Makale Türü: Araştırma Makalesi/Research Article

BIBLIOMETRIC ANALYSIS ON ARTIFICIAL INTELLIGENCE AND E-COMMERCE WITH VOSVIEWER

Havva Koç[1]

Abstract

In recent years, the rapid advancements in Artificial Intelligence (AI) and e-commerce technologies have significantly transformed business practices and consumer behavior. This study presents a bibliometric analysis of research on "Artificial Intelligence and E-commerce," providing a comprehensive overview of the field. The analysis encompasses co-author and author citation analysis, document and country citation analysis, institutional citation analysis, and keyword analysis. The study focuses on disciplines such as Business, Management, Economics, and Business Finance within the Web of Science database. As of May 18, 2024, a total of 216 publications from 2002 to 2024 were analyzed. Among these, 33.79% were published in China, 18.27% in the USA, 11.42% in India, 5.94% in the UK, and 5.48% in Germany. The prominence of publications from these countries is attributed to China's economic growth, the USA's advanced technological infrastructure, and India's expertise in software and IT. Meanwhile, the UK and Germany excel due to their significant investments in technology and highly competitive economies.

This study indicates that publications on "Artificial Intelligence and E-commerce" remain limited, primarily due to the emerging nature of the field. Although e-commerce has expanded with the advent of the internet, AI applications in this domain remain relatively nascent. This research systematically synthesizes existing literature and identifies key trends. The article provides a thorough analysis, offering valuable insights for future research.

Keywords: International Trade, Artificial Intelligence, E-commerce, Bibliometric Analysis, Web of Science

1. Introduction

The rapid advancement of the digital era has caused significant transformations in the business world and consumer behavior, revealing new opportunities and challenges. This transformation, especially in the fields of Artificial Intelligence (AI) and E-commerce, provides effective tools for businesses to enhance operational efficiency and improve consumer experiences.

Artificial Intelligence is a field of technology that optimizes decision-making processes through big data analytics, machine learning, and algorithms. E-commerce, on the other hand, is a digital trade model that has expanded the boundaries of commerce through the widespread adoption of online shopping. The integration of these two domains holds strategic significance for both academic and practical applications. While AI enhances customer satisfaction by understanding consumer expectations and offering tailored solutions, e-commerce enables businesses to gain a competitive advantage in the global market.

The intersection of AI and E-commerce enables businesses to offer more innovative and

[1] Okan Üniversitesi, e-posta: havvakoc@trakya.edu.tr, ORCID: 0000-0002-0906-1438

personalized services, while reshaping consumer habits and expectations. For example, AI-based recommendation systems optimize the purchasing experience by presenting consumers with products aligned with their interests, while chatbots and virtual assistants provide round-the-clock customer support, enhancing operational efficiency.

This study aims to provide a detailed analysis of academic research on "Artificial Intelligence and E-commerce" and evaluate the literature from a comprehensive perspective. The research examines a total of 216 publications indexed in the Web of Science (WoS) database as of May 18, 2024, focusing on fields such as Business, Management, Economics, and Business Finance.

The methodological framework of this research is based on a bibliometric analysis approach, aiming to track the evolution of AI and E-commerce research over time, map the geographical distribution of publications, and identify the most influential authors. Additionally, this study examines key trends and potential future research directions in these fields, offering valuable insights for both academic and practical applications.

The subsequent sections of this study are organized as follows:

- Conceptual Framework: Discusses the concepts of the new economy and digital economy and examines the relationship between AI and E-commerce.
- Methodology: Explains the bibliometric performance and scientific mapping approach.
- Analysis: Details the datasets and analytical methods used.
- Findings: Presents the results of the research, including the distribution of publications over time, the countries with the highest contributions, keyword analyses, and central trends in the fields of "Artificial Intelligence and E-commerce".
- Conclusion and Recommendations: Summarizes the key findings of the study and evaluates future research directions and the potential contributions of the field.

By conducting a comprehensive analysis of the literature on "Artificial Intelligence and E-commerce", this study seeks to enhance understanding of these dynamic fields and offer guidance for future research.

2. Conceptual Framework

The new economy, which has emerged from the integration of information and communication technologies into the business world since the late 20th century, is characterized by knowledge-based and innovative business models. Unlike traditional industrial societies, this economy is driven by digital technologies and the internet, with knowledge and innovation serving as the key drivers of economic growth (Chaffey & Smith, 2013).

The digital economy refers to a system in which economic activities are primarily conducted through digital technologies. The proliferation of the internet and digital platforms has enabled the digitalization of trade, services, and communication, significantly accelerating the speed and scope of economic interactions. Core components of the digital economy include e-commerce, digital marketing, fintech (financial technology), and digital business models (Warner & Wager, 2019).

AI and e-commerce are two rapidly evolving and complementary fields in the modern

business world. In this conceptual framework, it is essential to examine the fundamental components of AI and e-commerce, along with the innovative applications resulting from their integration (Li & Yu, 2022). AI encompasses algorithms and techniques that enable computer systems to perform tasks with human-like intelligence. Core components of AI include machine learning, natural language processing, image and speech recognition, robotics, and expert systems. These technologies, combined with big data analytics and powerful computing capabilities, enable more efficient and accurate decision-making in business processes (Chae & Goh, 2020; Aria & Cuccurullo, 2017).

In e-commerce, AI plays a crucial role in analyzing customer behavior, providing personalized shopping experiences, managing inventory, and optimizing supply chains. For instance, machine learning algorithms can analyze past shopping data to predict future purchasing trends and offer personalized product recommendations (Li & Yu, 2022).

E-commerce involves the production, promotion, sale, insurance, distribution, and payment of goods and services through computer networks. This concept encompasses a wide range of activities, including retail sales, digital marketing, payment systems, and customer service. The key advantages of e-commerce include 24/7 accessibility, a broad product selection, easy price comparison, and access to global markets (Chaffey & Smith, 2013). The widespread adoption of e-commerce has led to significant changes in consumer behavior and reshaped business marketing strategies. The increasing time consumers spend on online platforms has amplified the importance of data analytics and digital advertising (Park & Lee, 2021).

The integration of AI and E-commerce has brought revolutionary changes to the business world. Some notable applications of this integration include:

- Personalized Shopping Experiences: AI analyzes customers' past shopping behaviors to offer personalized product recommendations and targeted advertising campaigns. Personalized shopping experiences enhance customer satisfaction and positively impact sales.
- Inventory and Supply Chain Management: AI-based predictive models improve efficiency in inventory management and supply chain processes by forecasting demand fluctuations, minimizing issues like overstock or stock shortages.
- Customer Service: Chatbots and virtual assistants use AI to instantly respond to customer inquiries and automate customer service processes, reducing costs and increasing customer satisfaction.

Research on the integration of AI and e-commerce is crucial for maintaining a competitive advantage and developing innovative business models. Such research not only helps in understanding technological advancements but also provides valuable insights for strategic decision-making in businesses. The conceptual framework of this study examines the fundamental components of AI and e-commerce and the innovative applications resulting from their integration into the business world. This framework contributes to a deeper understanding of the bibliometric analyses conducted and provides a more comprehensive examination of the literature in this field.

3. Methodology: Bibliometric Performance and Scientific Mapping Analysis

Bibliometric analysis is a method used to track the development and growth of a specific discipline or field. It also reveals emerging themes within the field and how these themes evolve into a structured framework. By examining key characteristics in the literature, one can gain insights into the changes and trends within the field. Data such as the number of publications, authors, journals, geographical distribution, publication types, and titles are analyzed, providing valuable clues about the field's development (Lee et al., 2020).

Following the presentation of basic information, dominant themes identified based on the frequency of keywords or phrases are carefully examined, along with related sub-keywords. This analysis plays a crucial role in understanding which topics are significant within the field and which ones attract more attention. Subsequently, the relationships between these keywords are visually represented through network visualization to enhance clarity (Donthu et al., 2021; Han et al., 2021).

Bibliometric evaluation aims to systematically analyze the literature based on specific criteria, including co-citation, author, and co-word techniques. In this study, the co-word technique is specifically utilized, as it effectively clarifies the relationships between concepts and terms in the literature.

Co-word or shared-word analysis, proposed by Callon et al. (1983), identifies both the relationships and the strength of these relationships between words that appear in research over different periods. This analysis focuses on groups of keywords found in publications, visualizing word relationships to map the conceptual framework of the literature under review. The resulting conceptual framework helps identify the fundamental building blocks of research areas and provides insight into the core themes of any given topic. Co-word analysis offers several advantages over co-citation and co-author analysis, as it allows for the exploration of relationships within a field, helps track scientific developments, and contributes to a deeper understanding of the knowledge within that field (Callon et al., 1983).

In this study, various sources related to the field of "Artificial Intelligence and E-commerce" were reviewed through a literature review, and bibliometric analyses were conducted. The aim was to determine the contexts in which these two terms have evolved. The study begins by discussing its limitations and the data used, followed by a description of the research methodology.

3.1 Methodology

Bibliometric analysis is a method used to evaluate research performance, trends, and scientific impact through the numerical analysis of scholarly publications and citations. Various databases and software tools, such as WoS, Scopus, and Google Scholar, are commonly employed for conducting these analyses. WoS, which is part of the Web of Knowledge provided by Thomson Reuters, is a prominent citation indexing service widely used in scientific research (Hou et al., 2015).

WoS has a robust history as a citation database, providing comprehensive and reliable data for citation analyses, assessing research impact, and understanding scientific networks. Its broad coverage across disciplines, including social sciences, natural sciences, and humanities,

makes it particularly advantageous for multidisciplinary research. Additionally, WoS offers extensive data and specialized databases tailored to specific research areas, enabling in-depth investigations (Ho & Wang, 2020).

Popular software tools for bibliometric analyses include VOSviewer, BibExcel, CiteSpace, BiblioShiny (an extension of the bibliometrix R package), and HistCite. Among these, VOSviewer stands out as a powerful tool for visualizing bibliometric maps and conducting cluster analyses.

Therefore, for this study, the WoS database and VOSviewer bibliometric software have been selected as the primary tools.

3.2 Sample

The data in this study consist of articles containing the English terms "Artificial Intelligence and E-commerce". These data were obtained from carefully selected samples in the WoS database, which is part of the Web of Knowledge, a widely used citation indexing service provided by Thomson Reuters (Hou et al., 2015). The acquired data were visualized using VOSviewer by the author.

In the Web of Science Core Collection, 1,937 publications related to the concept of "Artificial Intelligence and E-commerce" were found across various disciplines and fields between 1998 and 2024. Of these publications, 1,927 were in English, 5 in Chinese, 3 in Turkish, 1 in French, and 1 in Ukrainian.

No restrictions were applied regarding publication type, author, or year in defining the population. During this period, searches using the keywords "Artificial Intelligence and E-commerce" identified 1,154 conference papers, 865 articles, and 22 book chapters. The study population includes publications available in the WoS database from 2002 to 2024. The sample was selected from publications within specific fields such as Business, Management, Economics, and Business Finance, with certain restrictions applied.

A total of 216 publications were identified within these designated fields.

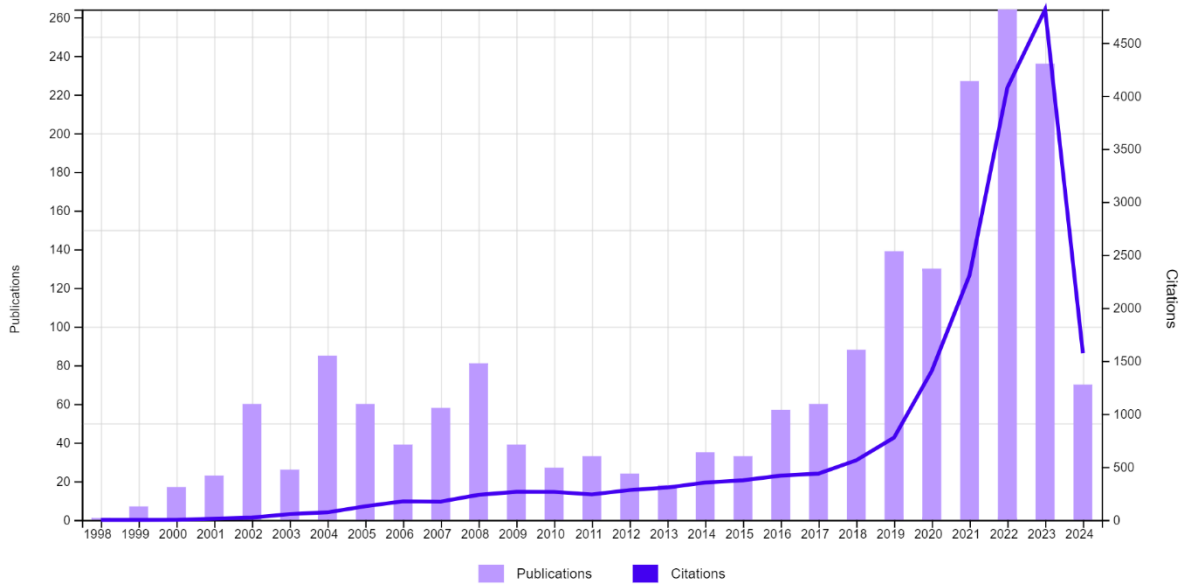
The bibliographic details of these works are presented sequentially under the findings section.

4. Findings

In this study, bibliometric analysis of publications in the field of "Artificial Intelligence and E-commerce" has been conducted.

Upon examining the distribution graph of publications and citations over the years, it is evident that the first publication related to the conceptual framework of "Artificial Intelligence and E-commerce" appeared in 1998. A significant rise in publications occurred in 2002, with 60 publications, followed by 81 in 2008. Although fluctuations occurred, the number of publications reached 81 again in 2018 and increased notably to 139 in 2019. The number of publications continued to rise, peaking at 264 in 2022, before slightly decreasing to 236 in 2023. As of May 18, 2024, there are 70 publications. Throughout the years, fluctuations have been observed, particularly a decline between 2016 and 2019; however, the overall trend shows an increase in the number of publications. These data indicate a growing interest and research

activity in the field of "Artificial Intelligence and E-commerce" over time.

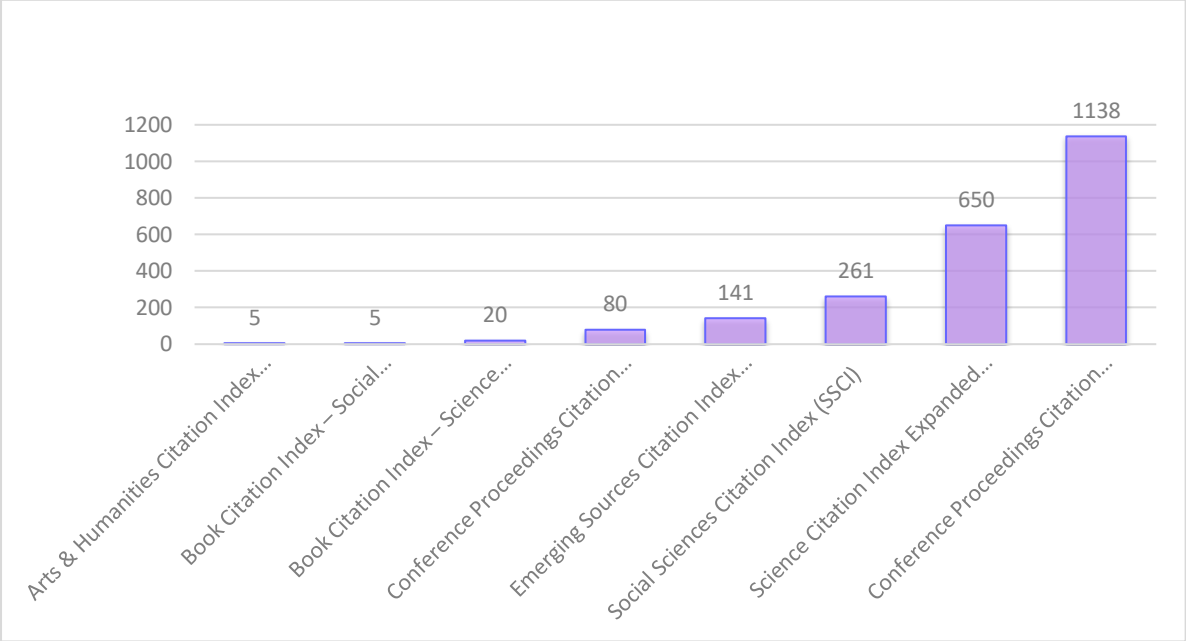


Graph 1. Times Cited and Publications Over 1998-2024

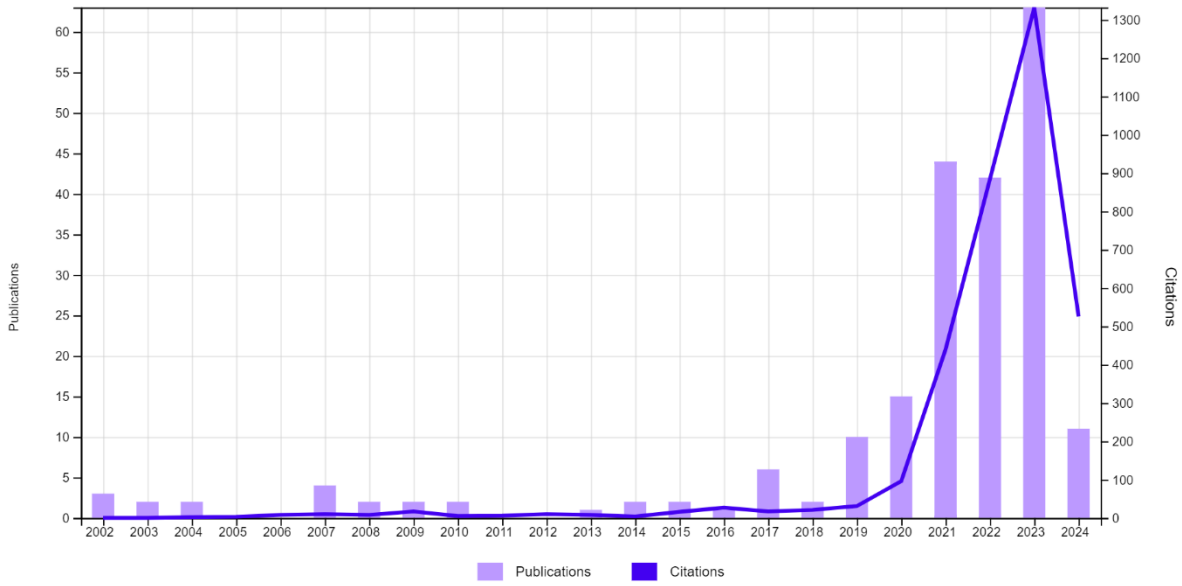
According to Graph 2 below, significant differences in publication numbers are observed across various WoS indexes. The indexes with the fewest publications are the Arts & Humanities Citation Index (A&HCI) and the Book Citation Index – Social Sciences & Humanities (BKCI-SSH), each containing only 5 publications. The Book Citation Index – Science (BKCI-S) has slightly more publications, with 20. The Conference Proceedings Citation Index – Social Science & Humanities (CPCI-SSH) includes 80 publications, while the Emerging Sources Citation Index (ESCI) contains 141 publications.

Among the indexes with the highest number of publications, the Social Sciences Citation Index (SSCI) stands out with 261 publications, while the Science Citation Index Expanded (SCI-EXPANDED) exceeds this with 650 publications. The index with the most publications is the Conference Proceedings Citation Index – Science (CPCI-S), which leads with a total of 1,138 publications. These data suggest that scientific research is primarily concentrated in the SCI-EXPANDED and CPCI-S indexes, indicating that these indexes attract a broader audience within academic fields.

Graph 2. Distribution of the Number of Publications According to WoS Indexes



According to the WoS Core Collection data, there are 1,154 proceeding papers, 865 articles, and 22 book chapters related to the concept of "Artificial Intelligence and E-commerce." When segmented by field, there are 151 publications in Business, 93 in Management, 28 in Economics, and 11 in Business Finance. In total, 216 publications were identified, including 153 articles, 50 proceeding papers, 16 early access articles, 13 review articles, 3 book chapters, and 2 editorial materials. These findings highlight the diversity of publication types and fields within the "Artificial Intelligence and E-commerce" domain. Graph 3 presents the publications and citations obtained after applying field restrictions.



Graph 3. Times Cited and Publications Dealing With "Artificial Intelligence and E-commerce" Over 2002-2024.

According to Graph 3, there has been a noticeable increase in both publication and

citation numbers over the years. Starting with 3 publications and 0 citations in 2002, both the number of publications and citations have grown significantly over time. Although no publications were recorded in 2005 and 2006, citation numbers stood at 3 and 8, respectively. In 2007, the number of publications increased to 4, with 10 citations. This upward trend continued through to 2023, with a particularly substantial rise in publications and citations from 2019 onwards. Specifically, in 2019, there were 10 publications and 31 citations; in 2020, 15 publications and 96 citations; in 2021, 44 publications and 440 citations; and in 2022, 42 publications and 884 citations. By 2023, the peak was reached with 63 publications and 1,332 citations. As of May 18, 2024, there have been 11 publications and 526 citations recorded. These data indicate a rapid increase in both research activities and citations related to this topic in recent years.

4.1 Literature Summary

In the literature summary below, a comprehensive and detailed review of the most cited studies is presented. The summary provides clear information about the topics, methodologies, and findings of each study, highlighting the key points of each work. Additionally, a general evaluation is offered on how these studies contribute to their respective contexts and the broader literature.

Table 1 lists the most cited authors and publications. In total, the top 10 publications with the highest citations are included in the table from among 216 studies. The average citation per publication is found to be 16,07.

Table 1. Most Cited Authors and Publications

Author(s)	Publication Year	Total Citations	Average per Year
Hoyer, W. D., Kroschke, M., Schmitt, B., Kraume, K., & Shankar, V.	2020	259	51,8
Adam, M., Wessel, M., & Benlian, A.	2021	252	50,4
Steinhoff, L., Arli, D., Weaven, S., & Kozlenkova, I. V.	2019	179	29,83
Thiebes, S., Lins, S., & Sunyaev, A.	2021	144	28,8
Moriuchi, E.	2019	136	22,67
Modgil, S., Singh, R. K., & Hannibal, C.	2022	126	31,5
Moussawi, S., Koufaris, M., & Benbunan-Fich, R.	2021	105	21

Brill, T. M., Munoz, L., & Miller, R. J.	2022	102	17
Pizzi, G., Scarpi, D., & Pantano, E.	2021	78	19,5
Song, M., Xing, X., Duan, Y., Cohen, J., & Mou, J.	2022	77	25,67

**Table 1 was created by the author based on information obtained from the WoS database as of May 18, 2024.*

Table 1 presents the authors and publications with the highest citations. At the top of the list is the work by Hoyer et al. (2020), which has accumulated a total of 259 citations, averaging 51.8 citations per year. This study explores the impact of emerging technologies on customer experience, introducing a novel framework that assesses the role of IoT, augmented reality (AR), virtual reality (VR), mixed reality (MR), virtual assistants, chatbots, and robots in the customer journey. Additionally, it discusses how technologies such as blockchain and 3D printing can enhance transparency and reduce delivery times. The study also addresses potential drawbacks of these technologies for future research, including issues like loss of control, privacy concerns, and over-reliance.

In second place is the study by Adam et al. (2021), which stands out as a significant contribution in the field. With 252 citations and an annual average of 50.4 citations, this research investigates the role of chatbots in customer service within e-commerce environments. While AI-based chatbots offer advantages such as cost and time savings, they often fall short of meeting customer expectations. The study conducted an online experiment to explore the effects of human-like design cues and the foot-in-the-door technique on user compliance. The findings suggest that human-like design and the need for consistency increase the likelihood of users complying with chatbot requests. Furthermore, the study revealed that social presence mediates this effect.

Occupying the third position, the study by Steinhoff et al. (2019) is notable for its relevance to the field. With 179 citations and an average annual citation rate of 29.83, this research explores the role of online relationships in interactions between companies and customers. The study examines tools that can manage customer relationships across various domains such as e-commerce, social media, online communities, mobile, big data, AI, and augmented reality. It offers a comprehensive analysis of the conceptual foundations of online relationship marketing, its evolution in business practices, and empirical findings from academic research. The authors propose a theory that uniquely defines online relationships as seamless, networked, multichannel, personalized, and humanized. Based on these five core characteristics, the study provides principles and recommendations predicting the performance effects of different online relationship marketing strategies.

Among other notable studies, Thiebes et al. (2021) explore the concept of trustworthy AI. The study investigates whether an AI system is trustworthy by examining whether it fulfills

its function-based obligations. It provides a comprehensive explanation of why trustworthy AI should possess attributes such as safety, fairness, and explainability, linking these discussions to philosophical debates on trustworthiness. Additionally, the study emphasizes that trustworthy AI is one that meets its functional obligations, which can be determined either by its design or through the benefits it provides.

Moriuchi (2019) published a study that has received 136 citations, with an average annual citation rate of 22.67. This research investigates the acceptance and effects of voice assistants (VAs) in e-commerce. The study examines the impact of VAs on consumer interaction and loyalty using the Technology Acceptance Model, focusing on perceived ease of use and perceived usefulness. It also evaluates the role of VA localization in online activities. The findings highlight the importance of integrating technology into the e-commerce environment.

Modgil et al. (2022) published a study that has received a total of 126 citations, with an average annual citation rate of 31.5. This research explores the role of AI in addressing supply chain disruptions experienced during the COVID-19 pandemic. Data obtained from interviews with e-commerce supply chain experts were systematically coded and analyzed to understand how AI can enhance supply chain resilience. The findings highlight five critical areas: ensuring transparency and visibility, securing last-mile deliveries, providing customized solutions to upstream and downstream supply chain stakeholders, minimizing the impacts of disruptions, and supporting flexible supply strategies. This study demonstrates the potential of AI technologies to enhance supply chain resilience through dynamic capabilities. It makes a significant contribution to bridging the gap between theory and practice, providing a framework for how AI can be applied in supply chain management.

Moussawi et al. (2021) focus on the capabilities of personal intelligent agents (PIAs) to assist individuals intelligently through natural language. Examples such as Siri and Alexa demonstrate that these agents are autonomous and proactive computer programs that interact with users using natural language. The study explains how the personalized, intelligent, and human-like behaviors of PIAs are modeled and tested based on information systems and AI research. An interactive lab study was conducted to examine how new users' perceptions of intelligence and anthropomorphism influence their intention to adopt PIAs. The results highlight the potential of PIA technologies to enhance users' capabilities and strengthen their personal identities, emphasizing the importance of these perceptions on PIA adoption. This research contributes to understanding critical factors in the PIA adoption process and offers new perspectives for future studies.

Brill et al. (2022) examine the complex structures and advanced AI-based technologies that power digital assistants such as Apple's Siri, Amazon's Alexa, and Google Assistant. These digital assistants are used for both basic personal tasks and more advanced functions, but their usage and impact vary from person to person. The research focused on customer satisfaction, using 244 survey responses analyzed with PLS-SEM. The findings confirmed that customer expectations have a positive and significant impact on the digital assistant interaction experience. The study provides valuable insights into how digital assistants can enhance customer experiences, emphasizing the need for firms to set appropriate expectations for customers when integrating this technology into their operations.

Pizzi et al. (2021) investigate the effects of AI-based digital assistants that retailers can use to support consumers during shopping. The research shows that non-human-like and automatically initiated versions of these assistants generate psychological resistance in consumers. This resistance increases perceived choice difficulty, which in turn positively influences choice certainty and satisfaction. Additionally, human-like assistants, particularly those initiated by the consumer, tend to mitigate these effects.

Song et al. (2022) examine the influence of chatbots, serving as customer service representatives in digital environments, on consumer decision-making processes. This study has garnered 77 citations, with an annual average citation rate of 25.67. Using the computers-as-social-actors paradigm, the research explores how differences in communication quality and privacy risk among service representative types affect consumers' intentions to adopt these technologies. Through five scenario-based experiments, the study finds that: the type of service representative directly impacts adoption intention; perceived communication quality and privacy risk mediate this effect; and factors such as the user's need for human interaction, perceived accuracy, communicative competence, and privacy risk perceptions act as moderators. These findings offer valuable insights for improving human-computer interaction in e-commerce contexts.

The literature summarized in Table 1 includes significant studies on the impact of e-commerce and AI technologies on customer experience and business processes. The most cited publications examine the role and effects of emerging technologies on the customer journey, with a focus on AI-based chatbots, virtual assistants, and digital helpers. Key topics explored include the use of AI in customer service, online relationships, and the design of trustworthy AI. Additionally, the role of AI in supply chain management and the effects of the pandemic on this area are discussed. These studies contribute to a deeper understanding of both the theoretical foundations and practical applications of AI and e-commerce technologies. Overall, the literature underscores how AI and new technologies are transforming customer relationships, enhancing business efficiency, and addressing potential risks. Studies at the intersection of AI and e-commerce are expected to play a pivotal role in guiding businesses through their digital transformation processes.

The literature review on artificial intelligence (AI) and e-commerce has identified the following gaps in the existing body of research:

Examination of Long-Term Effects: The long-term impacts of AI technologies on e-commerce, particularly in areas such as customer loyalty, brand attachment, and data privacy, have not been explored in detail.

Focus on the Post-Pandemic Era: The sustainability of AI solutions in the post-pandemic period, the lasting changes in consumer behavior, and the effects of AI on supply chain disruptions remain under-researched.

Analysis of Different E-commerce Categories: Studies on the use of AI in various e-commerce categories, such as digital products, niche markets, and second-hand trading platforms, are limited in the literature.

Social and Ethical Issues: The social and ethical dimensions of AI technologies,

including privacy concerns, data security, and ethical implications, have not been thoroughly investigated.

Bridging Theoretical Models with Practical Applications: There is insufficient empirical research on the application outcomes of theoretical models in the business context. Comprehensive studies are lacking on the performance of technologies such as machine learning, natural language processing (NLP), and deep learning across different sectors.

Addressing these gaps will contribute significantly to both the academic literature and the e-commerce industry.

4.2 Co-Author and Author Citation Analysis

Figure 1 illustrates that when the minimum publication threshold per author is set to one and the minimum citation threshold per author is also set to one, a total of 159 authors and 118 matches were identified. Among the most cited authors, Thiebes et al. (2021) lead with 144 citations from a single document, followed by Brill et al. (2022) with 102 citations from a single document, and Pantano et al. (2022) with 78 citations from one document. Authors who were not connected to others were excluded from the analysis. These data suggest that certain authors in the "Artificial Intelligence and E-commerce" domain are highly cited, and a significant portion of the research in this area is concentrated among these key contributors.

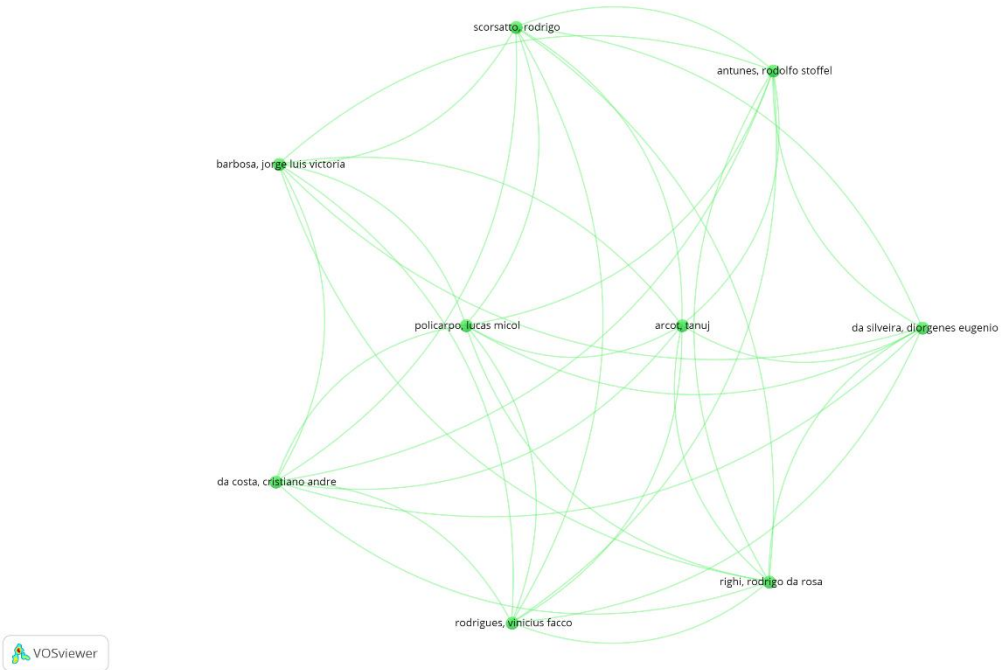


Figure 1. Co-Author Analysis

Figure 2 illustrates the co-citation network of authors. When the minimum threshold for both authors and citations is set to one, a total of 159 authors and 118 matches were identified. Each author in the figure is connected to others through co-citations, and those who are not

linked were excluded from the analysis. These data emphasize the collaboration and co-authorship networks within the "Artificial Intelligence and E-commerce" field, highlighting the extent of cooperation and shared research efforts among researchers.

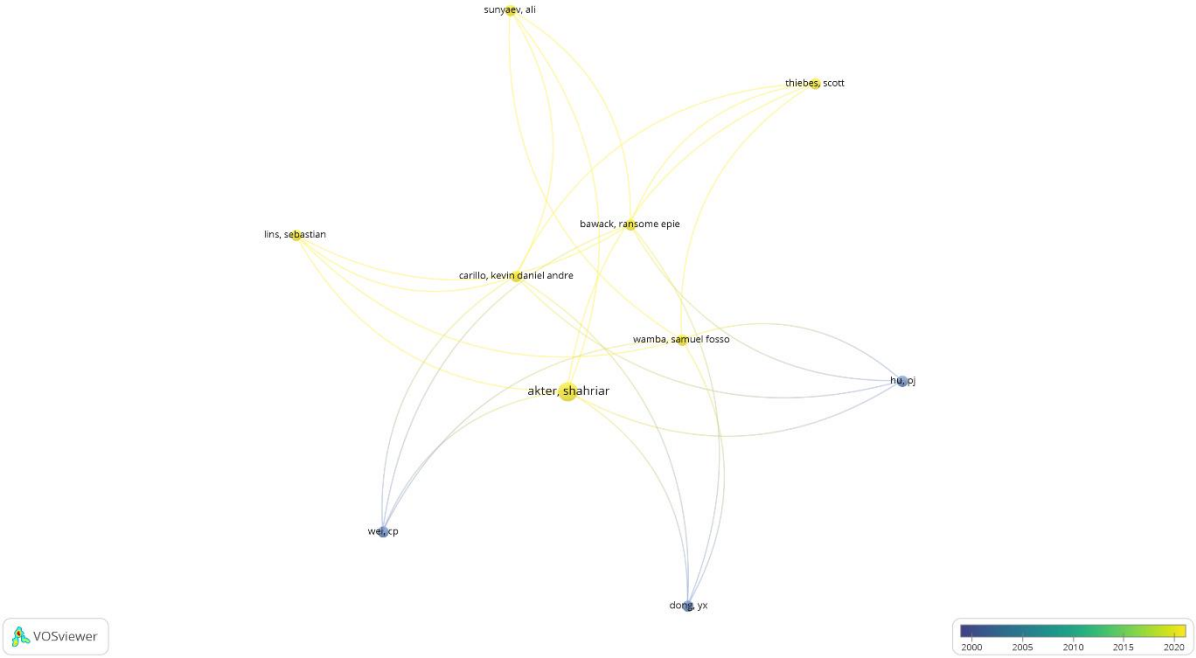


Figure 2. Co-Citation Analysis of Authors

Figure 2 presents observations on the co-citations of authors.

- Cluster 1 includes Bawack Ransome Epie, Thiebes Scott, Sunyaev Ali, Lins Sebastian, Hu PJ, Dong YX, and Wei CP.
- Cluster 2 consists of Carillo Kevin Danil Andre, Sunyaev Ali, Lins Sebastian, Thiebes Scott, Hu PJ, Dong YX, and Wei CP.
- Cluster 3 includes Akter Shahriar, Thiebes Scott, Sunyaev Ali, Lins Sebastian, Hu PJ, Dong YX, and Wei CP.
- Cluster 4 features Thiebes Scott, Bawack Ransome Epie, Carillo Kevin Danil Andre, Wamba Samuel Fosso, and Akter Shahriar.
- Cluster 5 comprises Lins Sebastian, Carillo Kevin Danil Andre, Bawack Ransome Epie, Wamba Samuel Fosso, and Akter Shahriar.
- Cluster 6 includes Sunyaev Ali, Carillo Kevin Danil Andre, Bawack Ransome Epie, Wamba Samuel Fosso, and Akter Shahriar.

These clusters represent the partnerships and collaboration networks among authors, offering valuable insights into the research landscape and the relationships within the "Artificial Intelligence and E-commerce" field.

4.3 Document Citation and Country Citation Analysis

Figure 3 presents the document citation analysis. With a minimum of one document

citation selected, there are 35 matches among 50 sources. Among the most cited documents, Thiebes et al. (2021) leads with 244 citations, followed by Brill et al. (2022) with 102 citations, Pizzi et al. (2021) with 78 citations, Moriuchi (2021) with 70 citations, and Bandara et al. (2020) with 46 citations. Nayal et al. (2022) and Baczkiewicz et al. (2021) share the same rank, each with 46 citations, while Kaptein & Parvinen (2015) has 34 citations and Bawack et al. (2022) has 33 citations. This analysis highlights the most cited documents in the field and their significance.

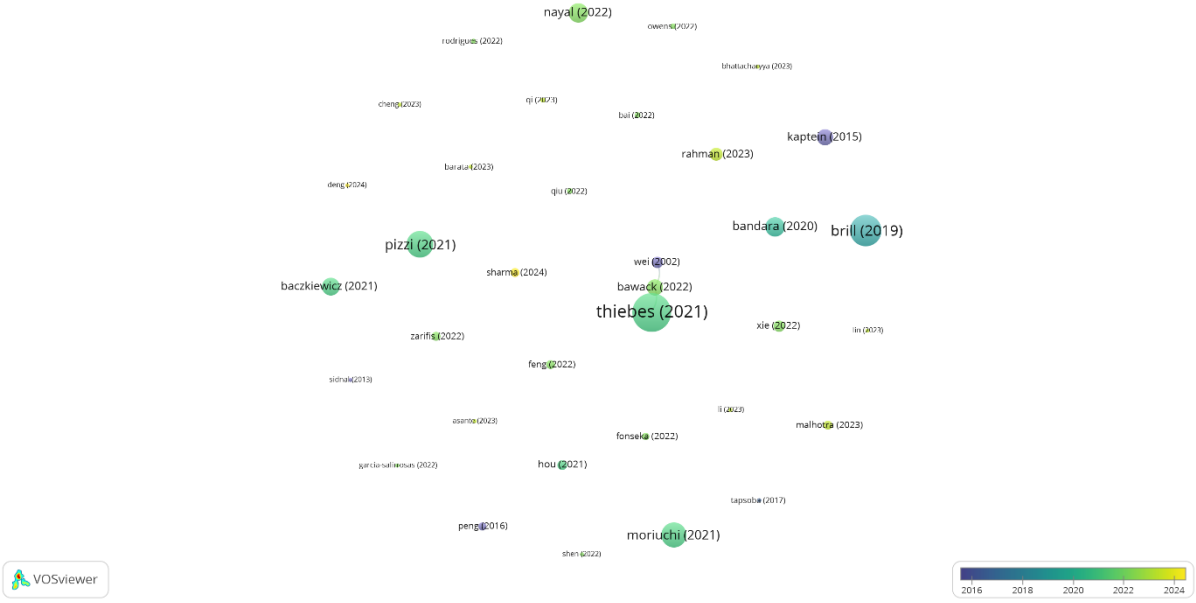


Figure 3. Document Citation Analysis (Weights: citations, Scores: pub. year)

Figure 3 presents the document citation analysis. When a minimum of one document citation is selected, there are 35 matches among 50 sources. It is observed that the period from 2018 to 2022 saw intensive research activities. The first source citation analysis pertains to Kaptein & Parvinen (2015).

Figure 4 displays the country citation analysis. When selecting a minimum of one document and one citation per country, 30 countries and 25 matches were found. The leading countries are:

- USA: 9 documents and 202 citations
- Germany: 2 documents and 151 citations
- England: 3 documents and 105 citations
- China: 21 documents and 102 citations
- Australia: 3 documents and 79 citations
- Italy: 1 document and 78 citations
- India: 5 documents and 62 citations
- Turkey: 1 document and 46 citations
- Finland: 2 documents and 41 citations

- Poland: 1 document and 39 citations

This analysis highlights the significant contributions of these countries in the field, demonstrating their impact and research output.

Figure 4. Country Citation Analysis (Scores Avg. Citations)

These data highlight the research and citation activities of specific countries in the field of "Artificial Intelligence and E-commerce." Notably, the USA, Germany, and the UK stand out due to their significant research output and citation activities in this domain.

The research conducted in countries like China, the USA, India, the UK, and Germany is largely influenced by their levels of economic and technological development. China, one of the world's largest economies, has rapidly emerged as a significant player in artificial intelligence and e-commerce, driven by its large population and substantial technological investments. Similarly, the USA's prominence in these fields is supported by its advanced technological infrastructure, significant research and development budgets, and a thriving entrepreneurial ecosystem.

India is globally recognized as a hub for software and information technology, bolstered by a skilled workforce, cost advantages, and a strong entrepreneurial spirit. Therefore, the concentration of research in artificial intelligence and e-commerce in India is unsurprising.

Industrialized European countries such as England and Germany have long been at the forefront of technology and industrial leadership. Their strong infrastructure, high educational standards, and investments in technology have fostered a concentration of research in artificial intelligence and e-commerce. England's role as a global financial center and Germany's expertise in engineering and manufacturing are key factors driving their prominence in these fields.

Leading online commerce platforms in these countries also make effective use of

artificial intelligence technologies. Chinese giants like Alibaba and US-based behemoths like Amazon leverage AI-driven tools to enhance customer experience and drive sales. Similarly, the growth of e-commerce and the development of online marketplaces in India and Europe have accelerated the adoption of AI technologies, boosting the competitiveness of small and medium-sized enterprises.

4.4 Organization Citation Analysis

In Figure 5, when a minimum of one document and one citation are selected per institution, there are 81 matches identified among 108 institutions. The analysis based on Average Publication Year Scores reveals the following top organizations:

- Karlsruhe Institute of Technology: 1 document, 144 citations
- University of Dallas: 1 document, 102 citations
- University of Wollongong: 2 documents, 79 citations
- University of Bologna: 1 document, 78 citations
- University of Bristol: 1 document, 78 citations
- Rochester Institute of Technology: 1 document, 70 citations
- Chaitanya Bharathi Institute of Technology: 1 document, 46 citations
- KJ Somaiya College of Engineering: 1 document, 46 citations
- NITIE (National Institute of Industrial Engineering): 1 document, 46 citations
- Yaşar University: 1 document, 46 citations

These findings highlight the organizations with significant citation impact in the field, illustrating their research influence in "Artificial Intelligence and E-commerce."

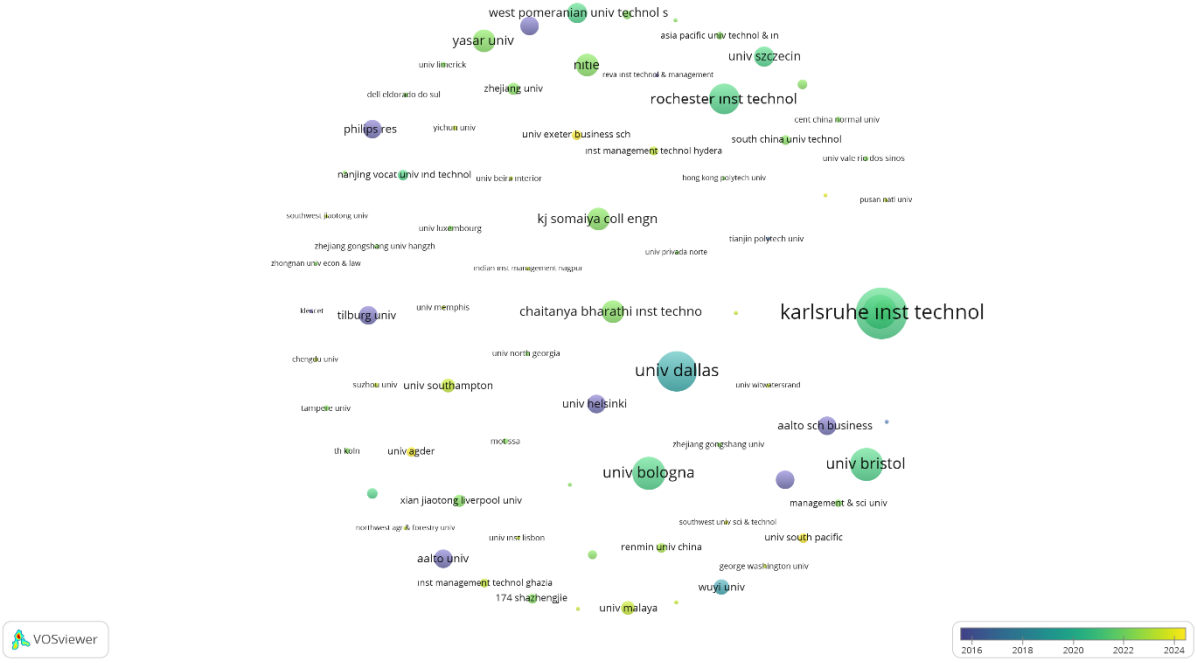


Figure 5. Organization Citation Analysis

According to Figure 5, institutions such as the Karlsruhe Institute of Technology and the University of Dallas are leaders in research activities within this field. The 2022 study titled "Exploring the Role of Artificial Intelligence in Managing Agricultural Supply Chain Risk to Counter the Impacts of the COVID-19 Pandemic," authored by Nayal et al., with a contributor from Yaşar University in Turkey, has received 46 citations. This study examines the role of artificial intelligence in managing agricultural supply chain risks, particularly in response to the impacts of the COVID-19 pandemic. Notably, it highlights the significant contribution from Turkey, which has garnered considerable citations in the field.

4.5 Keyword Analysis

Figure 6 depicts a shape containing 208 keywords when the minimum occurrence of a keyword is set to one.

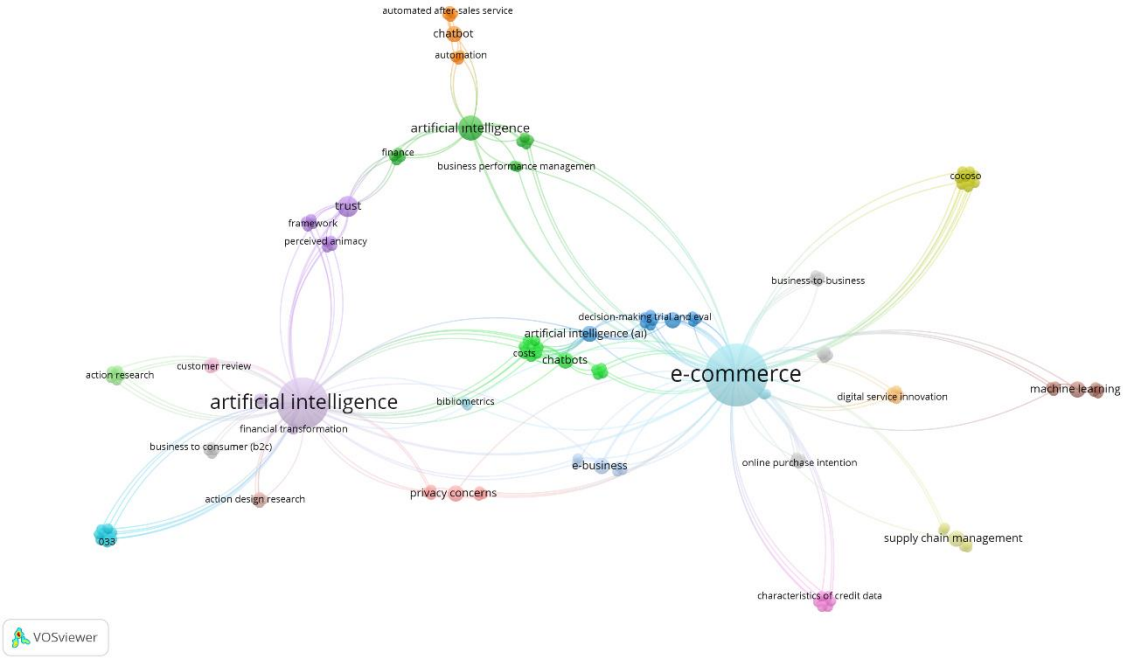


Figure 6. Keyword Analysis

Among the most frequently used keywords, "e-commerce" appears 18 times, "artificial intelligent" 13 times, "artificial intelligence (aı)" 2 times, "artificial ıntelligence" 4 times, "chatbots" 2 times, "trust" 3 times, "technology" 2 times, "business" 1 time, and "complexity theory" 1 time stand out.

It is evident from the figure that the term "artificial intelligence" has been incorrectly expressed:

- Instead of "artificial intelligent", it should be "artificial intelligence"
- Instead of "aı", it should be "AI," and
- Instead of "artificial ıntelligence", it should be "artificial intelligence"

When we selected a minimum occurrence of two for a keyword in Figure 7, the shape contained 13 keywords.

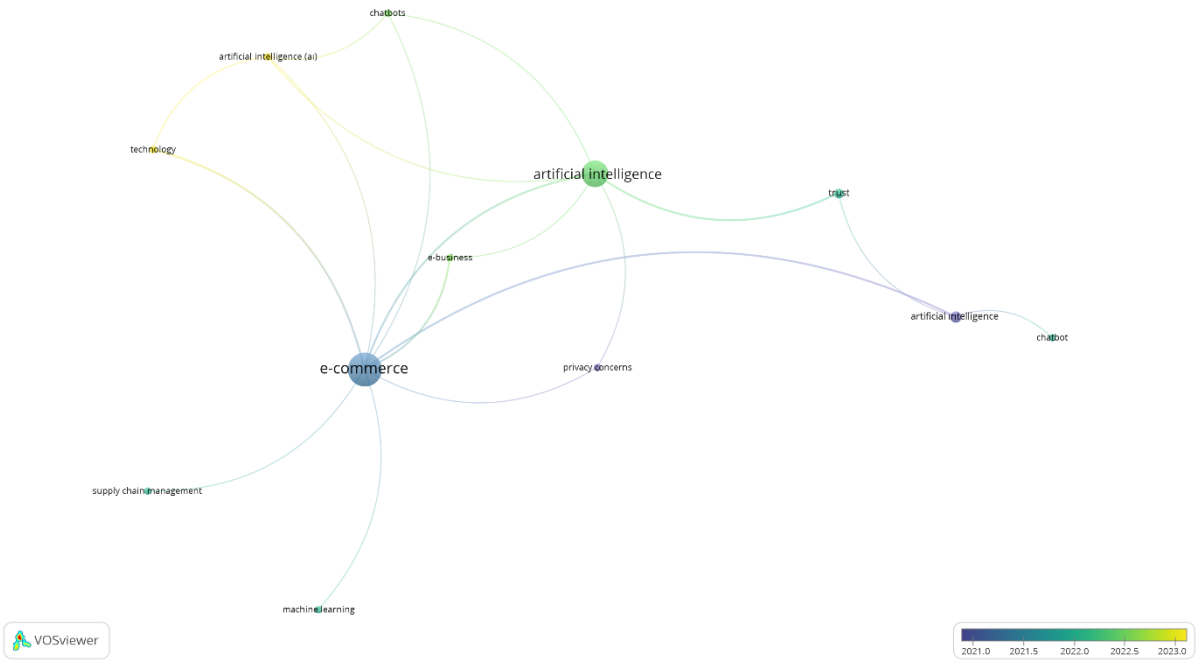


Figure 7. Keyword Analysis-2

According to Figure 7 above, e-commerce stands out with 18 occurrences, artificial intelligence with 13, artificial intelligence (AI) with 2, artificial intelligence with 4, chatbots with 2, e-business with 2, technology with 2, trust with 3, privacy concerns with 2, chatbot with 2, machine learning with 2, supply chain management with 2, and e-commerce platform with 2. These keywords reflect the main themes in research and literature in the field of "Artificial Intelligence and E-commerce." Errors in the spelling of "artificial intelligence" are clearly observed here as in Figure 6.

There are several key reasons why specific keywords emerge prominently in research and literature on "Artificial Intelligence and E-commerce". One of these reasons is the popularity of research topics and trends. Artificial Intelligence (AI): AI is a revolutionary topic across many domains of technology. In e-commerce, AI is widely used to enhance customer experience, increase efficiency, and provide more personalized services. Subfields of AI such as machine learning and chatbots play a significant role in automating e-commerce processes and boosting customer satisfaction and sales. Therefore, as seen from Figure 7, AI has gained popularity in the literature from 2022 to 2024. It is also evident from Figure 7 that e-commerce's literature presence predates that of artificial intelligence.

The integration of e-commerce with the transformative power of artificial intelligence suggests that this field is still in its maturation phase. As technological advancements continue and applications expand, emerging technologies are increasingly gaining attention in the literature. According to Figure 7, terms such as "chatbot," "chatbots," "machine learning," "supply chain management," and "e-business" saw a rise in popularity between 2020 and 2022.

Spelling variations such as "Artificial Intelligence (AI)" and "Artificial ıntelligence (aı)" may occur when different researchers use different terms to describe the same topic. This highlights the need for careful attention during literature reviews and data analysis to ensure consistency.

These keywords emphasize the significance and breadth of the main themes in research on "Artificial Intelligence and E-commerce." Furthermore, such spelling discrepancies and term variations reflect the dynamic and evolving nature of the field, pointing to critical considerations for researchers in maintaining accuracy and clarity.

5. Conclusion and Suggestions

This study aimed to provide a comprehensive analysis of academic research on "Artificial Intelligence and E-commerce" and to identify the key trends in the literature. Bibliometric analyses revealed a significant increase in the impact of artificial intelligence (AI) technologies on e-commerce, alongside a marked rise in research activity within this field. Citation analyses by country and institution underscored the influential roles of leading nations, such as the United States and China, as well as academic institutions like the Karlsruhe Institute of Technology. These findings highlight the critical contributions of research and educational institutions in the development and adoption of innovative technologies.

The analyzed publications demonstrate that AI-based solutions are pivotal in personalizing customer experiences, enhancing operational efficiency, and optimizing marketing strategies. Notably, there has been a growing focus on technologies such as machine learning, chatbots, and AI-driven recommendation systems. However, further research is needed to explore the applicability of these technologies across diverse sectors and to assess their specific advantages for businesses.

The identified gaps in the analyzed literature and opportunities for future research can be summarized as follows:

Long-term Effects of AI and E-commerce Technologies: Existing literature primarily focuses on the short-term impacts of AI technologies on e-commerce. However, the long-term effects remain underexplored. Comprehensive studies are needed to investigate how AI-driven solutions transform critical areas over time, such as customer loyalty, brand attachment, and data privacy. For instance, future research could examine the long-term potential of AI-based personalization strategies in fostering customer retention and their sustainability. Additionally, topics such as data privacy and ethical usage should be reassessed from a long-term perspective. Future studies could also guide e-commerce businesses in strategic decision-making by analyzing how these technologies shape individual customer behaviors, societal e-commerce habits, business models, and competitive dynamics.

Post-pandemic Research Directions: The rapid digitization of e-commerce and the increased use of AI technologies during the COVID-19 pandemic call for closer examination of their sustainability in the post-crisis period. While AI solutions such as chatbots, personalized recommendation systems, and logistics optimization tools played vital roles during the pandemic, their long-term effectiveness and adaptability remain unclear. Future studies could explore whether AI solutions adopted during the crisis continue to meet customer expectations

or lead to lasting changes in consumer behavior. Furthermore, the role of AI in addressing supply chain disruptions and building resilience against future crises should be investigated. Small and medium-sized enterprises (SMEs) also provide a fertile area for studying the long-term competitiveness of AI technologies in the post-pandemic era.

AI Applications Across Diverse E-commerce Categories: Current research predominantly focuses on the retail sector. However, the impact of AI technologies on other e-commerce categories—such as digital products, service-based platforms, niche markets, and second-hand trading platforms—remains underexplored. Future studies could examine the effects of AI adoption on customer experience, operational efficiency, and revenue optimization within these categories. Additionally, the performance and customer satisfaction contributions of AI-based solutions in B2B (business-to-business) and C2C (customer-to-customer) e-commerce platforms could also be evaluated.

Social and Ethical Issues: The increasing use of AI technologies necessitates deeper investigation into issues like privacy violations, data security, and ethical concerns. Future research could focus on potential manipulations caused by AI and propose solutions to enhance user trust.

Addressing Terminological Consistency: Observations highlight the need for greater attention to the consistency of key terms, such as "e-commerce" and "artificial intelligence," in the literature. Inconsistent terminology can negatively impact the accuracy of literature reviews. Ensuring terminological uniformity will improve the reliability of future research.

Bridging Theory and Practice: While theoretical models are extensively covered in the literature, their practical applications in the business world remain insufficiently examined. Bridging the gap between theory and practice could provide valuable insights for both academics and practitioners. Machine Learning: Future research could investigate the effectiveness of predictive models (e.g., time series analysis or regression methods) frequently discussed in the literature for demand forecasting in e-commerce firms of various scales. Additionally, the success of machine learning-based recommendation systems in boosting user engagement across different sectors and product categories could be further explored. Natural Language Processing (NLP): Although theoretical studies emphasize the utility of NLP techniques for understanding and addressing customer complaints, field studies are needed to evaluate their real-time performance in customer service systems and their impact on customer satisfaction. Deep Learning: The theoretical application of deep learning methods in image recognition and visual search functionalities has been widely discussed. However, empirical research is needed to assess their effectiveness on large datasets and evaluate their sustainability in terms of cost efficiency. Analyzing the challenges and limitations encountered during the implementation of these theoretical models, particularly for SMEs, would provide valuable insights for future research.

This study makes significant contributions to the literature on "Artificial Intelligence and E-commerce." Addressing the identified gaps and exploring the suggested areas for future research will not only enhance academic knowledge but also improve practical applications in this field. These recommendations provide a roadmap for understanding emerging trends in AI and e-commerce, while also addressing existing gaps in the literature. Future studies could

further advance the field by examining the societal and economic impacts of these technologies from a broader perspective, offering substantial contributions to both academia and the business world.

References

Adam, M., Wessel, M., & Benlian, A. (2021). AI-based chatbots in customer service and their effects on user compliance. Electronic Markets, 31(2), 427-445.

Aria, M., & Cuccurullo, C. (2017). Bibliometrix: An R-tool for comprehensive science mapping analysis. Journal of Informetrics, 11(4), 959-975.

Bandara, R., Fernando, M., & Akter, S. (2020). Privacy concerns in E-commerce: A taxonomy and a future research agenda. Electronic Markets, 30(3), 629-647.

Bawack, R. E., Wamba, S. F., Carillo, K. D. A., & Akter, S. (2022). Artificial intelligence in E-Commerce: a bibliometric study and literature review. Electronic Markets, 32(1), 297-338.

Baczkiewicz, A., Kizielewicz, B., Shekhovtsov, A., Watrobski, J., & Salabun, W. (2021). Methodical aspects of MCDM based E-commerce recommender system. Journal of Theoretical and Applied Electronic Commerce Research, 16(6), 2192-2229.

Brill, T. M., Munoz, L., & Miller, R. J. (2022). Siri, Alexa, and other digital assistants: a study of customer satisfaction with artificial intelligence applications. In The Role of Smart Technologies in Decision Making. Routledge.

Callon, M., Courtial, J. P., Turner, W. A., & Bauin, S. (1983). From translations to problematic networks: An introduction to co-word analysis. Social Science Information, 22(2), 191-235.

Chae, B., & Goh, G. (2020). Digital entrepreneurs in artificial intelligence and data analytics: Who are they?. Journal of Open Innovation: Technology, Market, and Complexity, 6(3), 56.

Chaffey, D., & Smith, P. R. (2013). eMarketing eXcellence: Planning and Optimizing Your Digital Marketing. Routledge.

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. Journal of Business Research, 133, 285-296.

Han, R., Lam, H. K., Zhan, Y., Wang, Y., Dwivedi, Y. K., & Tan, K. H. (2021). Artificial intelligence in business-to-business marketing: a bibliometric analysis of current research status, development and future directions. Industrial Management & Data Systems, 121(12), 2467-2497.

Ho, Y. S., & Wang, M. H. (2020). A bibliometric analysis of artificial intelligence publications from 1991 to 2018. COLLNET Journal of Scientometrics and Information Management, 14(2), 369-392.

Hou, Q., Mao, G., Zhao, L., Du, H., & Zuo, J. (2015). Mapping the scientific research on life cycle assessment: a bibliometric analysis. The International Journal of Life Cycle Assessment, 20, 541-555.

Hoyer, W. D., Kroschke, M., Schmitt, B., Kraume, K., & Shankar, V. (2020). Transforming the customer experience through new technologies. Journal of Interactive Marketing, 51(1), 57-71.

Kaptein, M., & Parvinen, P. (2015). Advancing e-commerce personalization: Process framework and case study. International Journal of Electronic Commerce, 19(3), 7-33.

Lee, I. S., Lee, H., Chen, Y. H., & Chae, Y. (2020). Bibliometric analysis of research assessing the use of acupuncture for pain treatment over the past 20 years. Journal of Pain Research, 367-376.

Li, N., & Yu, Y. (2022). Design and Application of Improved Ant Colony Algorithm in E-Commerce System. Wireless Communications and Mobile Computing, 2022(1), 9467095.

Modgil, S., Singh, R. K., & Hannibal, C. (2022). Artificial intelligence for supply chain resilience: learning from Covid-19. The International Journal of Logistics Management, 33(4), 1246-1268.

Moriuchi, E. (2019). Okay, Google!: An empirical study on voice assistants on consumer engagement and loyalty. Psychology & Marketing, 36(5), 489-501.

Moussawi, S., Koufaris, M., & Benbunan-Fich, R. (2021). How perceptions of intelligence and anthropomorphism affect adoption of personal intelligent agents. Electronic Markets, 31(2), 343-364.

Pantano, E., Pizzi, G., Scarpi, D., & Dennis, C. (2020). Competing during a pandemic? Retailers' ups and downs during the COVID-19 outbreak. Journal of Business Research, 116, 209-213.

Park, S., & Lee, K. (2021). Examining the impact of e-commerce growth on the spatial distribution of fashion and beauty stores in Seoul. Sustainability, 13(9), 5185.

Pizzi, G., Scarpi, D., & Pantano, E. (2021). Artificial intelligence and the new forms of interaction: Who has the control when interacting with a chatbot?. Journal of Business Research, 129, 878-890.

Steinhoff, L., Arli, D., Weaven, S., & Kozlenkova, I. V. (2019). Online relationship marketing. Journal of the Academy of Marketing Science, 47, 369-393.

Song, M., Xing, X., Duan, Y., Cohen, J., & Mou, J. (2022). Will artificial intelligence replace human customer service? The impact of communication quality and privacy risks on adoption intention. Journal of Retailing and Consumer Services, 66, 102900.

Thiebes, S., Lins, S., & Sunyaev, A. (2021). Trustworthy artificial intelligence. Electronic Markets, 31, 447-464.

Warner, K. S., & Wäger, M. (2019). Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. Long Range Planning, 52(3), 326-349.