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AI in Consumer Electronics Marketing: A Bibliometric Analysis

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KEYWORDS

Artificial Intelligence

Machine learning

Digital Marketing

Marketing Automation

Consumer Electronics

Personalization.

ABSTRACT

This bibliometric study investigates the growing significance of Artificial Intelligence (AI) in digital marketing for consumer electronics (1986-2024). Analyzing 401 articles from Scopus, it explores publication trends, authorship patterns, keyword co-occurrence, and citation networks. The research maps the current landscape, identifies key themes and gaps, and examines how AI shapes digital marketing. Findings reveal a surge in publications in the last five years, with China, the United States, and India as leading contributors. The study identifies 159 authors, 69 countries, and 15 prominent journals. This analysis provides insights for researchers and educators in identifying research areas, developments, and quality literature. The research confirms AI's potential in seven clusters: AI integration, machine learning, consumer behavior, digital transformation, personalization, and customer service, while highlighting the need for responsible AI practices. It also identifies gaps in understanding AI's long-term impact on consumer behavior and integration challenges. Addressing these limitations enables stakeholders to leverage AI ethically and effectively in digital marketing. Additionally, the study identifies influential authors, their locations, and frequently used keywords, informing a future research agenda focused on key themes, methodologies, and areas of inquiry

1. INTRODUCTION

Artificial Intelligence (AI) [1]has evolved into a cornerstone of consumer electronics [2], influencing the purchase of products such as mobile devices, virtual assistants, sensors[3], smart home appliances, and automotive electronics

AI, is defined as "a system's ability to interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation" [4]

Artificial intelligence systems utilizing machine learning, deep learning, or generative AI technologies enable consumers to perform tasks with greater efficiency. [5]

The chatGPT interface, for instance, provides consumers with accurate, detailed, and personalized product recommendations or solutions that improve over time [6]. Researchers categorize AI in various ways. For example.[7] suggests a tri-partite

typology that includes mechanical AI (i.e., the capability to execute repetitive or routine tasks), thinking AI (i.e., the ability to learn from data and make decisions), and feeling AI (i.e., the capacity to demonstrate empathy);[8] . Another relevant classification of AI includes (a) generative AI, which generates new, original, or creative content (e.g., text or images) using tools like ChatGPT or Copy.ai [9], and (b) predictive AI, which identifies patterns in historical data to forecast future outcomes, behaviors, or events, such as predictive SMS) [10].

By enabling consumers to perform specific tasks more efficiently or effectively (e.g., through predictive text), AI technologies can enhance their engagement, whether with the technology itself or with the brand/firm[11], [12]For instance, personalized solutions generated by AI can encourage consumers to increase their resource investments (e.g., monetary or referral-based) in brand interactions [13], thereby strengthening their engagement [14]. Consequently, the adoption of AI can help build value-driven customer relationships, highlighting the strategic importance of AI-based customer engagement [15]

The main goal of this study is to investigate and draw out the crucial areas for research in AI related to consumer electronics marketing The recent inroads made by AI into social media, and websites for B2C companies open a world of opportunities for consumer engagement through any or all of the tenets suggested by Hollebeek et al[16]. To fulfill the exploratory objectives of this research, the authors used bibliometric analysis as a tool and methodology.

Bibliometric analysis is defined by author Luque [17] refers to a structured collection of data organized in a logical manner, enabling easy access and allowing the information to be updated, utilized by any connected computer program, and processed according to various criteria. The accuracy and reliability of such analyses depend heavily on the careful selection of databases.

Why is bibliometric analysis important? Science is inherently cumulative [18]. with new research building upon previous studies to expand knowledge in a given field. A literature review involves identifying, accessing, and examining relevant materials that contribute to the study. Over the past two decades, there has been a surge in innovative research practices, accompanied by a significant increase in scientific output and its compilation in bibliographic databases. This trend has popularized the use of bibliometric tools, which employ statistical methods to evaluate scientific activities through the analysis of published literature [19].

This study employs bibliometric analysis, drawing data from the Scopus online database [20], to explore the uncertainties and potential of AI in consumer electronics marketing. Through analyzing publication trends [21], author collaborations, and citation networks [22], we aim to identify key themes, and research gaps, and enhance the understanding of the dynamic relationship between AI and digital marketing within the consumer electronics industry[23]. This exploration seeks to offer insights guiding future research and responsible AI implementation in the dynamic realm of consumer electronics marketing [24]

2. METHOD

This study employs bibliometric analysis, utilizing variables such as citations, keyword co-citation counts, and co-occurrence to examine the literature on AI in the context of various marketing applications[25] [26] [27]. For data processing, we used the Vosviewer application, which provides a secure platform for data import, conversion, compilation, and filtering across multiple frameworks, including Scopus, PubMed, and Web of Science (WoS). The Scopus database supports co-occurrence, co-authorship, and citation networks across each data course. Hence Scopus was our choice for the dataset leading to rigorous analysis. The following steps were followed rigorously to conduct the bibliometric analysis

The following variables have been used to explore the role of AI in consumer electronics marketing.

Variable 1: Authors

- Number in a subject, field, institution, country, growth productivity, Collaboration - co-authorship, associated network. Papers/author in a subject mapping

Variable 2: Origin

- Country, Document, Citation, and Link strength, Most Influential Institutions

Variable 3: Sources

- Source and Document Types, Distribution by year of Publications, Evolution of Published Studies, Distribution by Subject Area

Variable 4: Contents

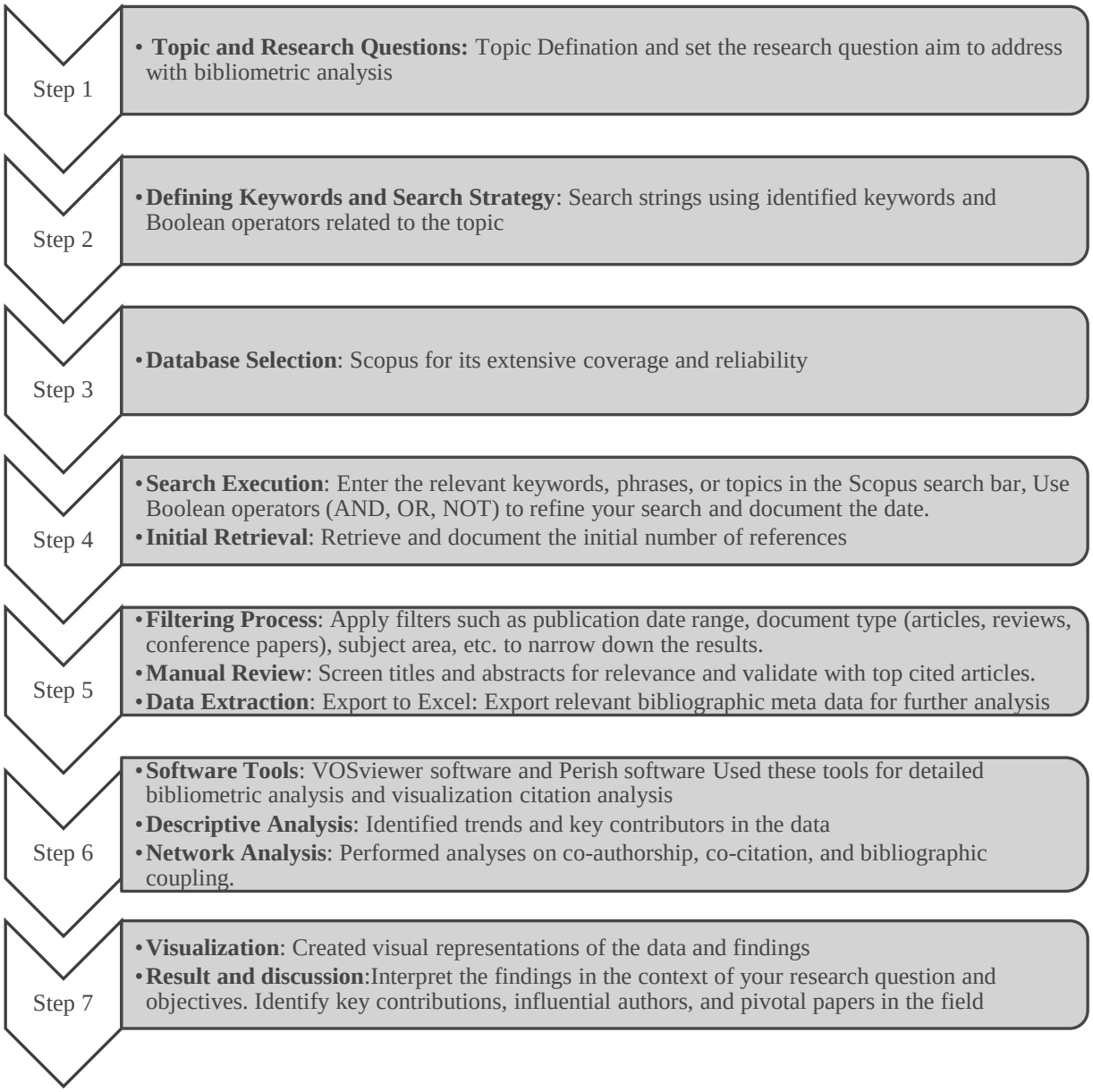
- Analysis of text distribution of words, Author-based co-occurrence network, Key-words Analysis, classification co-word analysis

Variable 5: Citations

- Base for citation indexes, impact factors, co-citation studies, etc

- Derived several references, and citations in articles and bibliographic coupling.

Figure 1 shows the steps involved in doing bibliometric analysis.



.Figure no 1 Research Methodology Steps followed in the bibliometric analysis using Vosviewer as a tool. (Source Author)

The steps involved in the Research Methodology have been further explained as below

Step 1 Topic and Research Questions

In recent times, AI has become pivotal in enhancing digital marketing, enabling marketers to create superior products, deliver relevant advertising, and uncover deeper insights into customer data patterns [28]. The integration of AI revolutionizes brand-consumer dynamics, allowing marketers to focus on customer needs promptly [29]. The impact of AI extends beyond digital marketing, influencing various industries [30]. This review explores the applications of AI in consumer electronics digital marketing through a bibliometric analysis [31], shedding light on its potential and uncertainties [32]. Personalization emerges as a key driver, enhancing customer engagement through targeted advertising and content delivery [33]. AI-powered chatbots also play a crucial role in transforming customer service, offering real-time support and resolving customer issues efficiently, ultimately fostering brand loyalty [34]. As the potential of AI appears vast, its precise impact remains uncertain, necessitating continued exploration and research [35].

Our study builds upon and extends existing literature by offering a systematic and quantitative analysis of AI's role in digital marketing for consumer electronics. While previous studies have discussed AI's potential in marketing broadly, our research

focuses specifically on its application within consumer electronics, offering insights that are crucial for both researchers and industry practitioners. By analyzing publication trends, author collaborations, and citation networks, we aim to not only summarize but also critically evaluate the state of current research. This approach enables us to highlight novel findings, challenge existing assumptions, and provide a clearer roadmap for future research endeavors in this rapidly evolving field.

This study aims to investigate research trends related to AI in Consumer Electronics Marketing. To this end, the following questions were formulated:

1. How does the distribution of document and source types reflect the scholarly landscape of AI in consumer electronics marketing research?
2. What trends have been observed in the volume of publications exploring AI in consumer electronics marketing over the past few decades?
3. Are there any specific periods with a surge in publications, and if so, what potential factors might explain them?
4. How does the distribution of publications across diverse subject areas in AI intersect with consumer electronics marketing, and what insights does this offer into the interdisciplinary landscape and current knowledge status of this field?

Step 2 & 3 Literature search: The Scopus index was chosen as the primary data repository for searching and extracting relevant documents. Which is considered “the largest abstract and citation database of peer-reviewed literature [36], including scientific journals, books, and conference proceedings”[37]. Empirical comparisons have shown that Scopus provides broader coverage of sources compared to the Web of Science, particularly in fields outside of medicine and the physical sciences [38].

In February 2024, the initial sample for this study was acquired through a thorough exploration of the Scopus) databases. Following this, a rigorous process of filtering and technical data processing was carried out. The choice of these databases was intentional, considering the importance of indexed articles published in high-impact journals (as per Journal Citation Report and Cite Score), along with the ease of categorizing and accessing publications. Particular emphasis was placed on the meticulous selection of keywords, the refinement of search fields, and the formulation of search syntax. Multiple search strategies were executed and subsequently validated to ensure robustness and accuracy. To gather bibliographic records on the impact of artificial intelligence on digital marketing for consumer electronics products, an initial filter was applied using specific search strings entered into the databases. The process utilized the following expressions as search strings (TITLE-ABS-KEY-AUTH(("Artificial intelligence" OR "machine learning" OR "AI") AND ("digital marketing" OR "Online Marketing" OR "marketing strategy" OR "Marketing Automation" OR "Personalization") AND ("consumer electronics" OR "Electronics Product*" OR "Electronic")) AND (LIMIT-TO (LANGUAGE, “English"))), as indicated in Figure 2.

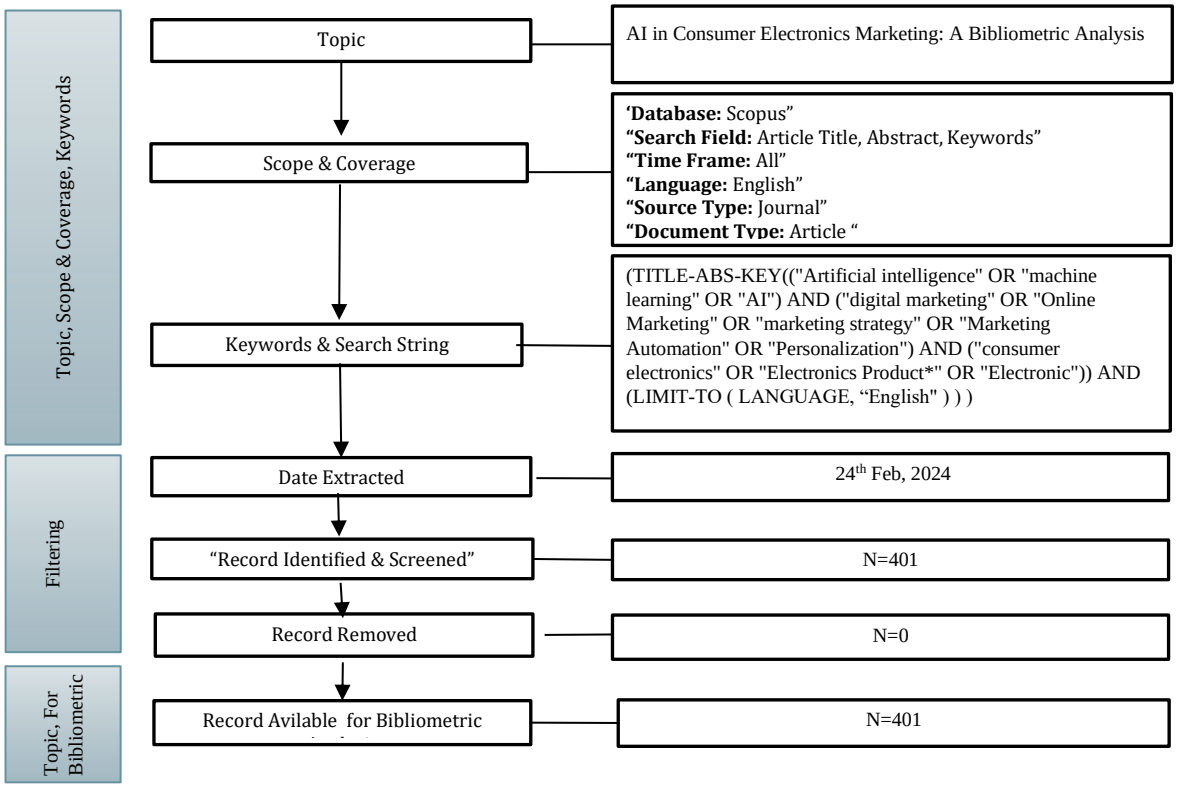


Figure 2. Flow diagram illustrating the search strategy. Source: Author.

The initial phase involved accessing the Scopus database to retrieve relevant bibliographic records using carefully constructed search strings. However, navigating through the extensive database posed challenges in terms of refining search queries, applying filters for language and relevance, and managing the volume of retrieved literature. Ensuring methodological rigor in data collection and analysis was paramount to maintaining data integrity and reliability. Challenges such as temporal constraints and publication bias necessitated careful consideration and validation of findings against established frameworks

Step 4 & 5 Literature classification: The database search yielded a total of 406 references published from 1986 to 2024 (up to Feb), the use of language filter limit to English. After this filter 401 documents were remaining. During the optimization of the search query, a manual review process was conducted, which involved examining the titles and abstracts of the retrieved articles. Additionally, the validity of the research strategy was verified by manually reviewing the top 100 cited articles. This step ensured that all selected articles were relevant to the study's theme and confirmed the absence of false-positive results.

Step 6 Bibliometric analysis: Data related to the bibliographic details of Scopus documents was saved in an Excel spreadsheet. The dataset contained critical information, including author affiliations, citation data, document titles, publication year, and source details (e.g., journal, book, or conference). Additionally, export filter counts from the Scopus database were extracted and transferred to Excel for further analysis. To align with the research objectives, we introduced additional categories such as geographic region, document type, topical focus, delivery mode, educational settings, research paper type, research design, research method, statistical techniques, and sample size. The final spreadsheet consisted of 402 rows, each representing a unique document, and 46 columns capturing various content attributes.

For analyzing the most cited documents, we employed Harzing's Publish or Perish software. The records were imported into VOSviewer, incorporating fields such as research area, authors, institutions, document title, keywords, abstract (where available), publication year, and citation counts. These records were then analyzed using bibliometric techniques, including occurrence lists and co-occurrence cross-tables. The processed data was exported to Excel to generate basic indicators, which were visualized through tables and graphs.

To systematically examine the characteristics and distribution of the scientific articles, we applied core bibliometric principles. This approach enabled us to statistically analyze the publication trends and derive meaningful insights into the research landscape.

Step 7 Visualization plays a critical role in bibliometric analysis, providing clear representations of complex data patterns and relationships. In this study, we utilized VOSviewer and Perish software to create visualizations that illustrate key aspects

of the research field. VOSviewer generated network maps displaying co-authorship, co-citation, and bibliographic coupling among researchers, institutions, and countries. These maps reveal the collaborative structures and intellectual connections within AI in consumer electronics marketing. Additionally, Perish software enabled detailed citation analysis, highlighting the most influential papers, authors, and journals. By transforming bibliometric data into graphs, charts, and network diagrams, we can better understand trends, key contributors, and the evolution of research topics.

3. RESULTS AND DISCUSSION

3.1 Descriptive Analysis and Visualizations using VOS VIEWER

Variable 1 – Authors

The data shows a relatively even distribution of publications among the listed authors, with the most productive author having only 4 publications (8.9%) as shown in Table 1. This suggests that the research field is not dominated by a few individual researchers, but rather there is a collaborative effort involving a diverse range of contributors. Overall, the data indicates a collaborative research landscape in this field, with contributions provided by various researchers spread across different institutions or countries.

AUTHOR NAME	Total Publications	Percentage (%)
Lops, P.	4	8.9%
Semeraro, G.	4	8.9%
Goldenberg, D.	3	6.7%
Abakouy, R.	2	4.4%
Akbari, A.	2	4.4%
Albert, J.	2	4.4%
Alepis, E.	2	4.4%
Burke, R.	2	4.4%
Cao, X.	2	4.4%
El Haddadi, A.	2	4.4%
Others Authors	20	
Total	**45**	

Table 1: Most Productive Authors

Visualization map of co-authorship networks. (Fractional counting)

Figure 3 shows a Visualization map of co-authorship networks. among countries in AI in consumer electronics marketing, created using VOSviewer with fractional counting. Countries with at least 10 documents and 10 citations are included.

In the map, nodes represent countries, with larger nodes indicating higher research output, and edges signify co-authorship links, with thicker edges representing stronger collaborations. The United States is a central node with extensive connections, indicating its significant role in international collaborations. Other key countries include China, India, and Australia, showing strong international links.

The map reveals regional clusters, with dense networks in Europe (e.g., UK, Germany, Spain) and Asia (e.g., China, India, Taiwan). This visualization highlights the global nature of research in AI in consumer electronics marketing and the interconnectedness of international research partnerships.

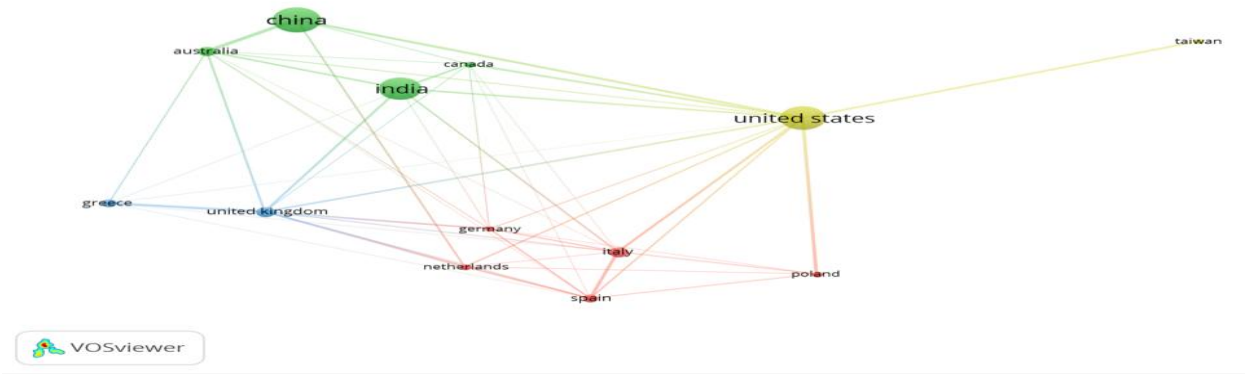


Figure 3 Co-authorship network visualization map (using fractional counting).

"Analysis Unit = Countries"

"Method Counting: Fractional counting"

"Minimum No. documents used for a country = 10"

"Minimum No. of citations used for a country = 10"

Co-authorship network visualization map (Full counting) Figure 4 depicts a Co-authorship network visualization map among countries in AI in consumer electronics marketing, created using VOSviewer with full counting. Countries included in the map have a minimum number of 10 citations and 10 documents

The United States is a dominant node with numerous connections, underscoring its pivotal role in international research collaborations. Other prominent countries include China, India, and Australia, all displaying significant international linkages. The visualization reveals regional clusters, indicating active collaboration networks within specific regions. Europe, with Nations like the United Kingdom, Germany, and Spain, forms a dense cluster, demonstrating strong intra-regional cooperation. Similarly, Asia shows a robust network, with China, India, and Taiwan being key contributors.

This map emphasizes the global nature of research in AI in consumer electronics marketing, showcasing the interconnectedness and collaboration among countries worldwide.

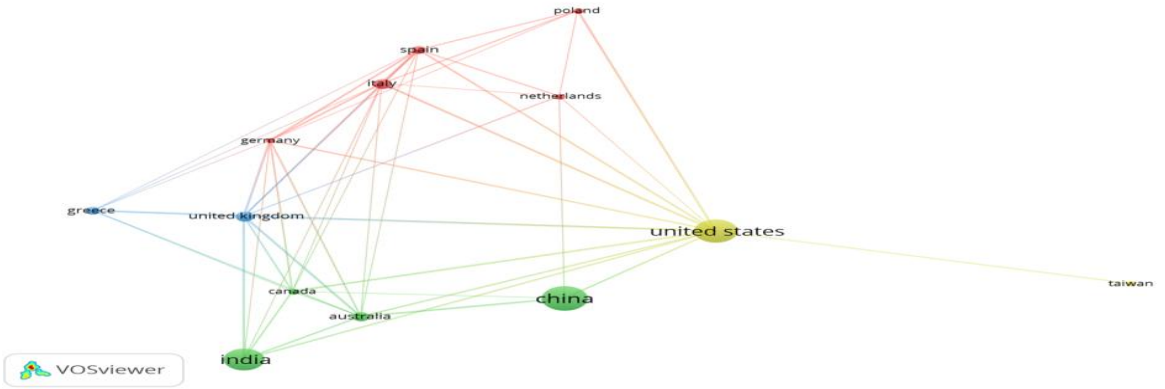


Figure 4: Visualization map of co-authorship networks (using full counting).

"Analysis of unit= Countries, Method used for counting: Full counting"

"Minimum documents per country: 10, Minimum citations per country: 10"

Network visualization map of the co-authorship: Figure 5 presents a network visualization map of co-authorship among authors in AI in consumer electronics marketing, created using VOSviewer with fractional counting. The map includes authors with at least one document and five citations.Nodes represent authors, with larger nodes indicating higher research output. Edges signify co-authorship links, with thicker edges representing stronger collaborations. Key authors such as Michael Berk, David J. Miklowitz, and Robert M. Post are central, indicating significant influence and extensive collaborations. The dense network of connections highlights strong collaborative efforts among researchers, with no distinct clusters, suggesting an integrated global research community. This visualization underscores the collaborative nature of research in AI in consumer electronics marketing and identifies the key contributors driving the field forward.

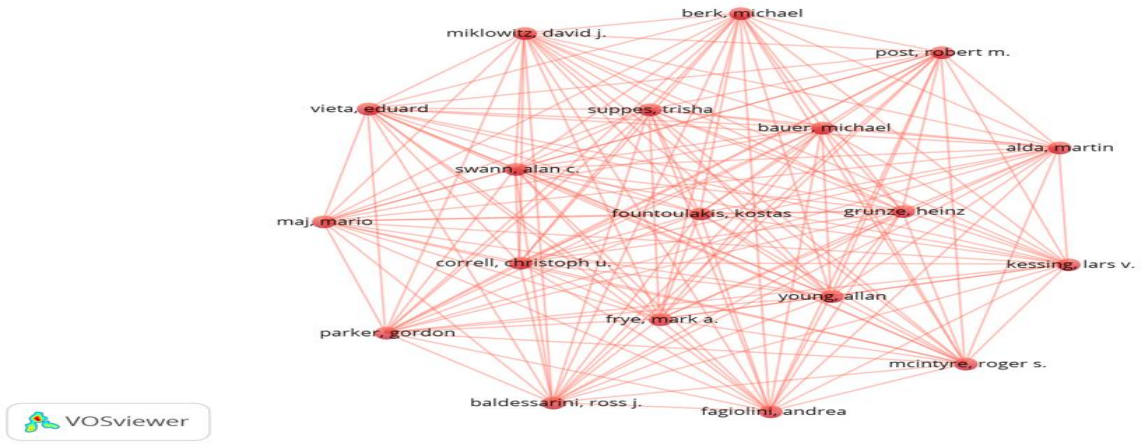


Figure 5: Co-authorship network visualization map.

"Analysis Unit used = Authors, Method used for counting: Fractional counting"

"Minimum documents per author: 1, Minimum citations per author: 5"

Variable 2: Origin

Country, Document, Citation, and Link strength (Fractional counting) In this research domain, the United States stands out as a leading force, Fractional counting, presenting 63 documents with a substantial citation count of 1704, showcasing a significant influence as shown in Table 2. China, despite having a high document count (68), demonstrates a relatively lower impact in terms of citations (518). The United Kingdom and Australia exhibit a well-balanced contribution, with noteworthy citations in relation to the number of documents. European countries such as Italy, Greece, Spain, and the Netherlands provide meaningful contributions, each highlighting distinct strengths. In the meantime, Taiwan presents a smaller yet discernible presence in the research landscape. Overall, this analysis emphasizes a collaborative and diverse international endeavor in exploring the intersection of AI and digital marketing.

Country	**Documents**	**"Citations"**	**Total link strength**
China	68	518	8
United States	63	1704	17
India	58	1135	7
Italy	22	280	8
United Kingdom	21	1106	12
Australia	20	1003	9
Greece	17	331	4
Spain	16	318	7
Canada	11	731	5
Netherlands	11	219	6
Poland	11	107	4
Germany	10	829	5
Taiwan	10	129	2
Total	**338**		

Table 2: Country, Document, Citation, and Link strength (Fractional counting)

Country, Document, Citation, and Link strength (full counting) The United States maintains its preeminence in full counting with 63 documents, a substantial citation count of 1704, and an increased total link strength of 35, solidifying its leadership in shaping the field. China, although exhibiting growth in total link strength (9), trails in citation impact compared to the U.S. As shown in the Table 3. The United Kingdom and Australia continue to provide balanced contributions, while Italy shows notable progress in total link strength. European countries, such as Greece, Spain, the Netherlands, and Poland, contribute meaningfully, each emphasizing unique strengths. This comprehensive analysis underscores a collaborative and evolving international effort, emphasizing the diverse exploration of AI's implications on digital marketing.

Country	Documents	"Citations"	Total link strength
China	68	518	9
United States	63	1704	35
India	58	1135	13
Italy	22	280	21
United kingdom	21	1106	27
Australia	20	1003	22
Greece	17	331	11
Spain	16	318	20
Canada	11	731	16
Netherlands	11	219	8
Poland	11	107	9
Germany	10	829	19
Taiwan	10	129	2
Total	**338**		

Table 3: Country, Document, Citation, and Link strength (full counting)

Most Influential Institutions

The data reveals a diverse distribution of publications among top institutions (Table 4), indicating broad expertise and interest in AI for consumer electronics marketing globally. Institutions from China, India, Ireland, Portugal, Italy, Australia, and the United States contribute, highlighting the international scope of research in advancing AI-driven digital marketing strategies for consumer electronics.

Institution	Total Publications	Percentage (%)
Zhejiang University	6	10.5%
Vellore Institute of Technology	5	8.8%
Amity University	5	8.8%
Symbiosis International Deemed University	5	8.8%
University College Dublin	4	7.0%
Universidade do Porto	4	7.0%
SRM Institute of Science and Technology	4	7.0%
ConsiglioNazionaledelleRicerche	4	7.0%
Universitàdeglistudi di Bari Aldo Moro	4	7.0%

UNSW Sydney	4	7.0%
Others	12	21.10%
Total	**57**	

Table 4: Leading institutions with at least four publications.

Distribution by year of Publications/Evolution of Published Studies The number of publications per year has increased steadily over the past decades, with a significant increase in recent years as shown in Fig. 6: Document by Year. There were only a handful of publications in the 1980s and 1990s, but the number of publications has grown significantly since then. There were 17 publications in 2007, and this number has more than tripled by 2021 (50 publications). The number of publications continued to grow in 2022 (58 publications) and 2023 (60 publications), as shows in the table 5

Year	Total Publications	Percentage (%)	Cumulative Percent
1986	1	0.2%	0.2%
1987	1	0.2%	0.5%
1995	1	0.2%	0.7%
1998	1	0.2%	1.0%
1999	2	0.5%	1.5%
2001	6	1.5%	3.0%
2002	6	1.5%	4.5%
2003	5	1.2%	5.7%
2004	9	2.2%	8.0%
2005	8	2.0%	10.0%
2006	3	0.7%	10.7%
2007	17	4.2%	15.0%
2008	10	2.5%	17.5%
2009	6	1.5%	19.0%
2010	3	0.7%	19.7%
2011	10	2.5%	22.2%
2012	6	1.5%	23.7%
2013	8	2.0%	25.7%
2014	3	0.7%	26.4%
2015	13	3.2%	29.7%
2016	8	2.0%	31.7%
2017	17	4.2%	35.9%
2018	14	3.5%	39.4%
2019	29	7.2%	46.6%
2020	30	7.5%	54.1%

2021	50	12.5%	66.6%
2022	58	14.5%	81.0%
2023	60	15.0%	96.0%
2024	16	4.0%	100.0%
Total	**401**	**100.0%**	

Table 5: Document by Year

As shown in the figure 6 the publication trend of research on AI in Consumer Electronics Marketing shows a significant evolution from 1986 to 2023. Between 1986 and 2000, publications remained minimal, reflecting the early stages of AI and its limited application in marketing. A gradual increase from 2001 to 2015 corresponds to growing interest in AI-driven solutions. A sharp rise begins in 2016, aligning with advancements in machine learning and AI integration into marketing strategies. The exponential growth from 2021 to 2023, peaking at nearly 70 publications, highlights the field's prominence due to widespread Integration of AI and digital transformation in analysing consumer behavior analysis, product personalization, and predictive analytics. This trend underscores the expanding role of AI in revolutionizing marketing within the consumer electronics industry

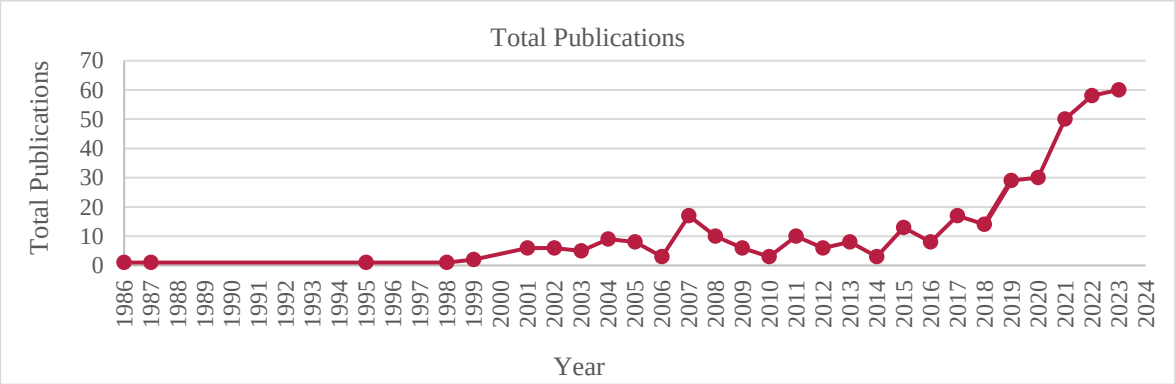


Figure 6: Document by Year (February 2024 data are not in the graph)

Variable 3 –Source and Document Types

In this field of study, Conference papers represent the most prevalent document type, making up 59% of all publications. Articles rank as the second most frequent document type, comprising 30% of the total publications. Reviews, book chapters, and conference reviews follow, accounting for 4%, 3%, and 2% of the total publications, respectively as shown in Table 6.

"Document Type"	**"Total Publications (TP)"**	**"Percentage (%)"**
Conference Paper	236	59%
Article	119	30%
Review	18	4%
Book Chapter	13	3%
Conference Review	9	2%
Others	6	2%
Total	**401**	**100%**

Table 6: Document Type

Conference proceedings are the most common source type, accounting for 47% of the total publications. Journals follow closely behind at 35%, with book series comprising 16% of the publications. Books and trade journals are less frequent, accounting for 2% and 0.25%, respectively, of the total publications as shown in Table 7

Source Type	**Total Publications (TP)**	**Percentage (%)**

Conference Proceeding	187	47%
Journal	139	35%
Book Series	66	16%
Book	8	2%
Trade Journal	1	0%
Total	**401**	**100%**

Table 7: Source Type

Distribution by Subject Area

Computer Science is the dominant field, contributing over 39% of the publications, followed by Engineering at nearly 21 %. Mathematics comes in third with 8%, Other disciplines, such as Decision Sciences, Medicine, and Business, Management, and Accounting, also contribute smaller but notable percentages. Interestingly, the number of publications per subject area shows a wide range, with Computer Science having the highest (281) as shown in table 8 this suggests a focus on the technical aspects of AI in marketing consumer electronics, with other disciplines playing a relatively smaller role in the current body of research

SUBJECT AREA	**Total Publications**	**Percentage (%)**
Computer Science	281	39.9%
Engineering	150	21.3%
Mathematics	63	8.9%
Medicine	54	7.7%
Decision Sciences	45	6.4%
Business, Management and Accounting	38	5.4%
Social Sciences	26	3.7%
Economics, Econometrics and Finance	19	2.7%
Physics and Astronomy	15	2.1%
Energy	14	2.0%
Total	**705**	**100.0%**

Table 8: Subject Area

Variable 4 – Contents (Text Analysis) Based on the VOSviewer visualization of the term co-occurrence network, several key themes emerge from the analysis of keywords in the field of AI in Consumer Electronics Marketing as shown in figure 7. The network is divided into distinct clusters, each representing a significant area of focus. The blue cluster centers around "electronic commerce," highlighting the importance of AI-driven personalization and recommendation systems in online retail. The green cluster emphasizes "marketing," indicating AI's significant influence on marketing strategies and consumer interaction within the digital landscape.

Figure 7:VOSviewer visualization of a co-occurrence network using all keywords. with a (fractional counting) minimum keywords are 10

Co-occurrence network based on Author Keyword The VOSviewer visualization of the term co-occurrence network highlights key themes in AI and consumer electronics marketing shown in figure 8. Central terms like "machine learning," "artificial intelligence," "personalization," and "e-commerce" reveal significant interconnections. Overall, the visualization illustrates that machine learning and AI are core to advancements in consumer electronics marketing

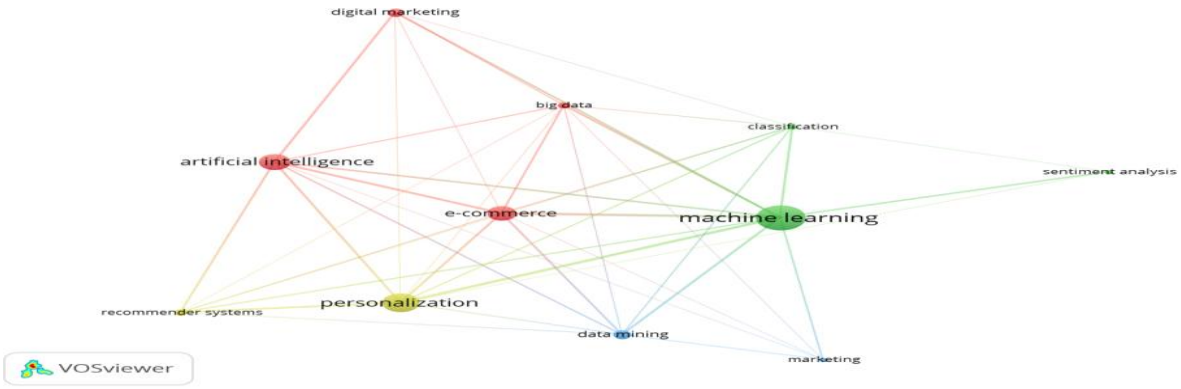


Figure 8 :VOSviewer visualization of a term co-occurrence network using author keywords (full counting method), with a minimum occurrence threshold of 10.

Keywords Analysis

The analysis of keywords shown in table 9 revealed that machine learning, personalization, and artificial intelligence were the most frequently occurring terms, appearing in 90, 61, and 52 instances. These findings suggest a strong focus on leveraging these AI-powered techniques to enhance consumer electronics marketing strategies.

Keyword	Occurrences	Percentage (%)	Total link strength
Machine learning	90	19.4%	124
Personalization	61	13.1%	66
Artificial intelligence	52	11.2%	66
E-commerce	46	9.9%	70
Data mining	26	5.6%	36
Digital Marketing	23	4.9%	30
Big data	17	3.7%	36
Recommender systems	16	3.4%	31
Classification	12	2.6%	29

Marketing	11	2.4%	12
Other keyword	111	23.9%	178
Total	**465**		

Table 9: Top Keywords

Variable 5 Citation Analysis Our analysis of citation data reveals insights into the impact and influence of the research publications included in the study. from 1986 to 2024, encompassing 401 papers cited 5427 times (Table 10). This results in an average of 13.53 citations per paper and 142.82 citations per year, indicating moderate to high research engagement. The age-weighted citation rate of 1142.92 suggests continued influence post-publication. The h-index (37), g-index (63), and PoPhI, norm (18) values collectively indicate both productivity and research impact. The h-index shows the presence of highly-cited papers, the g-index highlights a balanced profile with many publications receiving moderate citations, and the PoPhI, norm value confirms a higher citation impact compared to similar publications. In conclusion, the citation analysis paints a picture of a well-regarded body of research that has garnered significant attention and continues to influence the field, demonstrating both productivity and impact.

Citation Metrics	
Publication years:	1986-2024(Till Feb)
Citation years:	38 (1986-2024)
Papers:	401
Citations:	5427
“Citations/year:”	142.82
“Citations/paper:”	13.53
“Citations/author:”	1552.57
“Papers/author:”	149.45
“Authors/paper:”	3.63
Age-weighted citation rate:	1142.92
Hirsch h-index:	37
Egghe g-index:	63
PoPhI,norm:	18
PoPhI,annual:	0.47
FassinhA-index:	14
Reference date: 2024-02-27 12:59:38 +00530	

Table 10: Citations Metrics

Highly Cited Article

The table 11 outlines highly cited articles in the field of digital marketing research. Notably, the article by Y.K. Dwivedi et al. in 2021, "Setting the future of digital and social media marketing research: Perspectives and research propositions," stands out with an impressive citation count of 632, averaging 210.67 cites per year. The United States leads in impactful contributions, as seen in the collaborative recommendation analysis by O'Mahony et al. in 2004 and the patient-oriented deep representation of electronic health records by Zhang et al. in 2018. Several articles, such as those on fake review identification, personalized recommendation diversification, and mental health chatbots, reflect the intersection of technological innovation and user-centric concerns.

S No	Authors	Title	Year	Cites	Cites Per Year
1	"Y.K. Dwivedi, et al."	"Setting the future of digital and social media marketing research: Perspectives and research propositions"	2021	632	210.67
2	"M. O'Mahony, et al."	"Collaborative recommendation: A robustness analysis"	2004	272	13.6
3	"S. Afantenos, et al."	"Summarization from medical documents: A survey"	2005	154	8.11
4	"D. Isern, D. et al."	"Agents applied in health care: A review"	2010	149	10.64
5	"S.N. Alsubari, et al."	"Data analytics for the identification of fake reviews using supervised learning"	2022	122	61
6	"C.R. Andersonet al."	"Relational Markov models and their application to adaptive web navigation"	2002	98	4.45

Table 11: Highly cited articles

Citation by countries. The citation network visualization by country, as illustrated in Figure.9 illustrates the geographical distribution and impact of AI and consumer electronics marketing research. The United States emerged as central and influential, closely connected to Ireland, with significant contributions from Germany and Hong Kong. This highlights a concentrated yet globally collaborative research landscape in the field.

Figure 9: Visualization map of citation networks by country. (source VOSviewer)

Minimum documents per country: Minimum citations per author = 5

Visualization map of citation networks by documents: The visualization map (Figure 10) highlights the citation patterns among documents in the field of AI in Consumer Electronics Marketing. The map shows that Dwivedi (2021) is the most influential work, indicated by its prominent size. Other significant contributors include Afantenos (2005), Zhang (2018), and Rahim (2020). Clusters suggest thematic groupings, such as emerging AI applications (e.g., Sheikh 2021, Goldenberg 2021), and foundational AI methodologies (e.g., O'Sullivan 2004, Lee 2003). This visualization reveals key research hubs and indicates the centrality of recent advancements in driving the discourse. This insight underscores the rapid evolution and interdisciplinary nature of AI research in this domain.

Figure 10: Visualization map of citation networks by documents

Minimum citations per document = 10

Leveraging bibliometric analysis, this research review systematically cataloged the evolution of scholarly works concerning "The Impact of Artificial Intelligence on Digital Marketing of Consumer Electronics Products" over the preceding 25 years. Furthermore, the review elucidated significant themes that contribute to delineating the conceptual boundaries and breadth of Artificial Intelligence and Digital Marketing. This section is dedicated to elucidating the identified limitations and expounding upon the interpretation of findings derived from the review.

3.2 Interpretation of Findings: The bibliometric analysis emphasizes significant trends in AI integration within consumer electronics marketing strategies. Recent years have seen a notable surge in publications, reflecting heightened academic interest and a dynamic research environment. The global participation of China, the United States, and India underscores the widespread research efforts in this field. Terms like "personalization" and "customer service" indicate a strong focus on AI's influence in enhancing consumer interactions. The rise of "responsible AI practices" reflects increasing ethical considerations. Identification of 15 productive journals guides researchers and educators in accessing pivotal literature. Future research should delve into long-term consumer behavior impacts and integration challenges to deepen insights into AI's transformative role in digital marketing for consumer electronics.

Authors Distribution of publications among authors: The analysis of authorship patterns unveils a collaborative and diverse research landscape in AI for consumer electronics marketing. The even distribution of publications across authors (Table 1), with no single author dominating the field (most productive author with only 4 publications, 8.9% of the total), highlights this characteristic. This diversity extends beyond authorship count, encompassing a wide range of contributors (over 20 authors) with potentially varied backgrounds and expertise. This fosters a richer and more nuanced body of knowledge by incorporating multiple perspectives on the multifaceted challenges and opportunities in this field.

Network visualization maps (Figures 3 and 4) offer further insights into collaborative efforts at the country level. The co-authorship network maps showcase the central role of the United States in international research collaborations. The prominent US node with numerous connections signifies its pivotal role in driving research and fostering global partnerships. Notably, China, India, and Australia also demonstrate significant international linkages, indicating their active participation and substantial contributions to the field. Additionally, dense regional clusters are evident in Europe (UK, Germany, Spain) and Asia (China, India, Taiwan), suggesting that geographical proximity and shared regional interests might influence collaborative efforts.

The author-level network visualization map delves deeper into collaborative patterns. While highlighting key influential authors like Michael Berk, David J. Miklowitz, and Robert M. Post, the dense network underscores the strong collaborative nature of research in this field. Unlike distinct clusters, the interconnectedness suggests an integrated global research community. This facilitates the rapid dissemination of ideas and research findings, ultimately promoting collective advancement and innovation in AI for consumer electronics marketing.

The collaborative and diverse nature of research, evident in the even distribution of publications and extensive international linkages, fosters a healthy and dynamic research environment. Building on these findings, future research can strategically leverage collaboration to further advance the field. Initiatives such as collaborative research grants, joint international workshops, and conferences can foster knowledge exchange and spark new ideas by engaging a wider range of researchers. Recognizing and supporting emerging researchers through mentorship programs and early-career grants is also crucial for sustaining and growing the research community. By fostering collaboration and nurturing diverse perspectives, the field of AI in consumer electronics marketing can continue to generate impactful research outcomes with broader applications.

Origin The analysis of AI in consumer electronics marketing reveals a diverse and collaborative international research landscape. The United States leads with 63 documents and 1704 citations, underscoring its influential role. China, despite having the highest document count (68), shows a lower citation impact (518), indicating less influence. The United Kingdom and Australia demonstrate balanced contributions, with notable citations relative to their documents, highlighting strong research quality. European countries like Italy, Greece, Spain, and the Netherlands make meaningful contributions, each with distinct strengths, while Taiwan, though smaller, remains discernible in the research landscape.

The network visualization map emphasizes the collaborative nature of this field, with international co-authorships forming a dense, interconnected web of research activity. In full counting, the United States' leadership is further solidified with increased link strength, while China, the UK, Australia, and Italy show significant progress in collaboration. The spread of research effort across diverse institutions, as detailed in Table 4, indicates a broad base of expertise and interest, which is beneficial for the field. Institutions from China, India, Ireland, Portugal, Italy, Australia, and the US reflect the global nature of AI research in digital marketing.

The increasing number of publications over the years, from a few in the 1980s and 1990s to 60 in 2023, underscores the growing importance and interest in this area. This rise in publications highlights the expanding research community and continuous development of new insights and innovations. Overall, the data underscores a collaborative and evolving international effort in exploring AI's implications for digital marketing, showcasing diverse and dynamic contributions from researchers worldwide. This analysis emphasizes the importance of international collaboration and diverse institutional involvement in advancing AI in consumer electronics marketing

Document and source types

The analysis of AI in consumer electronics marketing reveals a dynamic and interdisciplinary research landscape. Most publications are conference papers (59%) and articles (30%), indicating a preference for rapid dissemination through conferences. Conference proceedings (47%) are the primary source type, underscoring the importance of conferences for showcasing advancements. Reviews, book chapters, and conference reviews suggest a multifaceted approach to advancing knowledge in this domain, while books and trade journals represent a smaller proportion, indicating less emphasis on long-form publications and industry-focused dissemination.

The steady rise in publications, especially from 2019 to 2023, reflects growing interest in AI for consumer electronics marketing. This increase can be linked to the rapid progress in AI technology, increased market demand for AI-powered consumer electronics, collaborative efforts between academia and industry, evolving policies and regulations, and the availability of large-scale datasets and computational resources.

The distribution of publications across various subject areas highlights the interdisciplinary nature of this research. Computer Science dominates, contributing nearly 40% of the publications, focusing on developing algorithms, machine learning models, and computational techniques to optimize marketing strategies. Engineering (21%) and Mathematics (9%) also play significant roles, emphasizing the importance of engineering principles and mathematical methodologies in AI solutions for consumer electronics marketing. Other fields such as Medicine, Management, Decision Sciences and Business and Accounting make notable contributions, reflecting the multifaceted nature of this field.

The varying emphasis across disciplines suggests room for further integration to enrich understanding and applications of AI in consumer electronics marketing. Cross-disciplinary collaborations can explore novel research directions, foster innovation, and address complex challenges requiring interdisciplinary perspectives. Future researchers can leverage these insights to identify gaps, foster collaborations, and explore new research avenues, advancing the field of AI in consumer electronics marketing

Research themes (Keyword analysis): The analysis of keywords in AI and consumer electronics marketing research highlights key concepts central to current discourse. Dominant keywords include machine learning, personalization, and artificial intelligence, indicating a focus on leveraging AI to enhance marketing strategies, personalize user experiences, and optimize decision-making processes. The prominence of e-commerce and data mining underscores the importance of digital platforms and data-driven approaches in this field. E-commerce is vital for product distribution and customer interaction, while data mining extracts valuable insights from large datasets to inform strategies. Table 12 shows seven clusters identified from 406 papers, with the top 80 keywords analyzed for future research. In the realm of consumer electronics marketing, Artificial Intelligence (AI) plays a multifaceted role, as highlighted by the clusters identified in the bibliometric analysis.

Cluster 1 emphasizes marketing strategies and the integration of AI, focusing on how digital marketing and automation can be enhanced through advanced technologies.

Cluster 2 delves into the technical aspects, particularly machine learning and AI techniques, underscoring the development and application of predictive and deep learning algorithms.

Cluster 3 centers on personalization and customer engagement, showcasing how AI-driven approaches can foster brand loyalty and improve customer service through personalized interactions. Understanding consumer behavior and enhancing their experience is the focus of

Cluster 4, which analyzes purchase patterns, user experiences, and consumer trends to tailor marketing efforts.

Cluster 5 examines consumer perception and utilizes content analysis to gauge and influence public opinion, employing sentiment analysis and predictive modeling to refine marketing strategies. Market segmentation and targeted advertising are the core of

Cluster 6, highlights how AI can identify and reach specific consumer segments with personalized marketing campaigns. Lastly,

Cluster 7 explores the broader impact of digital transformation and emerging technologies, including big data analytics, IoT, and autonomous systems, demonstrating how AI-driven innovations are revolutionizing the consumer electronics industry.

Together, these clusters provide a comprehensive overview of the dynamic interplay between AI and consumer electronics marketing, highlighting key themes, technological advancements, and future research direction.

Emerging trends in AI and consumer electronics marketing include digital marketing, big data, and recommender systems. Digital marketing reflects reliance on digital channels for promotion, while big data emphasizes the role of large-scale data analytics. Recommender systems show the importance of AI-driven recommendation engines for personalized product suggestions. Keyword distribution and link strengths provide insights into prevailing research themes, helping researchers identify trends, prioritize areas, and explore interdisciplinary collaboration. Overall, keyword analysis highlights key concepts, techniques, and trends shaping AI and consumer electronics marketing, driving advancements in this dynamic

field.

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7
Marketing strategies and AI integration.	**Machine learning and AI techniques.**	**Personalization and customer engagement.**	**Consumer behavior and experience.**	**Consumer perception and content analysis.**	**Market segmentation and targeted advertising.**	**Digital transformation and emerging technologies.**
Marketing Strategy	Machine Learning	Personalization	Consumer Behavior	Consumer Perception	Market Segmentation	Digital Transformation
Digital Marketing	Deep Learning	Customer Engagement	Purchase Patterns	Content Analysis	Customer Relationship	Big Data Analytics
AI Applications	Predictive Analytics	Brand Loyalty	User Experience	Sentiment Analysis	Targeted Advertising	Smart Devices
Marketing Automation	Machine Learning Techniques	Customer Service	Consumer Trends	Survey Research	Behavioral Targeting	IoT (Internet of Things)
Consumer Electronics	AI Integration	AI Chatbots	Customer Feedback	Data Mining	E-commerce Optimization	Cloud Computing
Recommendation Systems	Classification	Virtual Assistants	Consumer Insights	Predictive Modeling	Cross-Selling Strategies	Edge Computing
Sentiment Analysis	Forecasting	Customer Satisfaction	Shopping Behavior	Text Mining	Personalized Marketing	Connected Home
Brand Management	Algorithm Development	Real-Time Interaction	Customer Preferences	Social Media Analytics	Customer Analytics	Autonomous Systems
Ad Tech	AI Adoption	Customer Retention	Sales Forecasting	Network Analysis	Market Analysis	AI-Driven Insights
Online Marketing	Blockchain	Human-Computer Interaction	Strategic Planning	Information Retrieval	Social Media	Wearable Electronic Devices

Table 12 Keyword cluster

Citation analysis: The citation metrics presented in Table 10 offer significant insights into the research's impact and reach and significance in AI in consumer electronics marketing. Key points include:

Moderate to High Citation Rates: An average of 13.53 citations per paper and 142.82 citations per year indicates significant engagement with the research.

Long-lasting Influence: An age-weighted citation rate of 1142.92 suggests that publications continue to be influential long after their initial release.

Productivity and Impact: Metrics such as the h-index (37), g-index (63), and PoPhI,norm (18) highlight both the productivity and impact of the research. The h-index of 37 indicates a strong number of highly-cited papers, while the g-index of 63 reflects a balance with many publications receiving moderate citations.

Overall, the citation analysis paints a positive picture of the research's impact and influence. The findings are well-referenced, have lasting value, and showcase a productive research landscape with both highly-cited and moderately-cited publications.

The bibliometric analysis of AI in consumer electronics marketing over 25 years reveals a dynamic, globally collaborative research landscape, with significant publication growth from 2019 to 2023. Dominated by conference papers (59%), key themes include personalization, customer service, responsible AI practices, and machine learning. The U.S., China, and India lead in research output. Seven clusters highlight diverse areas from marketing strategies to digital transformation. Citation analysis indicates lasting influence, suggesting a productive field generating impactful knowledge. Future studies should prioritize exploring the long-term effects of AI., integration challenges, and ethical practices.

3.3 Limitations of the review: Bibliometric analysis, while insightful, has several limitations:

Quantitative Focus: Emphasizes metrics like citation counts and h-index, potentially overlooking qualitative dimensions such as theoretical contributions and practical implications.

Data Source Bias: Often relies on databases like Scopus, which may not include all relevant publications, especially those in less common languages or from less recognized journals, leading to skewed representations.

Citation Bias: Citations may not reflect research quality, influenced by factors like self-citation, collaboration networks, and trending topics.

Temporal Limitation: Emerging fields may show low citation counts due to their novelty, not lack of importance or quality.

To mitigate these, complement bibliometric analysis with meta-analysis, synthesizing qualitative and quantitative findings for a balanced assessment of research impact.

4. CONCLUSION

This bibliometric analysis of AI in consumer electronics marketing, conducted from 1986 to 2024, highlights a dynamic and rapidly evolving research landscape characterized by significant trends and collaborative efforts. The field has experienced a significant rise in the number of publications, particularly in recent years (53.4%), underscoring the growing academic interest in AI adoption and the dynamic nature of research in this area. The dominance of conference papers (59%) over articles (30%) and the prominence of conference proceedings (47%) reflect a preference for rapid dissemination of findings, facilitating timely sharing of advancements among researchers and practitioners.

The global distribution of contributors underscores the international scope of research efforts. Keyword analysis indicates a strong focus on AI's potential in personalization and customer service, while the emergence of "responsible AI practices" signifies an increasing awareness of ethical considerations. A major finding is the identification of seven key clusters in the keyword analysis, which highlight various aspects of AI's role in consumer electronics marketing. These clusters provide a structured overview of the field, aiding future researchers in identifying key themes, technological advancements, and potential research directions.

However, there are limitations to consider. The chosen timeframe may overlook recent trends, and relying solely on published works may introduce bias by excluding unpublished research. The study's focus on consumer electronics restricts its generalizability, and the selected database may not encompass all relevant publications. Despite these limitations, the study identifies significant research gaps, such as understanding the long-term impact of AI on consumer behavior and the challenges associated with integrating AI into existing workflows. Addressing these gaps through future research is crucial for developing a comprehensive understanding of AI's impact and ensuring its ethical and effective implementation.

This research contributes to a nuanced understanding of the current body of knowledge on AI and digital marketing for consumer electronics. It identifies influential journals and authors, providing valuable guidance to researchers and educators. The analysis highlights the need for further exploration of emerging themes, such as responsible AI practices and the long-term effects on consumer behavior. By addressing these research gaps and promoting ethical considerations, stakeholders can harness the potential of AI to drive success in the evolving digital marketing landscape. Overall, this research not only unveils the current state of AI in consumer electronics marketing but also provides a roadmap for future exploration through cluster analysis and emphasizes the importance of ethical considerations

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