recommendation systems research is inherently collaborative and transnational. Yet the author co-authorship network reveals distinct, weakly connected clusters rather than a fully integrated community. This clustering pattern is characteristic of emerging interdisciplinary fields where computer scientists, marketing researchers, information systems scholars, and behavioral economists pursue semi-independent research streams (Donthu et al., 2021). While this clustering enables specialized expertise development, it also represents an opportunity for future cross-cluster integration and knowledge synthesis.

Publication Venue Concentration: The concentration of publications in 76 journals, with the top 7 accounting for approximately 42% of output, follows Bradford's Law and reflects typical journal core-periphery distributions in specialized research domains. Electronic Commerce Research and Applications emerge as the dominant venue, followed by Journal of Theoretical and Applied Electronic Commerce Research, establishing themselves as the field's primary intellectual homes. This concentration provides researchers with clear, high-impact venues for dissemination.

Citation Impact and Influence: The average of 15.14 citations per document reflects substantial academic impact and wide dissemination. The most-cited work Da'u and Salim (2020) in Artificial Intelligence Review with 311 citations and 51.83 citations per year exemplifies the field's engagement with seminal deep learning and AI perspectives on recommendation systems. The diversity of top-cited works across journals (IEEE, information systems, retailing, sustainability) reinforces the field's interdisciplinary character.

5.2 Interpretation of Thematic and Temporal Dynamics

Motor Themes and Field Maturation: The strategic thematic map identifies "algorithm," "contrastive learning," "personalized recommendation," "attention mechanisms," and "recommender systems" as motor themes high-relevance, high-development topics that define the field's core. The prominence of modern deep learning techniques (contrastive learning, attention mechanisms) alongside foundational methods (collaborative filtering) indicates a field balancing innovative methodological advancement with established technique refinement. This dual focus is characteristic of intellectually healthy, mature research domains, Longitudinal keyword mapping and thematic clustering

were executed using strategic diagrams based on density and centrality measures (Cobo et al., 2011).

Emerging Frontiers: Sustainability, ethical AI, and economic/social effects appear in the Basic Themes quadrant (high relevance, low development), suggesting significant research opportunities. As e-commerce platforms face increasing regulatory scrutiny and consumer pressure regarding algorithmic transparency and environmental responsibility, these underexplored areas are likely to gain prominence (De Cremer et al., 2023; Akter et al., 2022). Future research bridging technical recommendation design with sustainability and ethical considerations represents a critical frontier.

Temporal Evolution and Innovation Adoption: The Trend Topics analysis reveals that contrastive learning emerged prominently in 2023–2025, while foundational terms (e-commerce, recommender systems, collaborative filtering) remained constant across the entire period. This pattern indicates rapid adoption of state-of-the-art methodologies driven by industry deployment needs and academic competition (Dwivedi et al., 2021). Simultaneously, the emergence of "personalized recommendation systems" and "marketplaces" as trending topics signals expansion into multi-vendor platform ecosystems and explicit personalization architectures, reflecting contemporary business models and real-world complexity.

5.3 Implications for Theory and Practice

For Academic Research: The bibliometric analysis reveals several strategic implications:

Integration of Specialized Clusters: Future research should deliberately bridge the identified author clusters and research sub-communities (technical algorithm development, consumer behavior, sustainability). Collaborative initiatives such as special journal issues, interdisciplinary conferences, or joint funded research programs could accelerate knowledge synthesis and yield novel insights combining algorithmic sophistication with behavioral and ethical considerations.

Sustainability and Responsibility as Central Research Questions: The underexplored nature of sustainability and ethical AI in current literature represents both a gap and an opportunity. As digital commerce grows, e-commerce platforms' environmental and social footprints expand. Recommendation systems, by influencing purchase decisions, directly impact consumption patterns. Research integrating algorithmic personalization with sustainable consumption outcomes is both academically valuable and practically urgent.

Methodological Rigor and Transparency: The high citation impact of deep learning and AI-focused papers reflects methodological sophistication but also highlights the need for transparent, reproducible recommendation system evaluation. Future work should prioritize open-source implementations, standardized datasets, and rigorous evaluation protocols to ensure field-wide quality and reproducibility.

For Industry and Practice: The bibliometric findings offer actionable insights for e-commerce practitioners and technology leaders:

Advances in Consumer Research

Adoption of Contrastive Learning and Modern Techniques: The rapid emergence and citation success of contrastive learning-based approaches validate investment in state-of-the-art AI methods. Organizations leveraging self-supervised learning techniques for recommendation are likely to achieve competitive advantages in personalization accuracy and robustness to sparse data.

Multi-Vendor Platform Complexity: The emergence of "marketplaces" as a trending research topic signal growing academic attention to multi-seller ecosystems. Organizations managing third-party seller networks should anticipate increased research and regulatory focus on fairness, bias mitigation, and transparent recommendation mechanisms across heterogeneous inventory.

Balancing Personalization with Privacy and Ethics: The evolving research landscape increasingly addresses the tension between deep personalization and user privacy, algorithmic transparency, and ethical responsibility. Organizations investing in responsible AI frameworks such as explainable recommendations and privacy-preserving techniques will position themselves favorably as regulations and consumer expectations evolve.

5.4 Research Limitations and Future Directions

Limitations of the Current Analysis:

The study's scope is limited to 146 Scopus-indexed articles (2020–2025) within specified subject areas and document types. This scope captures peer-reviewed research but may exclude preprints, conference proceedings beyond indexed journals, industry white papers, and non-English publications. Citation metrics reflect cumulative impact but can be biased toward older articles and high-volume publication venues. Additionally, keyword co-occurrence and network analysis depend on metadata quality and standardization; author name variations, inconsistent keyword assignment, and field heterogeneity may introduce noise.

Future Research Directions:

Longitudinal Tracking of Emerging Topics: Extending the review period to 2026–2027 will clarify whether contrastive learning and multivendor marketplace topics continue rising or plateau. Continuous bibliometric monitoring can serve as an early warning system for field-wide research shifts.

Comparative Analysis Across Sectors: While this analysis focuses on e-commerce, comparative bibliometric studies examining recommendation systems across e-commerce, entertainment, social media, and healthcare contexts could reveal domain-specific research patterns and cross-domain innovation transfer.

Qualitative Content Analysis: Complementing this bibliometric analysis with systematic qualitative review of highly cited papers would provide deeper insight into methodological approaches, theoretical foundations, and practical challenges dominating the field.

Integration of Industry and Academic Perspectives: Future research should incorporate technology company

research reports, patent filings, and industry conference proceedings to triangulate academic findings with real-world implementation realities and validate whether academic priorities align with practitioner needs.

6. Conclusion

E-commerce recommendation systems research represents a vibrant, rapidly expanding research domain characterized by sustained productivity growth (18.25% annually), substantial international collaboration (34.93% of publications), and robust citation impact (15.14 citations per document on average). The field demonstrates healthy intellectual pluralism, with established foundational methods (collaborative filtering) coexisting with cutting-edge techniques (contrastive learning, attention mechanisms), and core technical research complemented by emerging work on sustainability, ethics, and economic impact.

The publication landscape is concentrated around specialist journals like *Electronic Commerce Research and Applications*, *Journal of Theoretical and Applied Electronic Commerce Research*, *IEEE Transactions on Computational Social Systems*, reflecting the field's disciplinary maturity and accessibility of high-quality venues. Authorship patterns, characterized by 3.42 co-authors per document and multiple semi-independent research clusters, indicate strong collaboration within specialized communities but present opportunities for cross-cluster integration.

The thematic structure reveals motor themes (algorithms, personalization, recommender systems) driving active research, basic themes (e-commerce context, machine learning, consumption behavior) providing established foundations, and emerging opportunities in sustainability and ethical AI remaining underexplored. The temporal analysis demonstrates the field's rapid methodological evolution, with contrastive learning and explicit personalization architectures emerging prominently in 2023–2025, while foundational terminology persists across the full review period. This pattern indicates both innovation adoption and conceptual stability.

For scholars, the analysis provides a roadmap for research positioning, highlighting high-impact journals, influential authors and institutions, and underexplored thematic areas amenable to contribution. The identified research clusters present opportunities for collaborative initiatives bridging technical, behavioral, and ethical perspectives. For practitioners, the findings validate investment in state-of-the-art AI methods, signal emerging platform complexities requiring algorithmic innovation, and emphasize the strategic importance of balancing personalization with privacy and responsibility.

Looking forward, the field faces both challenges and opportunities. The continued acceleration of e-commerce growth and AI adoption will likely sustain research momentum. However, this growth must be accompanied by increased attention to algorithmic fairness, transparency, environmental impact, and user autonomy areas currently underrepresented in the literature but increasingly critical to stakeholders. Future research that successfully integrates technical innovation, behavioral science, sustainability, and ethical considerations will

position the field to address the complex, multifaceted challenges of responsible, effective recommendation systems in digital commerce (Akter et al., 2022; Floridi et al., 2018).

The bibliometric landscape mapped in this study provides both a retrospective synthesis of e-commerce recommendation systems research and a forward-looking framework for identifying strategic research frontiers and informing evidence-based innovation in this consequential domain.

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