European Economic Letters
ISSN 2323-5233
Vol 14, Issue 3 (2024)
http://eelet.org.uk

Revolutionizing Customer Experience Through Breakthrough Technologies in the Era of Industry 4.0: A Bibliometric Review

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Abstract

In today's hyper-competitive landscape, businesses recognize customer experience as the key differentiator. To thrive, firms leverage cutting-edge technologies that personalize interactions and redefine the customer journey. This pioneering study employed a bibliometric approach to comprehensively delve into the intricate interplay between major Industry 4.0 technologies such as AI, blockchain, cloud computing, big data, and the Internet of Things (IoT) and their transformative impact on the experiences of consumers. Harnessing the Scopus database, this study scrutinized 466 documents which were analyzed using Vosviewer and Biblioshiny package of R-Studio. The research aimed to unravel the annual scientific output, key contributors, seminal publications, and pivotal themes through co-citation and keyword co-occurrence analyses. Key findings of the study delineated four major themes "Sustainable Customer Engagement with Industry 4.0", "Redefining Service and Building Trust with AI", "Personalized Marketing in the Digital Age" and "Elevating Customer Journey with AR & VR Experiences". Beyond academic discourse, this study offers managerial, social and theoretical implications, furnishing guidance for responsible Industry 4.0 implementation to create exceptional customer experiences and gain a decisive competitive edge.

Keywords: Industry 4.0, Artificial Intelligence, Blockchain, Cloud Computing, Big Data, Internet of Things, Customer Experience, Bibliometric

1. Introduction

Today's dynamic 21st century is characterized by the emergence of Industry 4.0 also referred to as the Fourth Industrial Revolution or IR 4.0 which originated at Germany's Hannover Industrial Trade Fair in 2011 to bolster manufacturing competitiveness using breakthrough technologies (Roblek et al., 2016). According to Hayat et al. (2023), this revolution goes beyond mere technological upgrades and brings a paradigm shift in societal structures and business models. IR 4.0 by seamlessly integrating digital technologies like the Internet of Things (IoT), blockchain, Artificial Intelligence (AI), big data analytics and cloud computing elevating customer expectations. This integration bridges the boundaries between cyberspace and physical spaces, mainly represented by the CPS, which simultaneously merges the physical context with computational features for the improvement of human interaction and control by many new channels (Singh et al., 2024). This enables businesses to improve not only their manufacturing efficiency but also their competitive edge by providing greater value to customers through the analysis of consumer preferences and market trends in real time (Hallioui et al., 2022; Akter et al., 2022; Manavalan and Jayakrishna, 2020; Hayat et al., 2023).

In parallel, customer experience (CX) which encapsulates customer's cognitive, emotional, behavioral, and social responses to company offerings across the entire purchase continuum spanning pre-to-post-purchase stages has become a central concept in marketing in the digital age (Lemon and Verhoef, 2016). According to Sindhu and Bharti (2021), the Marketing Science Institute has underscored the establishment of CX as a groundbreaking concept in the marketing literature by consistently highlighting its importance in its biennial list of research priorities since 2011. The importance of CX in the era of IR4.0 cannot be overstated, as it fosters greater personalization, engagement and satisfaction, thereby leading to robust customer experiences which can serve as a crucial differentiator for businesses (Shaw and Ivens, 2002).

Smart technologies are redefining the customer journey by creating new touchpoints for searching for items and brands, assessing alternatives, reaching conclusions, and ultimately consumption, which improve the process of customer relationship management (Hoyer et al., 2020). For instance, IoT enables seamless device communication and custom production (Manavalan and Jayakrishna, 2020). Companies can use artificial intelligence by applying advanced algorithms and machine learning to tailor the interactions with clients, forecast consumers' needs, and provide valuable solutions (Haleem et al., 2022) Cloud computing facilitates data storage security (Murthy et al., 2020) that is highly valued in the contemporary economy, and blockchain provides reliability and transparency to the transactions. Altogether, these technologies complement each other to recast the customers relations such as Blockchain technology is rapidly integrating with the AI and IoT applications, a major factor of security, transparency, and trust improve, with real-time data being pivotal for engaging and analyzing the customer proactively, as well as predictive in nature like the self-driving or what we call the autonomous cars (Rane, 2023). Furthermore, the combination of AI algorithms with some of the efficient computer models assists the firms to execute their functions systematically, and extend efficient services, which raises the standard of CX.

This dynamic fusion of innovation and customer-centricity is revolutionizing business-customer dynamics across diverse industries. For example, the tourism and hospitality industry has witnessed advanced technologies like online bookings, check-ins, and keyless hotel entries (Mustafa, 2022), with blockchain-based booking systems can reduce fraud risk and ensure data integrity by facilitating decentralized bookings (Banerji et al., 2021). Retailers are leveraging augmented and virtual reality as virtual salespeople to enhance online shopping (Lee and Leonas, 2018), with the integration of AI, IoT and cloud-based analytics helps to implement dynamic pricing strategies which further drive more customer engagement by offering better offers and discounts (Kishen et al., 2021). The healthcare sector has seen the emergence of personalized health coaches, optimizing patient care and operational efficiency (Dimitrov, 2016). While the benefits of Industry 4.0 for a customer-centric future are substantial, but as the technology is getting more sophisticated, ensuring ethical concerns involving data privacy and security is crucial. Businesses must address these considerations for responsible implementation and to build trust and long-term loyalty (Wirtz et al., 2018).

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Despite the firms have been leveraging these technologies, there is a dearth of research focusing on their integrated applications, constraints, business possibilities, and collective influence on CX. Due to the evolving nature of innovation, the potential of their hybridization, recombination, and convergence remains unexplored. Existing studies often focused on one technology at a time, failing to holistically address their synergistic impact. Owing to their interconnectedness and relationship to data-driven decision-making, this study aims to bridge this gap by conducting a bibliometric literature review as a pioneering attempt to thoroughly explore the revolutionary potential of Industry 4.0 technologies, namely AI, blockchain, cloud, IoT, and Big Data in enhancing overall CX. By analyzing the current literature and identifying emerging trends, this study will provide valuable insights for businesses aiming to leverage innovative technologies to create exceptional customer experiences.

Building upon the identified gap and the strengths of bibliometric analysis, the study will address key research questions:

RQ1. How has the volume of research on the integration of Industry 4.0 technologies with CX evolved over time?

RQ2. Who are the major contributors shaping the research discourse in terms of authors, journals, papers, affiliations, and nations?

RQ3. What are the prominent research themes within the field of Industry 4.0 and its influence on CX?

The paper is organized as follows: The first section introduces the topic. Section 2 offers a concise literature overview. Following this, Section 3 details the research methodology while Section 4 reveals the findings of the study. Section 5 presents the discussion and conclusion with the last section addressing various limitations and future research directions of the study.

2. Literature Review

This literature review section offers an overview of existing studies within the industry 4.0 and CX domains, as detailed in **Table 1**. By synthesizing findings, it aims to identify gaps, trends, and emerging research directions for further exploration in this dynamic intersection of technology and consumer engagement.

Table 1. Synthesis of review studies on technologies in the industry 4.0 era and CX

Author(s)	Title	Findings
Peltier et al. (2024)	"Artificial intelligence in interactive marketing: a conceptual framework and research agenda"	conducted an extensive review of AI literature in marketing, and developed a framework for comprehending value co-creation in interactive marketing relationships.
Schneider-Kamp (2024)	"Can ethics be assembled? Consumer ethics in the age of artificial intelligence and smart objects"	examined consumer ethics with AI-enabled smart objects, emphasizing their interconnectedness and fluidity through a socio-material perspective.
Quy et al. (2023)	"Edge Computing for Real-Time Internet of Things Applications: Future Internet Revolution"	Offered a comprehensive understanding of edge computing for IoT applications, highlighting its benefits over cloud computing in various domains.
Robles and Mallinson (2023)	"Catching up with AI: Pushing toward a cohesive governance framework"	Discussed the applications of AI in public administration and proposed a systematic review of AI governance models to address public distrust and privacy concerns.
Li et al. (2023)	"Research on user-generated photos in tourism and hospitality: A systematic review and way forward"	Systematically reviewed user-generated photos in tourism and hospitality, identifying themes, methods, and theories, while proposing a multi-dimensional research framework.
Mondal et al. (2023)	"How to Bell the Cat? A Theoretical Review of Generative Artificial Intelligence towards Digital Disruption in All Walks of Life"	Focused on the economic and societal impact of Generative AI, exploring applications, challenges, and future research directions, proposing a framework for business managers to develop effective GAI strategies.
Pandey et al. (2023)	"Machine Learning Algorithms and Fundamentals as Emerging Safety Tools in Preservation of Fruits and Vegetables: A Review"	Explored machine learning in food processing to optimize operations, enhance safety, reduce waste, and improve customer experience, highlighting its potential for product personalization and food safety hazard identification.
Emodi et al. (2023)	"The Role of Internet of Things on Electric Vehicle Charging Infrastructure and Consumer Experience"	Investigated the impact of IoT on resolving challenges in EV charging infrastructure and consumer experience, highlighting policy needs for effective implementation.
Goi et al. (2023)	"The Impact of Digital Technologies on the Companies' Strategic Management"	Analysed digital technologies' influence on strategic management, emphasizing AI, IoT, and virtualization in reshaping business processes.
Sheoran (2023)	"A Consumer-Centric Paradigm Shift in Business Environment with the Evolution of the Internet of Things: A Literature Review"	Explored IoT's impact on business, focusing on consumer behavior and customer satisfaction enhancement while highlighting perceived benefits and risks of implementation.

Kim (2023)	"Connecting artificial intelligence to value creation in services: mechanism and implications"	Comprehensively reviewed AI in services, developed a value-creation mechanism, and provided insights for industrial transformation in the service sector.
Mehmood et al. (2023)	"Piloting personalization research through data-rich environments: a literature review and future research agenda"	Conducted systematic review on personalization, identified components, and challenges, proposed research directions for advancement in data-rich environments
Necula and Păvăloaia (2023)	"AI-Driven Recommendations: A Systematic Review of the State of the Art in E-Commerce"	Investigated AI in e-commerce recommender systems, analyzed trends, and discussed integration with other technologies to enhance consumer experience.
Kashyap et al. (2022)	"Artificial intelligence and its applications in e-commerce – a review analysis and research agenda"	Provided a systematic review of literature on AI in e-commerce, depicting its role in modernization.
Nicolescu and Tudorache (2022)	"Human-Computer Interaction in Customer Service: The Experience with AI Chatbots—A Systematic Literature Review"	Analyzed customer experience with AI chatbots, identifying influencing factors and dimensions, emphasizing response relevance and problem resolution's role in satisfaction.
Sharma et al. (2022)	"Artificial intelligence and hospitality industry: systematic review using TCCM and bibliometric analysis"	Provided a qualitative analysis of AI in hospitality, identifying trends, domains, and factors impacting competitiveness.
Vergallo and Mainetti (2022)	"The Role of Technology in Improving the Customer Experience in the Banking Sector: A Systematic Mapping Study"	Conducted systematic mapping study on technology adoption in banking for enhanced customer experience, identifying gaps, trends, and future challenges
Bhardwaj et al. (2021)	"Distributed denial of service attacks in cloud: State-of-the-art of scientific and commercial solutions"	Investigated DDoS attacks in cloud computing, identified gaps in defense solutions, discussed detection methods, tools, and emphasized the need for comprehensive security approaches.
Reis-Marques et al. (2021)	"Applications of blockchain technology to higher education arena: A bibliometric analysis"	Employed bibliometric analysis on blockchain research in higher education, identified gaps, applications, and future directions, proposing integration with AI and digital innovation for further exploration.
Lau and Staccini (2019)	"Artificial Intelligence in Health: New Opportunities, Challenges, and Practical Implications"	Summarized state of AI in consumer health informatics and education, underscoring a lack of evidence on its benefits, and emphasized on engaging patients and consumers in research.
Lee and Leonas (2018)	"Consumer experiences, the key to surviving in an omni-channel environment: Use of virtual technology"	Examined how omnichannel retailers utilize virtual technologies like AR/VR, virtual fitting rooms, and virtual salespeople to enhance online shopping and provided insights for brick-and-mortar retailers entering e-commerce.
Marinchak et al. (2018)	"Artificial intelligence: Redefining marketing management and the customer experience"	Reviewed AI adoption by marketers and consumers, highlighting the exponential increase in marketing capabilities, fundamentally altering buyer-seller exchange.

Dimitrov (2016)	"Medical internet of things and big data in healthcare"	Analyzed IoT and big data integration in healthcare for personalized preventative health management and highlighted the emergence of personalized health coaches and their importance in the aging population.

Source: Authors' elaboration.

The studies postulated the multifaceted impacts of Industry 4.0 technology on different dimensions of business and society with AI, blockchain, cloud computing, IoT, and big data exerting significant influence in various domains. While AI has enhanced marketing capabilities and reshaped customer experiences, blockchain has offered secure data management in higher education ((Marinchak et al., 2018; Reis-Marques et al., 2021; Sharma et al., 2022). Cloud computing drove scalability and cost-effectiveness (Bhardwaj et al., 2021), and IoT and big data analytics empowered decision-making processes across industries such as healthcare (Dimitrov, 2018), food processing (Pandey et al., 2023) and tourism (Buhalis and Sinarta, 2019). However, there is a notable absence of an evaluation approach that comprehensively assesses the revolutionizing CX through the convergence of these technologies. Therefore, conducting a bibliometric analysis of their integration with CX is highly relevant to comprehending the integrated frameworks to explore their collective impact. To address this issue, the current research will employ a qualitative and quantitative approach to establish a bibliometric analysis of the published literature and to drive sources and patterns, trends, and potential directions for subsequent research.

3. Materials and Method

The use of bibliometrics in scholarly research has been on the rise in recent years, which has made it possible in a systematic and scientific manner to identify various aspects of the literature (Donthu et al., 2021). It uses quantitative bibliometric measurement techniques such as the volume of published documents, document frequency, and citation analysis (Broadus, 1987). This bibliometric study followed a step-wise approach to the selection, assessment, and tracking of available and published materials related to the integration of Industry 4.0 with CX. The application of bibliometrics in scholarly research has witnessed a remarkable surge in recent years, facilitating its ability to objectively and methodologically identify different aspects of the literature (Donthu et al., 2021). It examines bibliometric data using quantitative tools like publication and citation statistics (Broadus, 1987). This bibliometric study utilized a step-wise approach to identify, evaluate, and monitor published literature concerning the fusion of Industry 4.0 and CX.

The procedure of Data Collection: The study sourced data from the "Scopus" database, a comprehensive repository widely recognized by researchers across multiple domains for conducting bibliometric analyses with larger coverage than the Web of Science with larger coverage over other databases to assess the research impact in the social sciences (Saxena et al., 2024; Dunakhe and Panse, 2022). The methodological procedure adopted for the present study is depicted in **Figure 1**. The data retrieval was performed on 20 April 2024 using the keywords *"Industry 4.0" OR "Fourth Industrial Revolution" OR "IR 4.0" OR "AI" OR "Artificial Intelligence" OR " Blockchain" OR "Cloud Computing" OR "Big data analytics" OR "IoT" OR "Internet of Things" AND "Customer Experience" OR "Consumer Experience" OR "Customer experiences" OR "consumption experience" OR "consumption experiences" OR "experiences of consumer" OR "experiences of customer"* based on insights gleaned from some prior review studies (Sindhu and Bharti, 2020; Hallioui et al., 2022). Initially, a string of relevant search terms to retrieve papers through title, abstract, or keyword searches, resulted in 1,231 documents in total which were further refined according to document type, publication stage, and language criteria. The document stage included only articles and review papers with conference proceedings, working papers, book chapters, and technical reports were excluded. Articles under review and in a language other than English were removed resulting in the inclusion of 466 articles for further analysis.

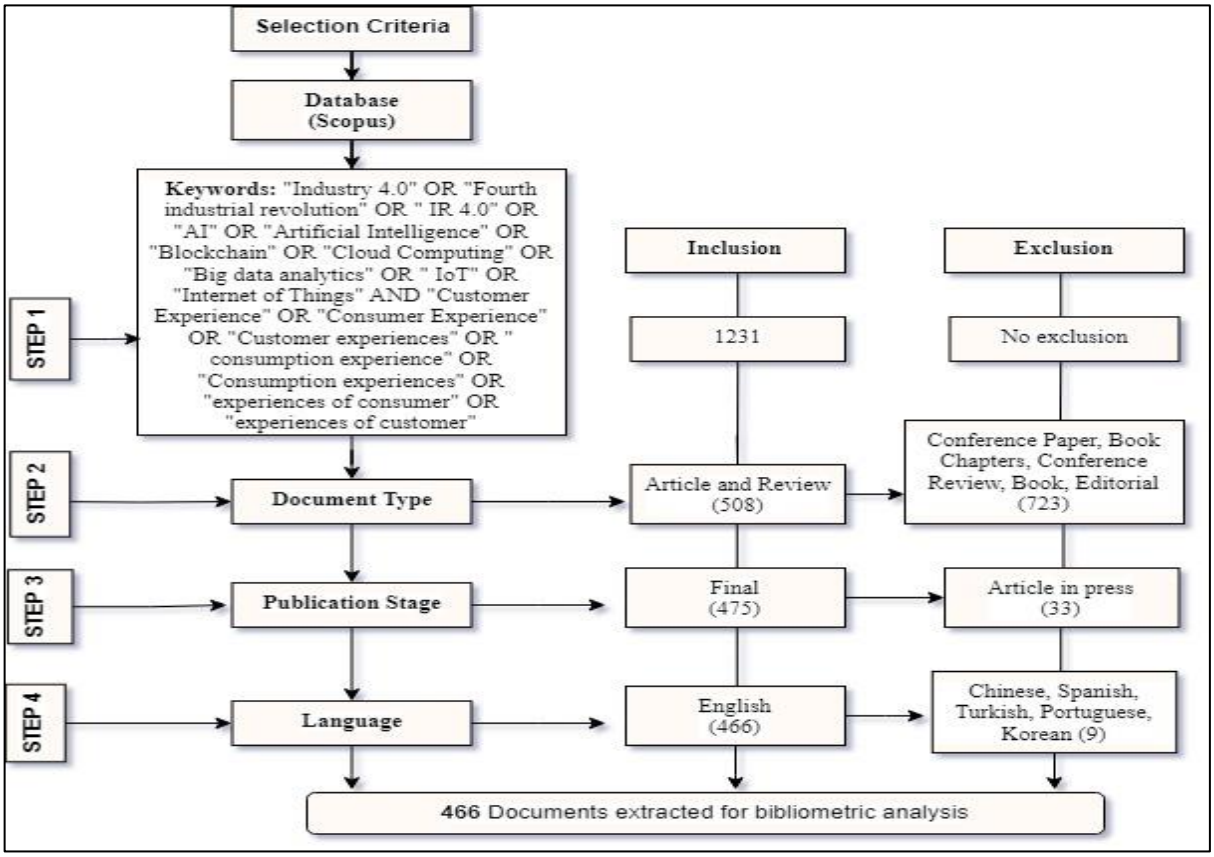

Figure 1. Methodological procedure of data collection

Source: Authors' elaboration

Software for conducting analysis: To carry out the analysis, Microsoft Excel, Vosviewer and the Biblioshiny package of R-studio software have been utilized. VoSviewer is one of the most popular tools in the Bibliometric analysis field because of its usability and effective visualizations for researchers. It has capability of depicting graphical illustrations of massive data and therefore aids in analyzing the bibliographic information as it enables one to identify additional relationship patterns and trends that may not be easily recognizable through other methods (Van Eck and Waltman, 2009). On the other hand, Biblioshiny provides results of bibliographical data in tabular form as well as graphs and thus can satisfy the various analytical requirements of users (Singh and Bashar, 2022).

Techniques of analysis: According to Broadus (1987), bibliometrics is described as the scientific evaluation of bibliographic records which combines a quantitative component with subjective analysis in an attempt to reduce prejudicial influence and thereby enhance research quality. It uses techniques such as co-citation and co-word analysis which helps to comprehend relationships between articles and visualizing general trends in the field of research. This research employed performance analysis and science mapping to gauge the performance and intellectual structure of the literature. Performance analysis delved into the impact and productivity by examining various facets including publication and citation trends, top contributors in terms of authors, affiliations, and countries, as well as influential journals and articles (Pattnaik et al., 2020). Within science mapping, this study unveiled the emerging themes and topics in the domain through the co-citation of cited references and the co-occurrence of keyword analysis, (Donthu et al., 2021).

4. Data Analysis

Descriptive Analysis of Data Characteristics

Figure 2 outlines the characteristics of the dataset used for the bibliometric analysis, consisting of 466 documents (436 articles and 30 reviews) published by 293 sources spanning 2004 to 2024. The majority of the articles have an average time of 3.03 years indicating the recency and relevancy of the research area. An annual growth rate of 21.23% is indicative of

burgeoning interest in the convergence of Industry 4.0 and CX. Collaboration among 1362 authors, with 30.69% international co-authorships, underscores the global engagement. The utilization of 19,328 references represents the multidisciplinary nature of this research.

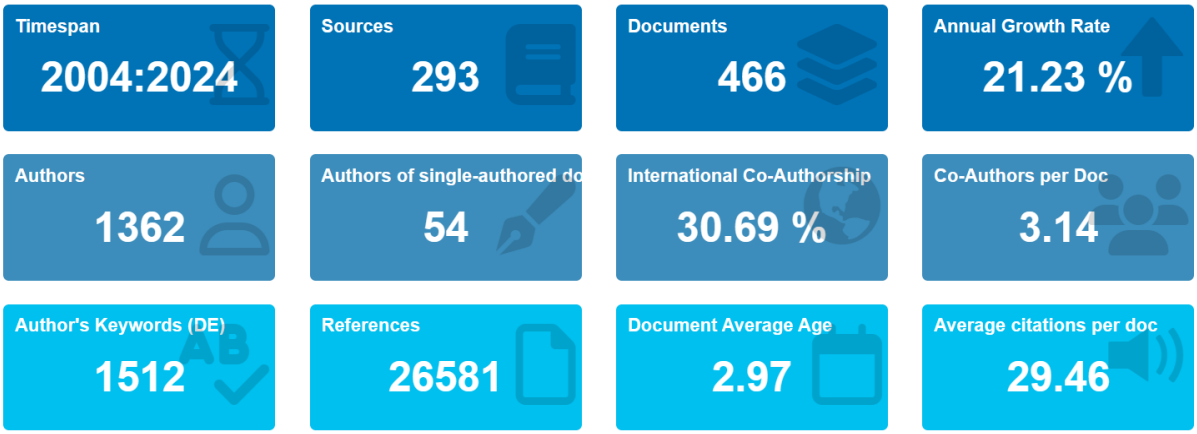

Figure 2. Data Characteristics

Source: Biblioshiny

Year-wise Publication and Citation of Documents

The inception of Industry 4.0 as a concept around 2011 likely prioritized initial efforts to develop core technologies over specific applications in enhancing CX. From 2014 to 2018 minimal research output is observed as exhibited in **Figure 3.** The rapid development of Industry 4.0 technologies has spurred innovative business models leading to a notable increase in publications from 2019 with documents almost doubled in comparison to 2018, constituting more than 86% of publications from 2019-2024.

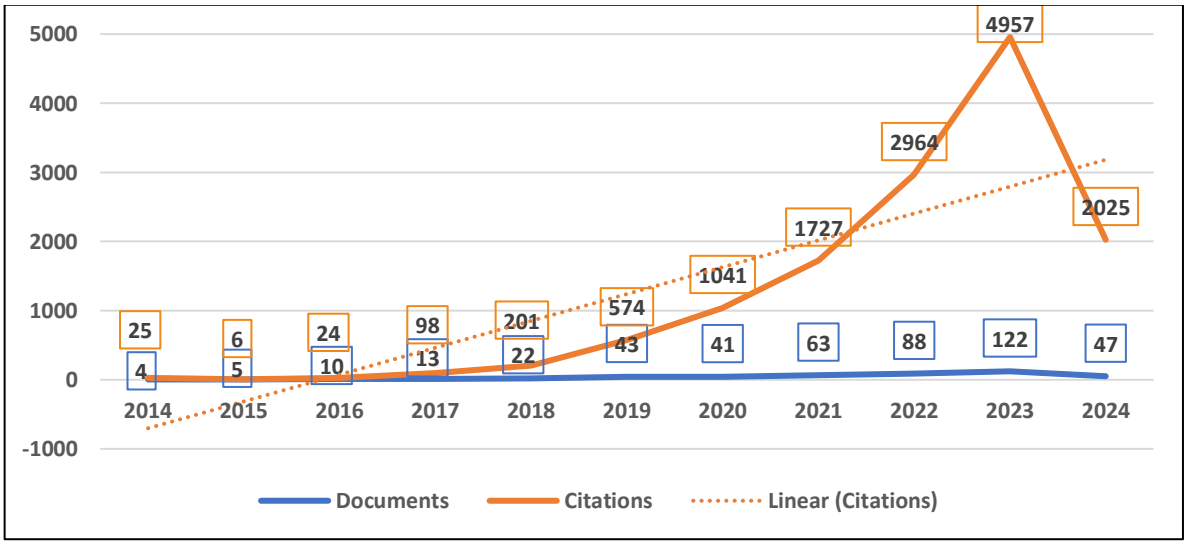

Figure 3. Year-wise Publication of Documents from 2014 to 2024
Source: Authors' elaboration

However, there was a slight decline in 2020, but the graph spiked upward thereafter crossing a threshold of 63 in 2021, and 88 in 2022 with a remarkable peak of 122 documents in 2023, which can be attributed to the COVID-19 pandemic accelerating the adoption of smart technologies specifically AI chatbots for customer support (Agarwal et al. 2024). Till 20, April 2024, approximately 47 documents have already been published, which is expected to grow significantly. Notably,

the continuous rise in citation count in contrast to the previous year underscores an increasing scholarly focus in this area, emphasizing the promptness of conducting this review.

Analysis of Subject-wise Publication of documents

Figure 4 outlines that the literature on IR 4.0 and CX spans a wide array of subject areas. Business, Management, and Accounting lead the forefront, comprising 26.50% of the research output, followed by Computer Science (21.7%), Engineering (13.5%), Social Sciences (9.0%) and others. The dominance of business and computer science research reflects the emphasis on Industry 4.0's practical applications in optimizing customer interactions by revamping business processes and technological advancements. Nonetheless, a comparatively smaller representation of Social Sciences suggests that technological and operational aspects of Industry 4.0 have received considerable attention with opportunities for further exploration of the social implications, consumer behavior, and societal antecedents of these emerging technologies.

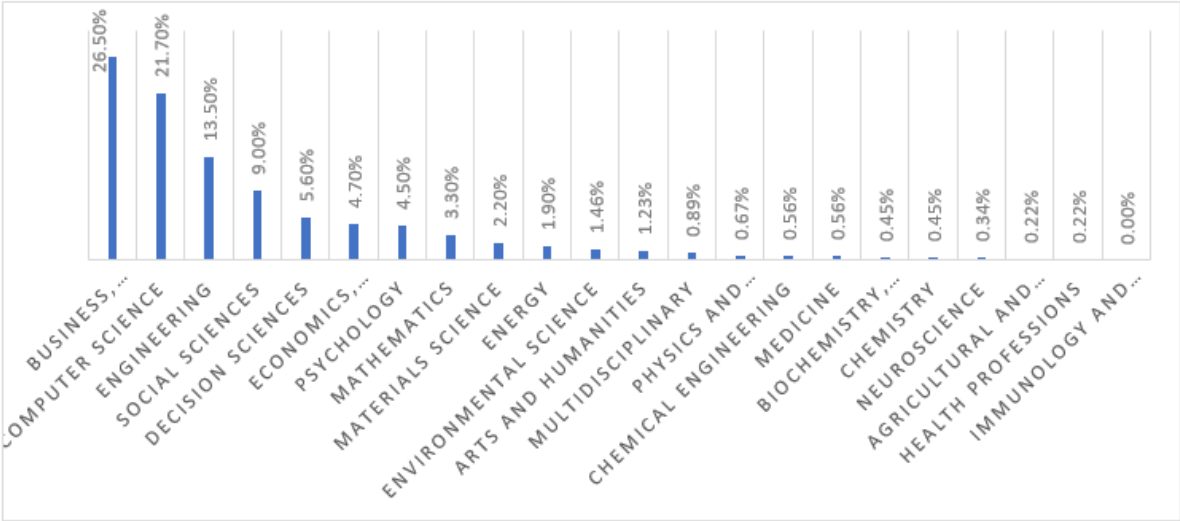

Figure 4. Subject-wise publication of documents

Most Influential Documents

Table 2 showcases the analysis of the most impactful documents exploring the transforming role of emerging technologies on CX. The presence of over 230 citations for the top ten relevant documents underscores the researcher's fervent pursuit of the CX revolution driven by technology. Warner and Wager, (2019) is the most cited document with 1,017 citations followed by Gomber et al., (2018) with 723 citations. Likewise, the document by Dimitrov D.V. is ranked 3rd with 617 citations followed by Ng and Wakenshaw (2017) and et al. (2019) having 418 and 395 citations respectively. The presence of over 230 citations for the top ten relevant documents underscores the researcher's fervent pursuit of the CX revolution driven by technology.

Digital transformation is an ongoing activity that utilizes new technologies (mobile, AI, cloud, blockchain, and IoT) to improve customer experiences, streamline operations, and possibly develop new business models (Warner and Wager, 2019). Gomber et al., (2018) provide an overview of existing research on the financial industry's response to a technological revolution (Fintech), emphasizing the need for increased efficiency and customer-centricity. The study presents a fintech innovation mapping approach to evaluate changes in operations, payment technology, loans, and investments, offering a thorough assessment of the industry's development. Ng and Wakenshaw, (2017) conducted a review of IoT, its trends, and applications providing its potential influence on various industries in the future. Dimitrov (2016) investigated the convergence of the IoT and big data in healthcare, anticipating their potential to transform patient management and decision-making processes. Hoffman and Novak examined how IoT alters consumer and object experiences using assemblage theory. They established various categories of consumer experiences, highlighting the influence of smart objects along with human-like features on these interactions (Hoffman and Novak, 2018). These studies emphasize the necessity of improved efficiency, customer-centric approaches, and adeptness in technological adoption while highlighting the ongoing process of digital transformation.

Table 2. Top 10 most cited documents

Authors	Title	Source	Year	Citations
Warner K.S.R.; Wäger M.	"Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal"	"Long Range Planning"	2019	1017
Gomber P.; Kauffman R.J.; Parker C.; Weber B.W.	"On the Fintech Revolution: Interpreting the Forces of Innovation, Disruption, and Transformation in Financial Services"	"Journal of Management Information Systems"	2018	723
Dimitrov D.V.	"Medical internet of things and big data in healthcare"	"Healthcare Informatics Research"	2016	617
Ng I.C.L.; Wakenshaw S.Y.L.	"The Internet-of-Things: Review and research directions"	"International Journal of Research in Marketing"	2017	418
Lu L.; Cai R.; Gursoy D.	"Developing and validating a service robot integration willingness scale"	"International Journal of Hospitality Management"	2019	395
Hoffman D.L.; Novak T.P.	"Consumer and object experience in the internet of things: An assemblage theory approach"	"Journal of Consumer Research"	2018	367
Buhalis D.; Sinarta Y.	"Real-time co-creation and nowness service: lessons from tourism and hospitality"	"Journal of Travel and Tourism Marketing"	2019	366
Hoyer W.D.; Kroschke M.; Schmitt B.; Kraume K.; Shankar V.	"Transforming the Customer Experience Through New Technologies"	Journal of Interactive Marketing"	2020	341
Puntoni S.; Reczek R.W.; Giesler M.; Botti S.	"Consumers and Artificial Intelligence: An Experiential Perspective"	"Journal of Marketing"	2021	305
Pencarelli T.	"The digital revolution in the travel and tourism industry"	"Information Technology and Tourism"	2020	233

Source: Authors' elaboration

Most Prolific Authors

Table 3 lists the leading contributors with consistent and high-impact papers in the realm of Industry 4.0 and CX. In terms of publications, Kumar A, Liu X and Zhang Y tops the list with 6, 5 and 4 publications respectively. The authors' citation count represents the acknowledgment and recognition of their research, where Novak TP stands out as the most prominent author with the highest number of citations i.e., 551, who has contributed 3 studies in the domain during 2004-2024. He is working in the area of studying CX and consumer-object relationships, primarily in the context of the IoT. For instance, he developed a framework that links the agentic (action-oriented) and expressive roles of consumers and objects to enhance consumer capabilities, suggesting that consumer perceptions of an object's role can be object-oriented rather than solely anthropomorphic (human-like) and views over various moral dilemmas in case of smart objects such as autonomous

vehicles. Besides, Prentice C with 166 citations primarily delved into the impact of AI on customer engagement, loyalty, and service quality, and Van Esch P having 161 citations is primarily interested in the intersection of AI with financial anxiety and retail interactions, particularly in light of digital marketing along with the use of augmented reality in retail settings.

Table 3. Leading authors

Authors	No. of Publications	Citations	PY_start	Articles Fractionalized
KUMAR A	6	37	2020	1.83
LIU X	5	100	2020	1.2
ZHANG Y	4	8	2021	1.2
HAN B	3	37	2019	1.58
NOVAK TP	3	551	2018	2
PRENTICE C	3	166	2020	1.25
VAN ESCH P	3	161	2019	0.92
CHEN J	3	9	2021	0.7
LI J	3	17	2019	1.75
MIHARDJO LWW	3	85	2019	1

Source: Biblioshiny

Most Relevant Affiliations

Figure 5 presents the top institutions in the stated domain in terms of their publications. Bina Nusantara University from Indonesia stands out as the most influential, with 15 publications. Likewise, Griffith University and RMIT University from Australia emerge as pivotal contributors with 14 and 10 publications respectively. The researchers at Huazhong University of Science and Technology in China have bagged 9 documents. The remaining institutions also substantially contributed by producing six or more documents each. A notable presence from both developing and developed economies indicates the global scope of research endeavors in enhancing CX in the era of Industry 4.0.

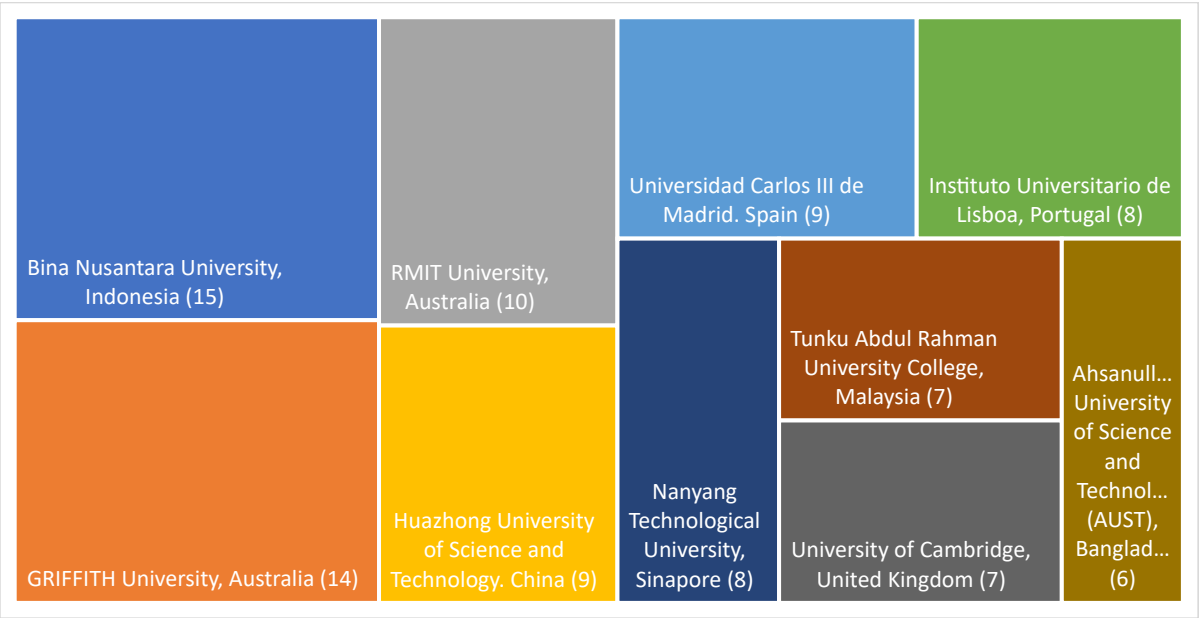

Figure 5. Most Relevant Affiliations
Source: Authors' elaboration

Most Prominent Sources

Table 4 highlights the leading journals in the field of integration of CX and Industry 4.0 as per their publication output, citation impact, and scholarly influence. Out of 293 sources, 18 met the threshold of four documents per source. As evident, "Journal of Retailing and Consumer Services" by Elsevier attracted the highest citation of 1871 with 13 publications and is indexed in "Scopus" along with ranking A in the Australian Business Deans Council (ABDC) journal category. Following the "Journal of Business Research" from Elsevier with a citation score of 440 and 8 documents, listed in Scopus. These journals serve as crucial platforms for disseminating research and knowledge in the domain of harnessing technology to excel CX.

Table 4. Top Ten Sources

Source Title	Publisher	No. of Publications	Total Citations	h_index	g_index	PY_start
Journal of Retailing and Consumer Services	Elsevier	13	630	9	13	2019
Psychology and Marketing	Wiley	10	157	4	10	2021
IEEE Access	IEEE	9	150	5	9	2017
Journal of Business Research	Elsevier	8	440	8	8	2020
Technological Forecasting and Social Change	Elsevier	7	224	5	7	2018
Sustainability (Switzerland)	MDPI	7	102	3	7	2018
Journal of Service Management	Emerald Publishing	6	140	4	6	2019
Frontiers in Psychology	Frontiers Media	5	29	4	5	2021
International Journal of Intelligent Systems and Applications in Engineering	Elsevier	5	13	2	3	2023
International Journal of Contemporary Hospitality Management	Emerald Publishing	4	185	4	4	2019

Most Influential Countries

The research on the transformative role of IR 4.0 on CX has a global reach, given that the 466 documents originate from 79 countries. Out of which, 17 met the threshold of 10 documents per country. **Table 6** depicts the ten most relevant countries, revealing the United States and the United Kingdom lead with citation counts of 4242 and 3207.

Table 6. Ten Most Prominent Countries

Country	Economy Type	Documents	Citations	Citations/Documents
India	Developing	91	1215	13.35
United States	Developed	84	4242	50.5
China	Developing	57	1084	19.02
United Kingdom	Developed	46	3307	71.89
Australia	Developed	32	1389	43.41
Taiwan	Developing	23	883	38.39
South Korea	Developed	23	472	20.52
Germany	Developed	18	2386	132.56
France	Developed	18	601	33.39
Spain	Developed	18	433	24.06

Germany stands out for its remarkable citations per document ratio of 132.56, indicating its robust contribution followed by the United Kingdom and the United States with 71.89 and 50.5 scores respectively. India, the United States and China demonstrate considerable publication volumes of 91, 84 and 57 documents, underscoring the prominence of developing countries that can be attributed to rapid technological adoption, and government measures in these countries are likely driving a surge in publications. However, a lower citations per document ratio in these countries reflects they might still be in the early phases of research, focusing more on foundational concepts than groundbreaking findings. Limited research collaboration could further restrict the exposure of their work, highlighting a potential gap in research visibility. Though good publication volume is commendable, other aspects such as publishing in high-quality journals and encouraging international collaboration could considerably improve citations and the overall impact of the research.

Co-Authorship of Countries

To enhance country-level productivity insights, the authors' collaborative endeavors were examined using co-authorship analysis, representing geographic collaborations and spatial distribution (Perianes-Rodriguez et al., 2016). Co-authorship analysis reveals collaborative dynamics and intellectual links between authors from different nations and organizations within a particular field of research (Cisneros et al., 2018). The lines joining points on the map signify co-authorship between countries, while proximity between clusters indicates the strength of their collaborative relationships. A minimum of 5 publications and 30 citations resulted in the inclusion of 31 out of the 79 countries. As depicted in **Figure 6**, the analysis delineated three main clusters with distinct colors. The red cluster encompasses 12 countries and is led by the United Kingdom, boasting 46 publications, 3307 citations, and a total link strength of 44 which has robust international collaborations with Germany, France, Italy, Spain, Netherlands, Brazil, and Portugal with 19 links in total. This cluster delved into the influence of AI-powered technologies on CX within the realm of emerging tech like chatbots and the metaverse. Furthermore, the UK demonstrates significant connections with India, the US, China, and Australia across clusters. The green cluster consists of 11 nations, headed by the United States bagged the highest citation count of 4242, with 84 publications and 51 total link strength in number followed by China. Within the cluster, the US has collaborated with Australia, China, Singapore, Indonesia, Taiwan and South Africa. These countries focused on addressing consumer resilience, operational difficulties, and potential disruptions that businesses are facing as they embrace Industry 4.0 technologies across a range of industries, including banking, transportation, and telecommunications. Finally, the blue cluster includes 8 countries spearheaded by India which has the maximum number of publications (91) in the domain with 1215 citations and 29 link strength in total. Most of India's research alliances primarily extend to Middle Eastern nations including Saudi Arabia, Jordan, and the United Arab Emirates, working on the nexus of cutting-edge technologies like blockchain, AI, and big data with e-commerce, aiming to improve user experience, sustainability, brand engagement, and innovation. In terms of temporal relevance **(Figure 7**), notably, the co-authorships are quite recent with Vietnam leading with an average publication year of 2022.92. Following closely behind is Thailand with 2022.83, followed by Portugal at 2022.78, Romania at 2022.75, and 2022.67 for the USA.

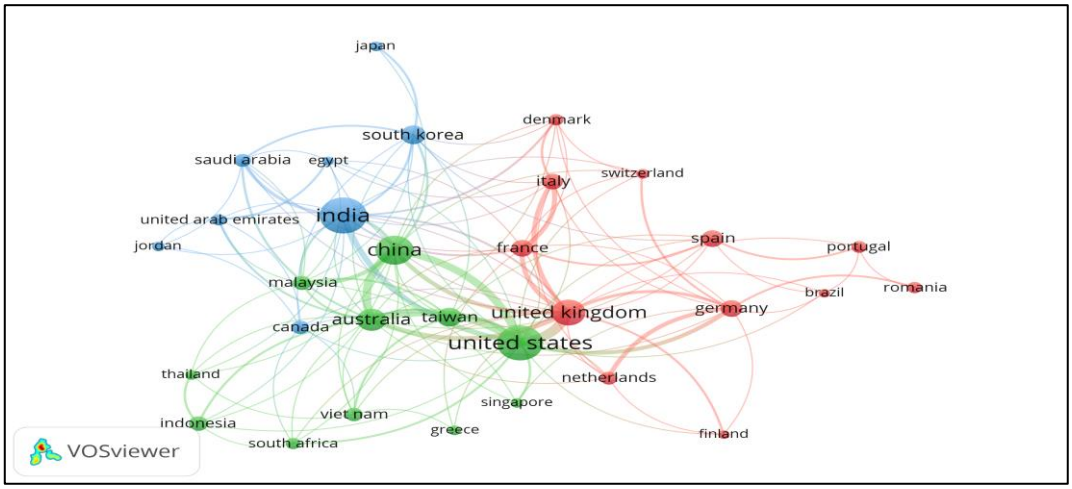

Figure 6. Co-Authorship Network of Countries

Source: Vosviewer

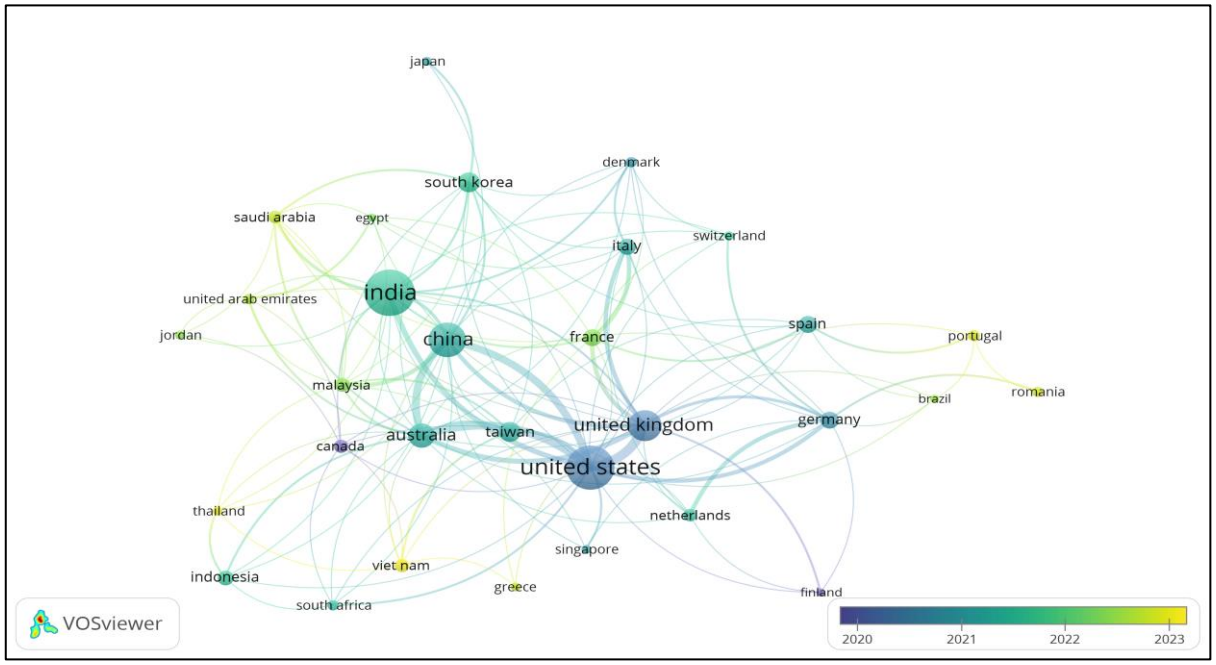

Figure 7. Co-Authorship of Countries (Year wise)
Source: Vosviewer

Co-Citation of cited References

Co-citation analysis unveils inter-relationships and thematic clusters among referenced documents to explore a field's intellectual landscape and emerging themes (Rossetto et al., 2018). It aids in identifying influential original documents and academic foundations (Donthu et al., 2021). Out of 26,275 cited references, 51 met the criterion of co-cited references with a minimum of six citations each. Co-citations are indicated by the connecting lines linking different nodes as shown in **Figure 8**. According to Leung et al. (2017), the size of the bubbles indicates garnered citations and the thickness of the connecting lines indicates the intensity of the co-citation linkages between them. In addition, the color of the bubbles indicates the cluster to which a document falls.

The Red cluster focused on "Holistic Customer Experience Management for Sustainable Growth" which delved into different facets of creating and delivering positive experiences for customers at every stage of their purchase journey. As noted by Lemon and Verhoef (2016), business functions should be connected, and even external actors – for favorable customer experiences. Subsequently, branding experience, social environment and technology have an impact on customer satisfaction and technology (Brakus et al., 2009; Verhoef et al., 2009; Foroudi et al., 2018). Experiential marketing influences consumers' behavior and it is imperative that marketers understand how these users interface with the smart technology (Foroudi et al., 2018). In other words, this cluster emphasizes the need to understand the subtleties of CXM in the context of digital transformation and the importance of using overarching tactics for all CX points to enhance customer loyalty and ultimately drive sustainable business development.

The Blue cluster has clubbed the documents published in the area of "Service Delivery 4.0: AI, Robots & AR/VR" addressed the growing impact of AI-powered technologies, including robots, augmented reality (AR), virtual reality (VR), and chatbots on service delivery, presenting opportunities and challenges. According to the theory of AI job replacement, AI would automate tasks starting with requiring mechanical intelligence to more advanced analytical tasks, and eventually entry of robots in service-related roles (Huang and Rust, 2018). These changes have raised ethical concerns at the individual, market, and societal levels and can trigger discomfort and compensatory behaviors in consumers such as a desire for social connection or increased spending (Wirtz et al., 2018; Mende et al., 2019). Additionally, technologies like AR/VR transforming the CX by providing immersive and interactive ways of interacting across the entire shopping journey (Hoyer et al., 2020). This cluster revolves around the disruptive potential of AI in reshaping workforce dynamics, consumer behavior, and service delivery apart from creating opportunities for innovation.

The Green cluster dealt with the "Multifaced impact of Artificial Intelligence on Marketing" which explored how AI is transforming marketing tactics, interactions with brands, and customer behaviors. Although AI chatbots enhance personalization and convenience, customer perception and trust mediate their impact on CX (Luo et al., 2019; Ameen et al., 2021), with the significance of social influence, enjoyment, customer perception regarding chatbot identity disclosure, and anthropomorphism (human-like) apart from ease of use emphasizes the need for strategic implementation. In general, this cluster underscored the capabilities of AI in enhancing CX, stressing the necessity of balancing the technical aspects of AI technologies with user acceptance, perception, and trust.

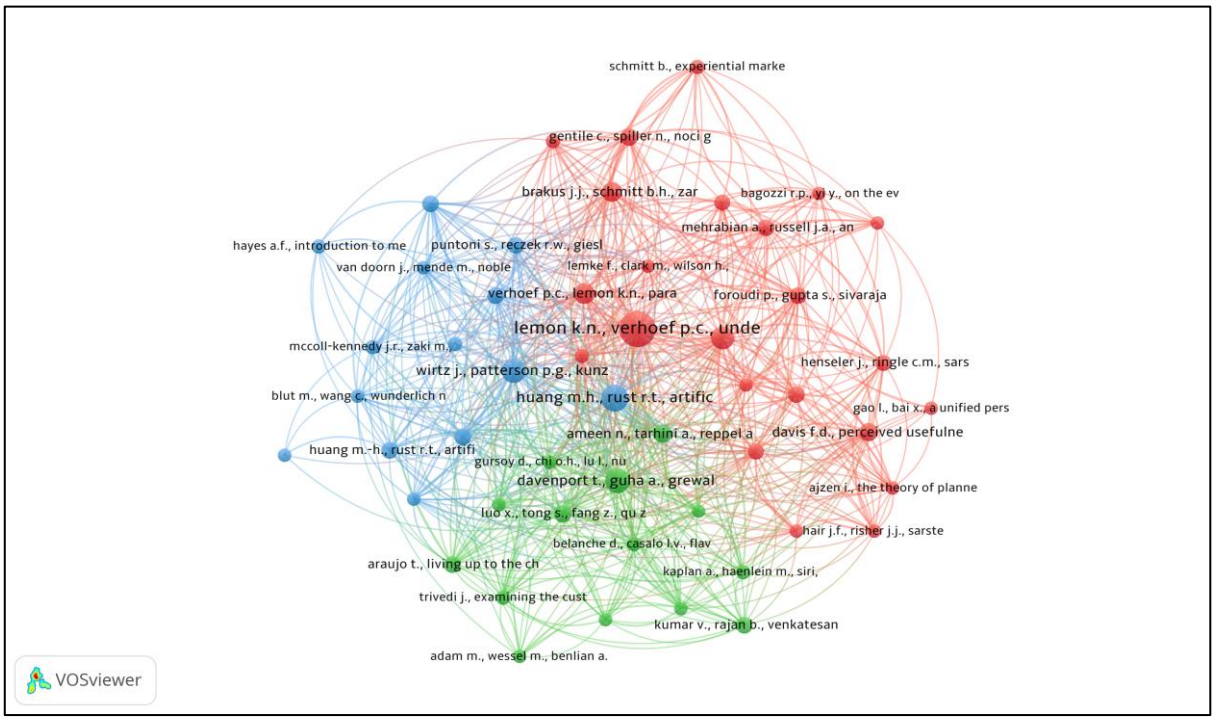

Figure 8. Co-Citation of Cited References

Source: Vosviewer

Table 7 provides a thorough overview of the understanding of co-citation of cited references by identifying impactful papers under each theme, sources in which they were published, the number of links and their link strength in total.

Table 7. Documents with Maximum Links

Cluster	Theme	Document	Title	Source	Total Links	Total Link Strength
Red	"Holistic Customer Experience Management (CXM) for Sustainable Growth"	Lemon and Verhoef (2016)	"Understanding Customer Experience Throughout the Customer Journey"	Journal of Marketing	45	153
		Verhoef et al. 2009	"Customer Experience Creation: Determinants, Dynamics and Management Strategies"	Journal of Retailing	37	74
		Brakus et al. 2009	"Customer Experience Creation: Determinants, Dynamics and Management Strategies"	Journal of Marketing	30	66

Green	"Multifaced impact of Artificial Intelligence in Marketing"	Davenport et al. (2020)	"How Artificial Intelligence Will Change the Future of Marketing"	Journal of the Academy of Marketing Science	40	91
		Luo et al. (2019)	"Frontiers: Machines vs. Humans: The Impact of Artificial Intelligence Chatbot Disclosure on Customer Purchases"	Marketing Science	35	53
		Ameen et al. (2021)	"Customer experiences in the age of artificial intelligence"	Computers in Human Behavior	31	49
Blue	"Service Delivery 4.0: AI, Robots & AR/VR"	Huang and Rust (2018)	"Artificial intelligence in service"	Journal of Service Research	43	97
		Wirtz et al. (2018)	"Brave new world: service robots in the frontline"	Journal of Service Management	32	65
		Mende et al. (2019)	"Service robots rising: How humanoid robots influence service experiences and elicit compensatory consumer responses"	Journal of Marketing Research	27	54

Co-Occurrence of Keyword Analysis

Co-word analysis examines how often keywords appear together in scholarly articles within a research domain and offers valuable insights into research trends (Whittaker, 1989). This study has utilized the VOSviewer to construct visual network maps illustrating the co-occurrence of keywords to unveil emerging themes pertinent to the transformation of CX facilitated by Industry 4.0. With a minimum threshold set at 6 occurrences out of a total of 2,799 keywords, 84 keywords met this criterion, underscoring significant associations within the domain. **Table 8** depicts that Artificial intelligence is the most prominent keyword with 159 occurrences and a total of 421 links Strength, followed by Customer Experience with an occurrence of 123 times having 329 links strength in total. **Figure 9** represents the visualization of the co-word network, depicting the emergence of four distinct clusters represented by four different colors. **Table 9** provides an overview of thematic clusters and associated papers, shedding light on the convergence of contemporary technologies and consumer experiences.

Table 8. Keyword Analysis

Keyword	**Occurrences**	**Total Links**	**Total Link Strength**	**Cluster**
Artificial Intelligence	159	78	421	Green
Customer Experience	123	76	329	Green
Internet of Things	60	59	166	Red
Sales	57	75	236	Red
Machine Learning	37	53	129	Yellow
Big Data	35	52	135	Red
Digital Transformation	22	24	39	Red

Blockchain	21	30	64	Red
Chatbots	21	33	61	Blue
Marketing	21	36	64	Blue

Source: Author's Elaboration

Thematic Analysis

Cluster 1 (Red) is the largest within the network comprising 40 items with prominent keywords including internet of things, cloud computing, commerce, big data, iot, industry 4.0, blockchain, decision making, customer engagement, sustainability, and sustainable development. The prime focus of this cluster revolves around "Sustainable Customer Engagement with Industry 4.0". For example, Mihardjo et al. (2020) studied how the supply chain integration of Industry 4.0 technologies helps firms to clearly improve customer value by proposing a co-creation model. Silva et al. (2020) discussed the increased application of big data in fashion retail, which focuses on the opportunity to transform existing business models through enhanced performance, increased profitability, and customer satisfaction. Large amounts of data are created by IoT devices and can be utilized by organizations to enhance customers' experiences based on the Customer Service Life Cycle framework (Ives et al., 2021). In fact, Balaji and Roy (2017) also supported and proved the significance of IoT adoption in the retail context suggesting that factors like ease of use and aesthetic appeal influence customers' value co-creation, thereby affecting customers' intentions to further use IoT and engage in word-of-mouth promotion. This cluster is aimed at realizing strategic advantages for enterprises and customers, raising customer value, and achieving sustainable growth and profitability in different industries based on breakthrough technologies.

Cluster 2 (Green) consists of 17 items with keywords such as AI, artificial intelligence, anthropomorphism, quality of service chatbot, consumption behavior, customer experience, customer service, perception, service quality and trust. The central theme emerging from this cluster is "Redefining Service and Building Trust with AI". Aw et al. (2022) investigated the impact of various attributes of digital voice assistants (DVA) on user interactions and perceptions, suggesting that human-like and strong functionalities (performance, security) of DVAs foster positive user perceptions and continued use for an AI-powered shopping experience. Manser et al. (2021) explored the effects of AI integration into mobile banking on both the value creation and customer ease, especially the shift towards transactional or cognitive value over hedonic value. Przegalinska et al. (2019) assessed the attachment and effectiveness of the chatbot, particularly focusing on trust and social presence in human–bot interactions to build efficient socially aware chatbots for commercial purposes. The primary theme of the cluster is on the adaptability of AI and its impact on customer interactions in different domains with emphasis placed on aspects of trust for effective adoption.

Table 9: Thematic Clusters

Theme	Document	Title	Source	Total Citations
"Sustainable Customer Engagement with Industry 4.0"	Nguyen et al. (2021)	"Determinants of continuance intention towards banks' chatbot services in vietnam: A necessity for sustainable development"	Sustainability (Switzerland)	72
	Silva et al. (2020)	"Big Data in fashion: transforming the retail sector"	Journal of Business Strategy	36
	Ives et al. (2016)	"Enhancing customer service through the internet of things and digital data streams"	MIS Quarterly Executive	42
	Balaji and Roy (2017)		Journal of Marketing Management	209

		"Value co-creation with Internet of things technology in the retail industry"		
"Redefining Service and Building Trust with AI"	Aw et al. (2022) Manser et al. (2021) Przegalinska et al. (2019)	"Alexa, what's on my shopping list? Transforming customer experience with digital voice assistants" "Enhancing the value co-creation process: artificial intelligence and mobile banking service platforms" "In bot we trust: A new methodology of chatbot performance measures"	Technological Forecasting and Social Change Journal of Research in Interactive Marketing Business Horizons	69 110 160
"Personalized Marketing in the Digital Age"	Galletta et al. (2017) Van and Stewart (2021) Lo and Campos (2018)	"A Cloud-Based System for Improving Retention Marketing Loyalty Programs in Industry 4.0: A Study on Big Data Storage Implications" "Artificial Intelligence (AI): Revolutionizing Digital Marketing" "Blending Internet-of-Things (IoT) solutions into relationship marketing strategies"	IEEE Access Australasian Marketing Journal Technological Forecasting and Social Change	31 37 72
"Elevating Customer Journey with AR & VR Experiences"	Zarantonello and Schmitt (2023) Joy et al. (2022) van Esch et al. (2019)	"Experiential AR/VR: a consumer and service framework and research agenda" "Digital future of luxury brands: Metaverse, digital fashion, and non-fungible tokens" "Anthropomorphism and augmented reality in the retail environment"	Journal of Service Management Strategic Change Journal of Retailing and Consumer Services	31 90 108

Cluster 3 (Blue) includes 14 items having keywords like digital marketing, marketing, personalization, retail, social media, technology adoption, and technology acceptance, chatbots, chatgpt, consumer experience. The major theme that emerges from this cluster is "Personalized Marketing in the Digital Age". As facilitated by Industry 4.0, cloud computing and social media are transforming production cycles and analyzing vast customer data for personalized product recommendations to

foster inclusive CX (Galletta et al. 2018). AI-enabled digital marketing has the potential to revolutionize social media marketing, content creation, lead generation, and customer experience management (CXM) (van and Stewart, 2021). The IoT also has the capability to comprehend consumer behavior and shape targeted strategies by enabling devices to collect and exchange data, thus enabling firms to respond to the market efficiently for sustained competitiveness (Lo and Campos, 2018). This cluster primarily focuses on converging advanced technologies to tailor marketing tactics and enhance CX in the modern digital era.

Cluster 4 (Yellow) comprises 13 items with major keywords including deep learning, machine learning, natural language processing, user experience, augmented reality, consumer behavior, customer journey, data mining, and virtual reality (VR). The key idea behind this cluster is "Elevating Customer Journey with AR & VR Experiences". Augmented Reality (AR) infused with anthropomorphism (human characteristics to non-human entities) with human-like characteristics enhances CX in retail with positive brand perception and stronger customer relationships (Van Esch et al., 2019). Moreover, emerging technologies like machine learning (ML), blockchain, metaverse or VR in luxury fashion facilitate the emergence of digital fashion of virtual clothing, particularly among youngsters, urging the industry to strategize for this blended reality (Joy et al., 2022). AR and VR technologies are the most promising tools in the service industry for enabling experiential consumption and immersive CX (Zarantonello and Schmitt (2022). This cluster is centered around elevating the CX across the entire customer journey through immersive AR and VR experiences.

Figure 10 presents the temporal thematic evolution of keywords with the visualized co-occurrence network to identify emerging topics in the domain of Industry 4.0 and CX. Interestingly, some of the most recent keywords including ChatGPT, technology adoption, and blockchain have average publication years of 2023.57, 2023.33, and 2023.11, respectively, underscores the field is moving towards exploring how AI chatbots, secure transactions (blockchain), and widespread Industry 4.0 adoption can enhance customer interactions and trust.

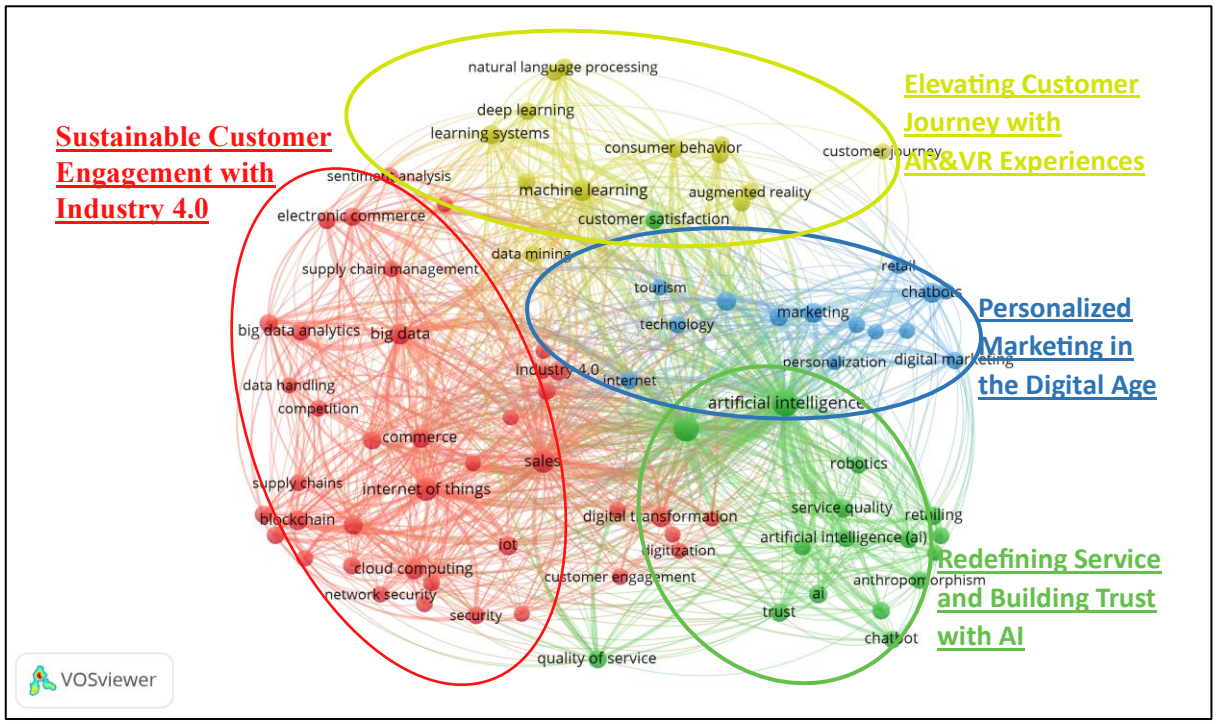

Figure 9. Analysis of Co-Occurrence of Keywords
Source: Vosviewer

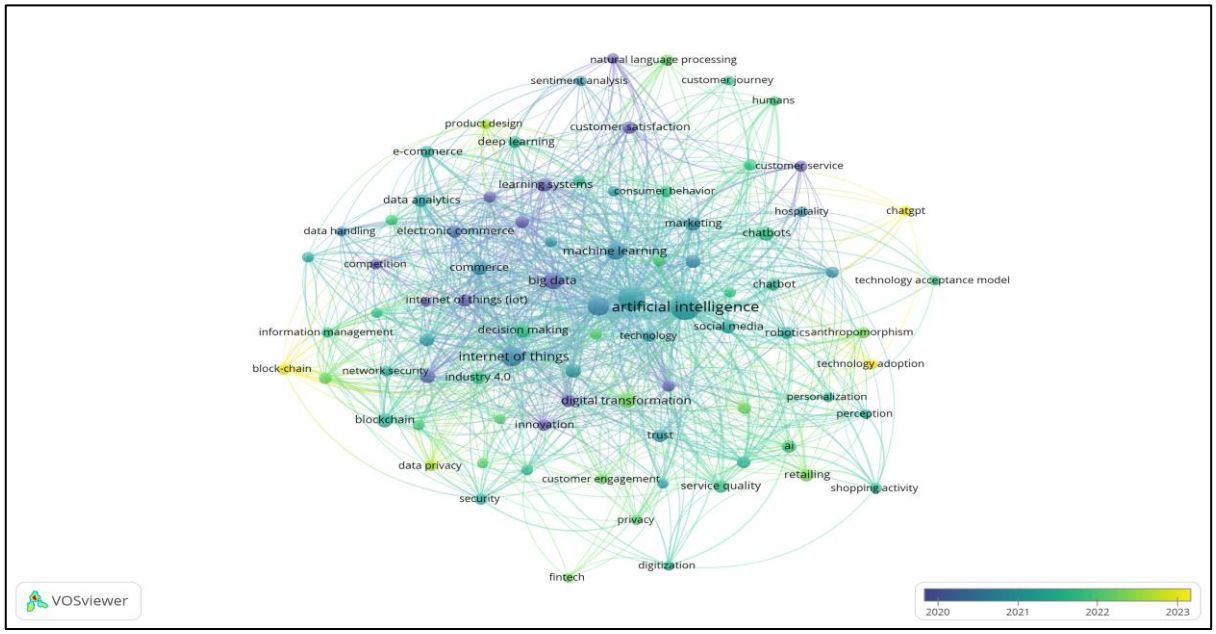

Figure 10. Temporal Evolution of Co-Occurrence of Keywords (Year Wise)

5. Discussion and Conclusion

The current study focused on exploring CX in the context of IR 4.0, as understanding CX dynamics is critical in today's scenario, characterized by the integration of digital technology into industrial processes and evolving customer interaction dramatically. The Scopus database retrieved 466 documents which were analyzed using VOSviewer and biblioshiny software to unveil publication trends, prominent authorship, county of origin, most relevant affiliations, publishing source, and emerging themes. The findings revealed a consistently growing publication pattern over the decade, indicating the growing interest of researchers in this field. More than seventy-five countries have contributed to this domain representing global prominence. India, the US, China, and the UK emerged as leading nations in terms of publications. The co-word analysis unraveled four thematic clusters, “Sustainable Customer Engagement with Industry 4.0”, “Redefining Service and Building Trust with AI”, “Personalized Marketing in the Digital Age” and “Elevating Customer Journey with AR & VR Experiences”. Bina Nusantara University from Indonesia followed by Griffith University in Australia were prominent institutions contributing to this field. The Journal of Retailing and Consumer Services published by Elsevier followed by Psychology and Marketing by Wiley have diffused maximum publications. Novak TP and Prentice C garnered the highest citations, focusing on CX and consumer-object relationships, primarily in the context of the IoT. Warner and Wagers (2019) followed by Gomber et al. (2018) were the two most significant publications. The study further uncovered three key research clusters through references’ co-citation analysis, underscoring the growing significance of ethical considerations in this field. As advanced technologies are becoming integral to CX strategies, concerns about data privacy, biased algorithms, and digital monitoring have garnered significant traction. To the best of the author's knowledge, this study is a pioneering attempt to integrate the technologies of the fourth industrial revolution within the realm of CX to provide a holistic and panoramic view of this interdisciplinary field. From a theoretical standpoint, this study advances comprehension of the interplay between cutting-edge technologies and CX, uncovering clusters from various domains like innovation, ethics, consumer engagement, marketing, sustainability, firm-customer relationships, and effective service delivery indicating a shift from micro-level interactions to the broader one. Empirical testing of theories across diverse contexts is encouraged to strengthen and refine our understanding of this rapidly evolving field. On a managerial level, findings inform the strategic adoption of technology, driving innovation by pinpointing pivotal themes, challenges, and opportunities, and identifying crucial areas for businesses such as human-like characteristics and perceived trust. The study also offers social implications encompassing shifts in societal norms, altering employment patterns and workforce dynamics. Moreover, comprehending consumer willingness to embrace new technologies can provide insights into societal readiness and attitudes toward innovation, shaping social dynamics and perspectives on technological progress.

6. Limitations and Directions for Future Research

First and foremost, the study focuses on the Scopus database only as the source of information, which is further filtered by articles published in the English language only limits the generalizability of the findings. This methodology inherently restricts the inclusion of all sorts of important publications including conference papers, book chapters, and editorials and documents published in other languages apart from English. Therefore, this could limit the scope as well as the depth of observations elicited from the study. In order to overcome such limitations, future research should engage a more diversified approach by using more than one database. Such a synergized path of theoretical and bibliometric methods would help enrich the general literature and would contribute to offering a broad perspective on the presented subject area.

Furthermore, specific research areas of Industry 4.0 on the changing customer experience (CX) need further investigation. As such, there is a substantial knowledge gap in the literature concerning the application of contemporary concepts like Augmented Reality (AR), Virtual Reality (VR), and the Metaverse and their impact on customer experience. According to Ameen et al. (2021), such interfaces need to be investigated, because these evolving technological touchpoints can profoundly redefine consumer-to-business relationships.

Moreover, the findings identified a disparity in the distribution of research between the social sciences on the one hand and computer science and engineering on the other. The social aspects and consequences of customers' engagement with Industry 4.0 technologies and the motivation behind and patterns of such interactions are not fully researched. Closing this gap is essential for achieving a more complete understanding of how this technological change affects consumers' behavior and social values by exploring the social consequences, driving forces, and behavioral patterns underlying customer interactions with Industry 4.0 technologies.

Furthermore, as Industry 4.0 advances, it is highly essential to respond to ethical questions associated with the protection of data. However, there is a lack of focus on these ethical factors which might yield adverse outcomes that could negatively affect customer trust and satisfaction (Lo and Campos 2018). Consequently, subsequent research must adhere to these ethical issues to ensure that the impact of Industry 4.0 on CX is both responsible and constructive.

References

1. Agarwal, P., Swami, S., & Malhotra, S. K. (2024). Artificial intelligence adoption in the post COVID-19 new-normal and Role of Smart Technologies in Transforming Business: A review. *Journal of Science and Technology Policy Management*, *15*(3), 506–529.
2. Akter, S., Michael, K., Uddin, M. R., McCarthy, G., & Rahman, M. (2020). Transforming business using digital innovations: the application of AI, blockchain, cloud and data analytics. *Annals of Operation Research/Annals of Operations Research*, *308*(1–2), 7–39. https://doi.org/10.1007/s10479-020-03620-w
3. Ameen, N., Tarhini, A., Reppel, A., & Anand, A. (2021). Customer experiences in the age of artificial intelligence. *Computers in Human Behavior*, *114*, 106548. https://doi.org/10.1016/j.chb.2020.106548
4. Aw, E. C., Tan, G. W., Cham, T., Raman, R., & Ooi, K. (2022). Alexa, what's on my shopping list? Transforming customer experience with digital voice assistants. *Technological Forecasting & Social Change/Technological Forecasting and Social Change*, *180*, 121711. https://doi.org/10.1016/j.techfore.2022.121711
5. Balaji, M. S., & Roy, S. K. (2016). Value co-creation with Internet of things technology in the retail industry. *MM. Journal Of Marketing Management/Journal Of Marketing Management*, *33*(1–2), 7–31. https://doi.org/10.1080/0267257x.2016.1217914
6. Banerji, D., Rashideh, W., Arora, B., & Pratihari, A. R. (2021). Application potential of blockchain technologies in the travel and tourism industry. In EAI/Springer Innovations in Communication and Computing (pp. 289–299). https://doi.org/10.1007/978-3-030-65691-1_19
7. Bashar, A., Singh, S., & Pathak, V. K. (2022). A bibliometric review of online impulse buying behaviour. *International Journal of Electronic Business*, *17*(2), 162. https://doi.org/10.1504/ijeb.2022.121963
8. Bhardwaj, A., Mangat, V., Vig, R., Halder, S., & Conti, M. (2021). Distributed denial of service attacks in cloud: State-of-the-art of scientific and commercial solutions. *Computer Science Review*, *39*, 100332. https://doi.org/10.1016/j.cosrev.2020.100332
9. Brakus, J. J., Schmitt, B. H., & Zarantonello, L. (2009). Brand Experience: What is It? How is it Measured? Does it Affect Loyalty? *Journal of Marketing*, *73*(3), 52–68. https://doi.org/10.1509/jmkg.73.3.052

10. Buhalis, D., & Sinarta, Y. (2019). Real-time co-creation and nowness service: lessons from tourism and hospitality. *Journal of Travel & Tourism Marketing*, *36*(5), 563–582. https://doi.org/10.1080/10548408.2019.1592059
11. Davenport, T., Guha, A., Grewal, D., & Bressgott, T. (2019). How artificial intelligence will change the future of marketing. Journal of the Academy of Marketing Science, 48(1), 24–42. https://doi.org/10.1007/s11747-019-00696-0
12. Dimitrov, D. V. (2016). Medical internet of things and big data in healthcare. *Healthcare Informatics Research*, *22*(3), 156. https://doi.org/10.4258/hir.2016.22.3.156
13. 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. https://doi.org/10.1016/j.jbusres.2021.04.070
14. Dunakhe, K., & Panse, C. (2021). Impact of digital marketing – a bibliometric review. *International Journal of Innovation Science*, *14*(3/4), 506–518. https://doi.org/10.1108/ijis-11-2020-0263
15. Emodi, N. V., Akuru, U. B., Dioha, M. O., Adoba, P., Kuhudzai, R. J., & Bamisile, O. (2023). The role of internet of things on electric vehicle charging infrastructure and consumer experience. *Energies*, *16*(10), 4248. https://doi.org/10.3390/en16104248
16. Foroudi, P., Gupta, S., Sivarajah, U., & Broderick, A. (2018). Investigating the effects of smart technology on customer dynamics and customer experience. *Computers in Human Behavior*, *80*, 271–282. https://doi.org/10.1016/j.chb.2017.11.014
17. Galletta, A., Carnevale, L., Celesti, A., Fazio, M., & Villari, M. (2018). A Cloud-Based System for Improving Retention Marketing Loyalty Programs in Industry 4.0: A study on Big data Storage Implications. *IEEE Access*, *6*, 5485–5492. https://doi.org/10.1109/access.2017.2776400
18. Goi, V., Ahieieva, I., Mamonov, K., Pavliuk, S., & Dligach, A. (2023). The Impact of Digital Technologies on the Companies' Strategic Management. *Indianjournals*, 1291–1299.
19. Gomber, P., Kauffman, R. J., Parker, C., & Weber, B. W. (2018). On the Fintech Revolution: Interpreting the Forces of Innovation, Disruption, and Transformation in Financial Services. *Journal of Management Information Systems*, *35*(1), 220–265. https://doi.org/10.1080/07421222.2018.1440766
20. Gültaş, P. (2023). STRATEGIC INSIGHTS: NAVIGATING DIGITAL TRANSFORMATION AND CUSTOMER-CENTRICITY FOR ENHANCED BUSINESS SUCCESS. *Intraders International Trade Academic Journal*. https://doi.org/10.55065/intraders.1393775
21. Gursoy, D., Chi, O. H., Lu, L., & Nunkoo, R. (2019). Consumers acceptance of artificially intelligent (AI) device use in service delivery. *International Journal of Information Management*, *49*, 157–169. https://doi.org/10.1016/j.ijinfomgt.2019.03.008
22. Haleem, A., Javaid, M., Qadri, M. A., Singh, R. P., & Suman, R. (2022). Artificial intelligence (AI) applications for marketing: A literature-based study. *International Journal of Intelligent Networks*, *3*, 119–132. https://doi.org/10.1016/j.ijin.2022.08.005
23. Hallioui, A., Herrou, B., Santos, R. S., Katina, P. F., & Egbue, O. (2022). Systems-based approach to contemporary business management: An enabler of business sustainability in a context of industry 4.0, circular economy, competitiveness and diverse stakeholders. *Journal of Cleaner Production*, *373*, 133819. https://doi.org/10.1016/j.jclepro.2022.133819
24. Hayat, A., Shahare, V., Sharma, A. K., & Arora, N. (2023). Introduction to industry 4.0. *Blockchain and Its Applications in Industry 4.0*, 29–59.
25. Hoffman, D. L., & Novak, T. P. (2017b). Consumer and object experience in the Internet of Things: An Assemblage Theory approach. *˜the œJournal of Consumer Research/Journal of Consumer Research*, *44*(6), 1178–1204. https://doi.org/10.1093/jcr/ucx105
26. Hoyer, W. D., Kroschke, M., Schmitt, B., Kraume, K., & Shankar, V. (2020). Transforming the customer experience through new technologies. *Journal of Interactive Marketing*, *51*, 57–71. https://doi.org/10.1016/j.intmar.2020.04.001
27. Huang, M., & Rust, R. T. (2018). Artificial intelligence in service. *Journal of Service Research*, *21*(2), 155–172. https://doi.org/10.1177/1094670517752459
28. Ives, B., Palese, B., & Rodriguez, J. A. (2016). Enhancing Customer Service through the Internet of Things and Digital Data Streams. *MIS Quarterly Executive*, *15*(4), 5. Retrieved from http://dblp.uni-trier.de/db/journals/misqe/misqe15.html#IvesPR16

29. Joy, A., Zhu, Y., Peña, C., & Brouard, M. (2022). Digital future of luxury brands: Metaverse, digital fashion, and non-fungible tokens. *Strategic Change*, *31*(3), 337–343. https://doi.org/10.1002/jsc.2502
30. Kashyap, Dr. A. K., Sahu, I., & Kumar, Dr. A. (2022). Artificial Intelligence and Its Applications in E-Commerce–a Review Analysis and Research Agenda. *Journal of Theoretical and Applied Information Technology*, *100*(24), 7347–7365.
31. Kim, M. (2023). Connecting artificial intelligence to value creation in services: mechanism and implications. *Service Business*, *17*(4), 851–878. https://doi.org/10.1007/s11628-023-00547-7
32. Kishen, R., Upadhyay, S., Jaimon, F., Suresh, S., NelliKozlova, Bozhuk, S., Mottaeva, A. B., & Barykin, S. Y. (2021). Prospects for artificial intelligence implementation to design personalized customer engagement strategies. Journal of Legal Ethical and Regulatory Issues, 24. https://www.abacademies.org/articles/prospects-for-artificial-intelligence-implementation-to-design-personalized-customer-engagement-strategies.pdf
33. Lau, A. Y. S., & Staccini, P. (2019). Artificial intelligence in health: new opportunities, challenges, and practical implications. *Yearbook of Medical Informatics*, *28*(01), 174–178. https://doi.org/10.1055/s-0039-1677935
34. Lee, H., & Leonas, K. (2018). Consumer experiences, the key to survive in an omni-channel environment: use of virtual technology. *Journal of Textile and Apparel Technology and Management*, *10*(3). Retrieved from https://ojs.cnr.ncsu.edu/index.php/JTATM/article/download/13353/5997
35. Lemon, K. N., & Verhoef, P. C. (2016). Understanding customer experience throughout the customer journey. *Journal of Marketing*, *80*(6), 69–96. https://doi.org/10.1509/jm.15.0420
36. Li, H., Zhang, L., & Hsu, C. H. (2023). Research on user-generated photos in tourism and hospitality: A systematic review and way forward. *Tourism Management*, *96*, 104714. https://doi.org/10.1016/j.tourman.2022.104714
37. Lo, F., & Campos, N. (2018). Blending Internet-of-Things (IoT) solutions into relationship marketing strategies. *Technological Forecasting & Social Change/Technological Forecasting and Social Change*, *137*, 10–18. https://doi.org/10.1016/j.techfore.2018.09.029
38. Lu, L., Cai, R., & Gursoy, D. (2019). Developing and validating a service robot integration willingness scale. *International Journal of Hospitality Management*, *80*, 36–51. https://doi.org/10.1016/j.ijhm.2019.01.005
39. Luo, X., Tong, S., Fang, Z., & Qu, Z. (2019). Frontiers: Machines vs. Humans: The Impact of Artificial Intelligence Chatbot Disclosure on Customer Purchases. *Marketing Science*. https://doi.org/10.1287/mksc.2019.1192
40. Manavalan, E., & Jayakrishna, K. (2020). A review of Internet of Things (IoT) embedded Sustainable Supply Chain for Industry 4.0 requirements. *Computers & Industrial Engineering*, *127*, 925–953.
41. MarinchaK, C. M., Forrest, E., & Hoanca, B. (2020). Artificial intelligence: Redefining marketing management and the customer experience. *International Journal of E-Entrepreneurship and Innovation (IJEEI)*, *8*(2), 14–24.
42. Mehmood, K., Verleye, K., De Keyser, A., & Larivière, B. (2022). Piloting personalization research through data-rich environments: a literature review and future research agenda. *Journal of Service Management*, *34*(3), 520–552. https://doi.org/10.1108/josm-10-2021-0405
43. Mende, M., Scott, M. L., Van Doorn, J., Grewal, D., & Shanks, I. (2019). Service Robots Rising: How humanoid robots influence service experiences and elicit compensatory consumer responses. *Journal of Marketing Research*, *56*(4), 535–556. https://doi.org/10.1177/0022243718822827
44. Mihardjo, L. W. W., Sasmoko, S., Alamsyah, F., & Elidjen, E. (2020). Maximising co-creation strategy through integration of distinctive capabilities and customer experiences in supply chain management. Uncertain Supply Chain Management, 187–196. https://doi.org/10.5267/j.uscm.2019.7.005
45. Mondal, S., Das, S., & Vrana, V. G. (2023). How to Bell the Cat? A Theoretical Review of Generative Artificial Intelligence towards Digital Disruption in All Walks of Life. *Technologies*, *11*(2), 44. https://doi.org/10.3390/technologies11020044
46. Murthy, C. V. N. U. B., Shri, M. L., Kadry, S., & Lim, S. (2020). Blockchain based cloud computing: architecture and research challenges. *IEEE Access*, *8*, 205190–205205. https://doi.org/10.1109/access.2020.3036812
47. Mustafa, E. (2022). Technology in Hotel Sector. *Technology Application in Aviation, Tourism and Hospitality: Recent Developments and Emerging Issues*, 73–87.
48. Necula, S., & Păvăloaia, V. (2023). AI-Driven Recommendations: A Systematic review of the state of the art in E-Commerce. *Applied Sciences*, *13*(9), 5531. https://doi.org/10.3390/app13095531
49. Ng, I. C., & Wakenshaw, S. Y. (2017). The Internet-of-Things: Review and research directions. *International Journal of Research in Marketing*, *34*(1), 3–21. https://doi.org/10.1016/j.ijresmar.2016.11.003

50. Nicolescu, L., & Tudorache, M. T. (2022). Human-Computer Interaction in Customer Service: The Experience with AI Chatbots—A Systematic Literature Review. *Electronics*, *11*(10), 1579. https://doi.org/10.3390/electronics11101579
51. Novak, T. P., & Hoffman, D. L. (2018). Relationship journeys in the internet of things: a new framework for understanding interactions between consumers and smart objects. *Journal of the Academy of Marketing Science*, *47*(2), 216–237. https://doi.org/10.1007/s11747-018-0608-3
52. Pandey, V. K., Srivastava, S., Dash, K. K., Singh, R., Mukarram, S. A., Kovács, B., & Harsányi, E. (2026). Machine Learning Algorithms and Fundamentals as Emerging safety Tools in Preservation of Fruits and vegetables: a review. *Processes*, *11*(6). https://doi.org/10.3390/pr11061720
53. Pattnaik, D., Hassan, M. K., Kumar, S., & Paul, J. (2020). Trade credit research before and after the global financial crisis of 2008 – A bibliometric overview. *Research in International Business and Finance*, *54*, 101287. https://doi.org/10.1016/j.ribaf.2020.101287
54. Payne, E. H. M., Peltier, J., & Barger, V. A. (2021). Enhancing the value co-creation process: artificial intelligence and mobile banking service platforms. *Journal of Research in Interactive Marketing*, *15*(1), 68–85. https://doi.org/10.1108/jrim-10-2020-0214
55. Peltier, J. W., Dahl, A. J., & Schibrowsky, J. A. (2023). Artificial intelligence in interactive marketing: a conceptual framework and research agenda. *Journal of Research in Interactive Marketing*, *18*(1), 54–90. https://doi.org/10.1108/jrim-01-2023-0030
56. Pencarelli, T. (2019). The digital revolution in the travel and tourism industry. *Information Technology & Tourism*, *22*(3), 455–476. https://doi.org/10.1007/s40558-019-00160-3
57. Perianes-Rodriguez, A., Waltman, L., & Van Eck, N. J. (2016). Constructing bibliometric networks: A comparison between full and fractional counting. *Journal of Informetrics*, *10*(4), 1178–1195. https://doi.org/10.1016/j.joi.2016.10.006
58. Przegalinska, A., Ciechanowski, L., Stroz, A., Gloor, P., & Mazurek, G. (2019). In bot we trust: A new methodology of chatbot performance measures. *Business Horizons*, *62*(6), 785–797. https://doi.org/10.1016/j.bushor.2019.08.005
59. Puntoni, S., Reczek, R. W., Giesler, M., & Botti, S. (2020). Consumers and Artificial intelligence: An Experiential perspective. *Journal of Marketing*, *85*(1), 131–151. https://doi.org/10.1177/0022242920953847
60. Quy, N. M., Ngoc, L. A., Ban, N. T., Van Hau, N., & Quy, V. K. (2023). Edge Computing for Real-Time Internet of Things Applications: Future Internet Revolution. *Wireless Personal Communications*, *132*(2), 1423–1452. https://doi.org/10.1007/s11277-023-10669-w
61. Rane, N. (2023). Enhancing Customer Loyalty through Artificial Intelligence (AI), Internet of Things (IoT), and Big Data Technologies: Improving Customer Satisfaction, Engagement, Relationship, and Experience. *Social Science Research Network*. https://doi.org/10.2139/ssrn.4616051
62. Reis-Marques, C., Figueiredo, R., & De Castro Neto, M. (2021). Applications of blockchain Technology to Higher Education Arena: A Bibliometric analysis. *European Journal of Investigation in Health, Psychology and Education/European Journal of Investigation in Health, Psychology and Education*, *11*(4), 1406–1421. https://doi.org/10.3390/ejihpe11040101
63. Roblek, V., Meško, M., & Krapež, A. (2016). A complex view of industry 4.0. *SAGE Open*, *6*(2), 215824401665398. https://doi.org/10.1177/2158244016653987
64. Robles, P., & Mallinson, D. J. (2023). Catching up with AI: Pushing toward a cohesive governance framework. *Politics & Policy*, *51*(3), 355–372. https://doi.org/10.1111/polp.12529
65. Saxena, S., Amritesh, A., Mishra, S. C., & Mukerji, B. (2023). A multi-method bibliometric review of value co-creation research. *Management Research Review*, *47*(2), 183–203. https://doi.org/10.1108/mrr-09-2022-0646
66. Schneider-Kamp, A. (2024). Can ethics be assembled? Consumer ethics in the age of artificial intelligence and smart objects. *Consumption, Markets and Culture/Consumption Markets & Culture*, 1–12. https://doi.org/10.1080/10253866.2024.2302598
67. Sharma, K., Dhir, S., & Ongsakul, V. (2022). Artificial intelligence and hospitality industry: systematic review using TCCM and bibliometric analysis. *Journal of International Business and Entrepreneurship Development*, *14*(1), 48. https://doi.org/10.1504/jibed.2022.124245
68. Shaw, C., & Ivens, J. (2002). Building great customer experiences. *Palgrave Macmillan UK eBooks*. https://doi.org/10.1057/9780230554719

69. Sheoran, S., & Vij, S. (2021). A Consumer-Centric Paradigm Shift in Business Environment with the Evolution of the Internet of Things: A Literature Review. *Vision*, *27*(4), 431–442. https://doi.org/10.1177/09722629211033944
70. Silva, E. S., Hassani, H., & Madsen, D. Ø. (2019). Big Data in fashion: transforming the retail sector. *Journal of Business Strategy/˜the œJournal of Business Strategy*, *41*(4), 21–27. https://doi.org/10.1108/jbs-04-2019-0062
71. Sindhu, P., & Bharti, K. (2020). Mapping customer experience: a taxonomical study using bibliometric visualization. *VINE Journal of Information and Knowledge Management Systems*, *51*(4), 592–617. https://doi.org/10.1108/vjikms-11-2019-0178
72. Singh, N., Panigrahi, P. K., Zhang, Z., & Jasimuddin, S. M. (2024). Cyber-physical systems: a bibliometric analysis of literature. Journal of Intelligent Manufacturing. https://doi.org/10.1007/s10845-024-02380-9 Van Eck, N. J., & Waltman, L. (2009). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, *84*(2), 523–538. https://doi.org/10.1007/s11192-009-0146-3
73. Van Esch, P., Arli, D., Gheshlaghi, M. H., Andonopoulos, V., Von Der Heidt, T., & Northey, G. (2019). Anthropomorphism and augmented reality in the retail environment. *Journal of Retailing and Consumer Services*, *49*, 35–42. https://doi.org/10.1016/j.jretconser.2019.03.002
74. Vergallo, R., & Mainetti, L. (2022). The role of technology in improving the customer experience in the banking sector: A Systematic Mapping study. *IEEE Access*, *10*, 118024–118042. https://doi.org/10.1109/access.2022.3218010
75. Verhoef, P. C., Lemon, K. N., Parasuraman, A., Roggeveen, A., Tsiros, M., & Schlesinger, L. A. (2009). Customer Experience Creation: determinants, dynamics and management strategies. *Journal of Retailing*, *85*(1), 31–41. https://doi.org/10.1016/j.jretai.2008.11.001
76. 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. https://doi.org/10.1016/j.lrp.2018.12.001
77. Whittaker, J. (1989). Creativity and Conformity in Science: Titles, Keywords and co-word analysis. *Social Studies of Science*, *19*(3), 473–496. https://doi.org/10.1177/030631289019003004
78. Wirtz, J., Patterson, P. G., Kunz, W. H., Gruber, T., Lu, V. N., Paluch, S., & Martins, A. (2018). Brave new world: service robots in the frontline. *Journal of Service Management*, *29*(5), 907–931. https://doi.org/10.1108/josm-04-2018-0119
79. Zarantonello, L., & Schmitt, B. H. (2022). Experiential AR/VR: a consumer and service framework and research agenda. *Journal of Service Management*, *34*(1), 34–55. https://doi.org/10.1108/josm-12-2021-0479