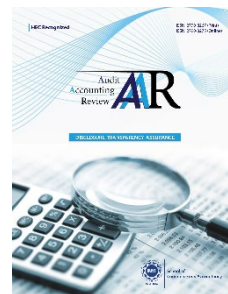
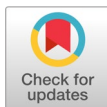


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- Author (s):** Hafiz Khurram Shahzad¹, Fouzia Hadi Ali¹, and Sabra Munir²
- Affiliation (s):** ¹University of the Punjab, Lahore, Pakistan
²PAC Group of Colleges, Lahore, Pakistan
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Do numbers speak? Bibliometric Analysis of AI Application and Corporate ESG Performance

Hafiz Khurram Shahzad^{1*}, Fouzia Hadi Ali¹, and Sabra Munir²

¹Hailey College of Commerce, University of the Punjab, Lahore, Pakistan

²PAC Group of Colleges, Lahore, Pakistan

Abstract

In current business landscape, strategic management confronts two forces, one is technological advancements and other is corporate Environmental, Social, and Governance (ESG) performance for competitive advantage in complex economic system. The current study aimed to observe Artificial Intelligence (AI) application and corporate ESG performance. Bibliometric analysis was performed using Scopus database, and 320 related documents were retrieved through advanced search. The study employed performance analysis, thematic analysis, and scientific mapping technique to achieve the mentioned goals. The results depicted a global collaboration in this field. International collaboration was evidenced from journals and authors' names with co-authorship among countries, including China, United Arab Emirates (UAE), India, France, Italy, United States of America (USA), Germany, Sweden, and Saudi Arabia. This shows that the topic is emerging and spreading over Asia, Middle East, and Europe. Co-occurrence of keywords helps to understand the relation among digital transformation, AI, sustainable development, ESG, technological innovation, green innovation and carbon in the strategic decision-making process. Moreover, the current study focused to explain AI application and corporate ESG performance between the years 2020 and 2025. Therefore, significant themes explained interdisciplinary and globally collaboration.

Keywords: artificial intelligence, bibliometric analysis, environmental, social, and governance, sustainability

JEL Codes: M14, O33

Introduction

In the recent business landscape, two forces, that is, technological disruption and pressure from stakeholders are reshaping as to how to make corporate strategic decisions. The extensive use of Artificial Intelligence

*Corresponding Author: Khurramshahzady2k@gmail.com

(AI) in different operations of an organization is restructuring the company's approach to handle with care the responsibilities of Environmental, Social, and Governance (ESG)-related issues. On the other hand, growing pressure from different stakeholders, such as government and regulatory bodies emphasize to think about adopting ESG criteria more seriously. Recent study shows that AI adoption and usage has increased since mid-2024 (Liu et al., [2025](#)). Moreover, AI adoption has been used to increase growth and to get competitive edge in economic system. Hence, there is a need to make policies regarding AI adoption (Liu et al., [2025](#)).

Furthermore, more than 75% firms reported using AI application in the year 2024 as compared to 55% usage in the year 2023, showing an extensive increase in investment in AI application (Stanford Institute for Human-Centered Artificial Intelligence, [2025](#)). The report issued by the Organization for Economic Co-operation and development in the year 2025 showed that more than 15% organizations in G7 countries including Brazil used AI applications in production and supply chain processes (OECD, [2025](#)). Moreover, more than 65% countries of the region encouraged organizations to disclose sustainability information in annual financial statements in order to facilitate the information needs of different stakeholders. This initiative will develop to improve transparency, enhance accountability and help different investors, customers, regulators and other stakeholders make better informed decision (OECD, [2025](#)).

Xie et al. ([2025](#)) reported in the study that more than 5000 firms, listed in China stock exchange, showed a significant increase in ESG-related performance using AI application. The junctures of these two strong trends, that is, AI application and corporate ESG performance, have flickered an emerging field not only for academic purposes but also for researchers for deep inquiry in this matter. Researchers are trying to explore how AI adoption and application can optimize corporate ESG performance. Using AI application, organizations are able to optimize energy consumption in order to reduce carbon emissions. This may help organizations to secure different environmental factors, reduce hiring complexities and supply chain issues while improving social factors and optimizing compliance with governance practices. Resultantly, organization can enhance operational efficiency, strengthen stakeholder's trust and support long-term sustainable performance.

Organizations are legally bound to include their ESG disclosure in their

financial statement in different countries. The significance of this topic stems from its benefits to multiple stakeholders. The real-time observation of carbon emissions, supply chain, and well-being of employees lowers the cost, increases the savings, and enhances the risk management (Dwivedi et al., [2022](#)). For the benefit of this planet and society as a whole, the adoption of AI and ESG performance accelerate to achieve the goal of climate change mitigation and balance in social life (George et al., [2021](#)).

The concept of AI application and ESG performance started in early 21st century but it gained popularity after 2010. Initially, the study was started when computer scientists moved towards creating AI and management scholars thought about ESG. The first work was published in mid-2010s focusing on how big data improve sustainability reporting (Borges et al., [2021](#)). This study highlights the potential of big data technologies to collect, process and analyze large volume of information to assess sustainability in better way.

This concept used multiple management and economic fundamental theories, such as Resource-based View (RBV), which enhanced ESG performance and achieved excellence in competitive advantage (Mikalef & Gupta, [2021](#)). Freeman et al. ([2010](#)) explained that organizations were able to satisfy needs of all stakeholders by using AI technology. Furthermore, institutional theory also helped understand as to how societal norms and regulatory body pressures enforce to adopt AI and ESG for compliance. After this, firms moved towards digitization and sustainable business models (Parida et al., [2019](#)).

The use of AI is increasing not only in local environment but also globally in other countries. AI uses software and different tools to solve different problems efficiently and effectively. This concept is based on interdisciplinary nature and intersection of computer science, business management, and environmental science (Dwivedi et al., [2022](#)).

Literature on AI is diverse in nature and has been published in journals of computer sciences, environmental sciences, and business finance. This makes it hard to attain a comprehensive view of it. Extensive work has been done on AI application and corporate ESG performance that is purely quantitative-based and authors' expertise. However, a few researches have been conducted, number-based and objective, to analyze the patterns and trends on these nexuses. The extensive studies have been done on

sustainability and AI application but there is a lack of studies through systematic lens. Furthermore, there is a gap of basic questions pertaining to the development of different themes. Questions, such as what is the most influential study, who is the most influential author, and what is the geographic concentration of knowledge produced, remain unanswered in this field. So, bibliometric analysis is the most powerful methodological tool to address these types of questions. Bibliometric tool with Scopus database provides an opportunity to apply a quantitative technique, emerging trends, joint network of authors, and countries in the specific field.

This study aimed to investigate the adoption of advance and powerful technology and comprehensive business practices. This is not merely a digitization of business activities but it also enables the organizations to achieve sustainable growth. Additionally, it enables organizations to take competitive advantage not only in local market but also for complex global economy (Mikalef & Gupta, [2021](#)). The primary objective of this emerging field is to provide systematic review and trace out the initial and current status of the field.

Study Objectives

The current study aimed to address the following objectives:

- To conduct key scientific research, examine growth, and volume in the field.
- To discuss mapping structure, basic themes, influential authors, territories, and publications.
- To identify core keywords in the field.

The current study is not related with causal relationship between AI application and ESG performance. Rather, it is a bibliometric analysis based on mapping literature on AI application and ESG performance for the time period 2020-2025.

The remaining part of this study is organized as follows: The literature review critically discusses previous researches and the results of those researches. Methodology section explains retrieval of data from Scopus database, describes the research, and elucidates different bibliometric analysis techniques to retrieve the data and mapping figures. Discussion section provides different results around the research objectives, visualization of different figures, and interpretation of tables. The limitation

of the study is provided in next section and at last, there is a conclusion section to conclude all the discussion-related domains.

Literature Review

The adoption of digital technologies and ESG performance has become an emerging field of the researches backed by global sustainable development. The Resource-based Theory (RBT) was first introduced by Birger Wernerfelt in the year 1984. Wernerfelt ([1984](#)) claimed that the success of firms depends not on external factors but internal factors, technological advancements, and unique skills also play a crucial role in this regard. Similarly, the firms should develop such resources that have not been developed by their competitors to create long-term benefits. According to RBT, AI has become a valuable source to enhance ESG disclosure in financial statement and get competitive advantage (Mikalef & Gupta, [2021](#)).

Recent studies aimed to explore the relationship between AI adoption and ESG performance in different fields. For instance, Xie et al. ([2025](#)) depicted that corporations are integrating AI in different operations to reduce waste and increase productivity and present clear reporting. Similarly, Yu et al. ([2025](#)) explained that AI-supported firms achieved their internal and external ESG goals effectively. This discussion supports RBV that if a firm is stronger internally then it is said to be more compatible and sustainable as compared to others which are less strong internally. However, this concept was criticized by latter scholars. For instance, Ekaristi et al. ([2025](#)) mentioned that AI adoption is not rare yet. Therefore, firms may not get clear competitive advantage by using AI. Stakeholder theory was first introduced by Freeman in 1984 in his famous book Strategic Management.

Freeman ([2010](#)) challenged the traditional theory of wealth maximization and argued that responsibility of firms should not turn around only to wealth maximization but to all stakeholders including employees, customers, and community as a whole. According to stakeholder's theory, external and internal pressure is critical to adopt and implement AI and ESG model in the organization to fulfill the needs of all stakeholders (Freeman et al., [2010](#)). Not long ago, firms used AI applications to get not only wealth maximization for shareholders but also monitor the interests of all stakeholders for sustainability. Therefore, this corporate decision aligns with stakeholder's theory (Clarkson, [1995](#); Freeman et al., [2020](#)).

In the context of environmental theory, firms constantly respond to external factors, such as climate change, and stakeholders hope to achieve sustainability (Bansal & Song, [2017](#); Hart, [1995](#)). This theory is considered as a base theory in the age of digitization to move firms in the regime of responsibility and sustainability (Bansal & Song, [2017](#); Yu et al., [2025](#)). The use of AI also facilitates the firms to observe external factors more effectively and to improve the performance of corporate ESG (Del Río-González, [2005](#); Yu et al., [2025](#)). Firms use AI according to the environmental theory, AI adoption is responsible to reduce the cost of products, improve supply chain issues, and monitor the environmental issues. This leads towards reducing the ecological footprint significantly (Dwivedi et al., [2021](#)).

A bibliometric analysis showed that it has become an emerging field that encompasses developed countries. These include countries, such as China and India, Middle East countries, such as UAE, Eastern countries, such as USA, and European countries, such as Germany, France, and Italy. Many emerging economies, such as China and India have gained economic development using green innovation. On the other hand, AI use increases environmental challenges as well (Zhang et al., [2022](#)).

Methodology

This section outlines the methodological framework of the study. Furthermore, this section deals with the source of data, criteria for sample selection, and the application of bibliometric analysis as a part of methodology of this study.

Source of Data

The current study utilized the well-known Elsevier Scopus database as its primary data source. Scopus was selected, as compared to Web of Science (WoS), for its global reputation regarding the quality and reliability (Nobanee et al., [2021](#)). Furthermore, Scopus provides comprehensive and consistent data structure for a robust foundation for bibliometric analysis (Tunger & Eulerich, [2018](#)). Moreover, Scopus provides extensive interdisciplinary coverage, which ensures a more comprehensive retrieval of relevant literature for systematic and bibliometric analysis (Baas et al., [2020](#)). This extensive coverage minimizes the risk of omitting significant publications, thereby strengthening the foundation of analysis. This study employed VOS viewer for the construction of different maps, such as

keyword of co-occurrence and co-authorship networks used in bibliometric analysis.

Bibliometric Analysis as Part of Methodology

Bibliometric analysis is a set of techniques in which mathematical and statistical methods are applied to examine the connections among academic publications in order to understand/comprehend the interconnections of journal citations as well as to present the precise overview of research subjects (Abdelwahab et al., [2023](#)). This study drew its data, the most prominent factor for bibliometric analysis, from major citation indexes, especially Scopus and WoS. This study employed two core methodologies: performance analysis and scientific mapping, following the framework established by Nobanee et al. ([2021](#)). Bibliometric analysis offers valuable insights for evaluating scientific research, allocating funding, and guiding strategic planning. It effectively measures the productivity and impact of researchers, institutions, different countries, and entire field of study area (Costa et al., [2019](#)). Donthu et al. ([2021](#)) explained trends of Scopus. Its primary uses include identifying the emerging research trends, mapping intellectual connections among disciplines, and evaluating the impact of scholarly work.

Table 1

Data Retrieval Process

No.	Stages	Selection Mode	Results
1	Data base selection	Elsevier-Scopus Database with time frame 2020-2025(dated 14 th October, 2025) (TITLE-ABS-KEY (Artificial Intelligence (AI)) OR TITLE-ABS-KEY (ESG performance) OR TITLE-ABS-KEY (green innovation) OR TITLE-ABS-KEY (supply chain efficiency) AND TITLE-ABS-KEY (digital transformation)) AND PUBYEAR > 2019 AND PUBYEAR < 2026	10,095
3	Limiting subject areas (stage-2)	Business, management and accounting	2270

No.	Stages	Selection Mode	Results
4	Limiting document type (stage-3)	Document type: Article	1,061
5	Limiting no of journals (stage-4)	Journals: top 25 ABCD journals	340
6	Publication stage (stage-5)	Final	321
7	Language (stage-6)	English	320

Table 1 shows the data retrieval process, which is necessary for bibliometric analysis. It was downloaded from Scopus on 14th October 2025. The current study was limited to its research process using keywords, such as AI, ESG performance, green innovation, supply chain efficiency, and digital transformation. According to the table, when advanced search was conducted on Scopus using keywords, the result was 10,095. When research was limited to subject area, that is, business, management, and accounting, the result was 2,270. When the search reached to 3rd stage, limiting document type, that is, article, then results came down from 2,270 to 1,061. When search reached to 4th stage, that is, limiting to number of journals, then top 25 “ABCD” journals were selected, coming to 340 results. After selecting English language journal only, the results reached to 320 number of records.

Results

The current study used performance analysis and scientific mapping to evaluate and understand scientific publications and citations of individuals, organizations, and countries followed by Nobanee et al. (2021).

Bibliometric Performance Analysis

Figure 1 shows the publication trend of the AI application and ESG growth for the time period 2020-2025. A steady growth has been observed from the year 2020-2021 and from 2021-2022. There has been a significant publication trend for the time period 2022-2023, and more than 25 publications have been recorded in this year. There has been a rapid change in publications for the time period 2023-2024, and there are more than 50 publications. Furthermore, there are more than 25 publications for the time period 2024-2025.

Figure 1
Publication Trend

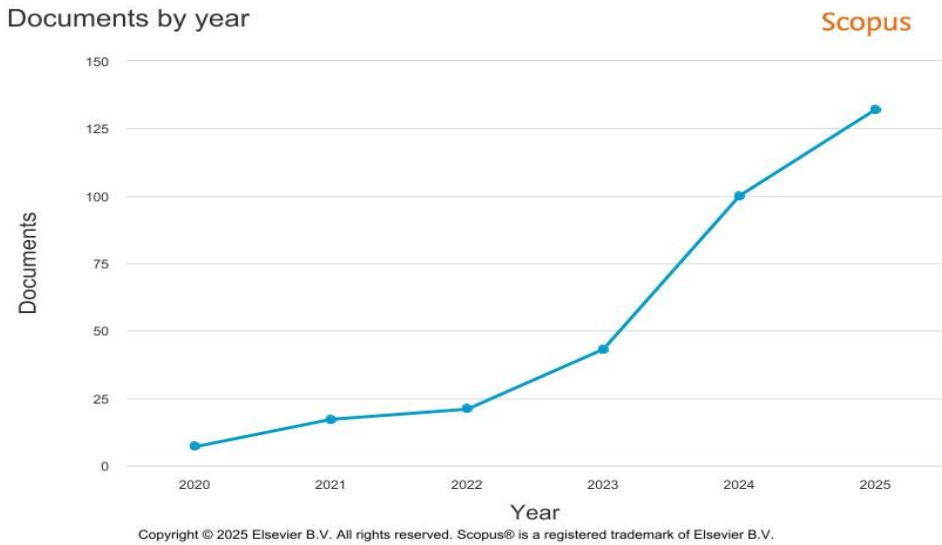


Figure 2
Documents by Subject Area

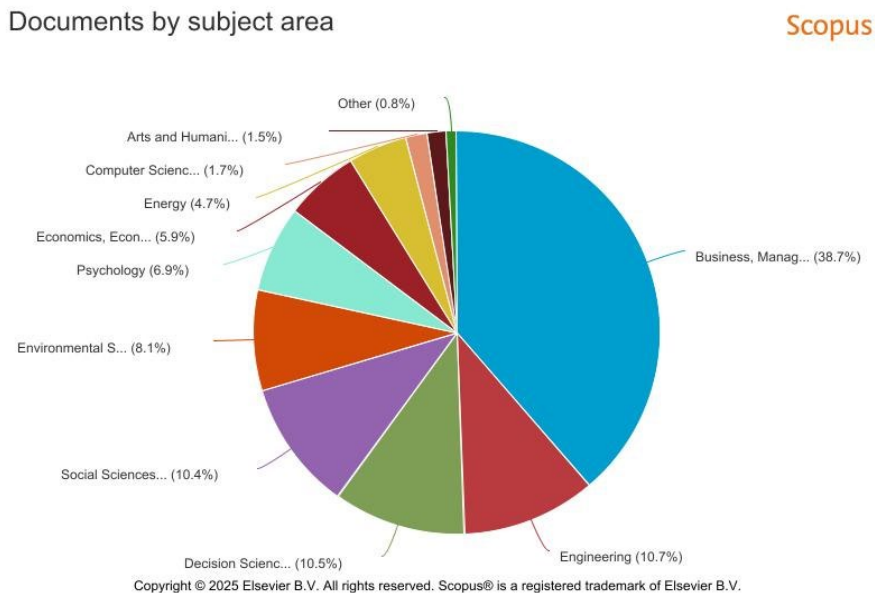


Figure 2 provides significant insights related to the distribution of publications in the field of AI and ESG growth. Pie chart shows AI and ESG articles in eleven different fields. The area of interest for a researcher is business, management and accounting, that is, 38.7% of whole domain. The future research direction is to explore engineering, decision science, and social science along with business, management and accounting, that is, 70% of whole domain.

Table 2

Most Influential Journals

Journal Name	ABDC Category	Publications	Cite Score (2025)	Publisher
Technological Forecasting and Social Change	A	45	26.4	Elsevier
Journal of Cleaner Production	A	39	19.3	Elsevier
Business Strategy and the Environment	A	17	21.8	John Wiley and Sons
Sustainable Futures	N/A	17	2.7	Elsevier
International Journal of Production Economics	A	16	17.1	Elsevier
Technology in Society	C	15	21.6	Elsevier
Cogent Business and Management	N/A	13	5.3	Cogent OA
IEEE Transactions on Engineering Management	A	13	11.3	IEEE
Journal of Business Research	C	13	19.9	Elsevier
Journal of Innovation and Knowledge	N/A	13	21.6	Elsevier
Humanities and Social Sciences Communications	N/A	12	4.8	Springer Nature
Administrative Sciences	B	11	5.6	MDPI
Corporate Social Responsibility and Environmental Management	C	11	12.7	John Wiley and Sons
Managerial and Decision Economics	B	11	4.6	John Wiley and Sons
Financial and Credit Activity Problems of Theory and Practice	N/A	8	1.9	Fintech Alliance LLC

Table 2 shows different journals contributing knowledge to AI

application and corporate ESG performance. The most influential journal is technological forecasting and social change having A category of ABDC. There are 45 publications between the years 2020-2025. Elsevier is the publisher, and cite score is 26.4 according to the year 2025. Likewise, the second most influential journal is the Journal of Cleaner Production having 39 publications and A rank according to ABDC category. Elsevier is the publisher of this journal. All remaining journals have less than 20 publications and publishers are Elsevier, MDPI, John Wiley and sons, and Springer Nature.

Table 3

Most Influential Articles

Title	Journal	Year	Cited
AI and innovation management: A review, framework, and research agenda	Technological Forecasting and Social Change, 162, 120392	2021	615
Linking circular economy and digitalization technologies: A systematic literature review of past achievements and future promises	Technological Forecasting and Social Change, 177, 121508	2022	481
The challenges and opportunities in the digitalization of companies in a post-COVID-19 world	IEEE Engineering Management Review, 48(3), pp. 97–103, 9153093	2020	362
Internationalization, digitalization, and sustainability: Are SMEs ready? A survey on synergies and substituting effects among growth paths	Technological Forecasting and Social Change, 166, 120650	2021	352
How AI capabilities enable business model innovation: Scaling AI through co-evolutionary processes and feedback loops	Journal of Business Research, 134, pp. 574–587	2021	337
Industry 4.0, innovation, and sustainable development: A systematic review and a roadmap to sustainable innovation	Business Strategy and the Environment, 30(8), pp. 4237–4257	2021	309
A performance measurement system for industry 4.0 enabled smart manufacturing system in SMMEs- A review and empirical investigation	International Journal of Production Economics, 229, 107853	2020	304
The digital transformation of external audit and its impact on corporate governance	Technological Forecasting and Social Change, 150, 119751	2020	298

Title	Journal	Year	Cited
How does artificial intelligence enable and enhance value co-creation in industrial markets? An exploratory case study in the healthcare ecosystem	Journal of Business Research , 129, pp. 849–859	2021	230
Managing the Strategic Transformation of Higher Education through Artificial Intelligence	Administrative Sciences , 13(9), 196	2023	223
Digitalization transformation and ESG performance: Evidence from China	Business Strategy and the Environment , 33(2), pp. 352–368	2024	201
How does digital transformation drive green total factor productivity? Evidence from Chinese listed enterprises	Journal of Cleaner Production , 406, 136954	2023	191
Analysis of the adoption of emergent technologies for risk management in the era of digital manufacturing	Technological Forecasting and Social Change , 178, 121562	2022	189
Can digital transformation improve market and ESG performance? Evidence from Chinese SMEs	Journal of Cleaner Production , 419, 137980	2023	175
AI enabling circular business model innovation in digital servitization: Conceptualizing dynamic capabilities, AI capacities, business models, and effects	Technological Forecasting and Social Change , 197, 122903	2023	168

Table 3 shows the data pertaining to the most influential article in the field. The article that has been cited 615 times in different publications is “Artificial Intelligence and Innovation management: A review framework, and Research agenda” published in technological forecasting and social change (2021). This result shows the role of AI in shaping the future research directions. The second influential article cited 418 times in different publications is, “Linking circular economy and digitalization technologies” (2022). Table 3 also shows that some manuscripts are not directly related with AI application and ESG performance rather than digitalization, digital transformation, and performance measurement system. However, these manuscripts are conceptually connected with broader themes and therefore, belong to search boundaries of this study.

Table 4
Most Influential Authors

Rank	Authors	Number of Docs in AI and ESG	Scopus ID	Year of 1 st Publication	Total Publications	Document H-Index	Current Affiliation	Country
1	Parida, V.	6	140652 52500	2006	194	69	Luleå University of Technology	Sweden
2	Lin, B.	4	350989 35000	2010	895	113	Xiamen University Fuzhou	China
3	Wang, S.	4	572375 59800	2021	39	16	University of Foreign Studies and Trade	China
4	Sjödin, D.	3	361361 76000	2010	67	37	Luleå University of Technology	Sweden
5	Vrontis, D.	3	571953 39008	1998	496	65	University of Nicosia	Cyprus
6	Zhang, H.	3	592040 12700	2024	18	9	Zhejiang Shuren	China
7	Appio, F.P.	2	538793 77400	2010	73	24	University PSB Paris School of Business	France
8	Arranz, C.F.A.	2	575571 77200	2019	22	13	University of Greenwich Business School	United Kingdom

Rank	Authors	Number of Docs in AI and ESG	Scopus ID	Year of 1 st Publication	Total Publications	Document H-Index	Current Affiliation	Country
9	Arroyabe, M.F.	2	560296 35400	2015	35	18	Essex Business School	United Kingdom
10	Chotisarn, N.	2	561221 56500	2013	20	5	Thammasat University	Thailand
11	Chowdhury, S.	2	572019 62502	2011	64	23	TBS Business School	France
12	Cifuentes-Faura, J.	2	572181 43353	2020	182	33	Universidad de Murcia	Spain
13	Frank, A.G.	2	547908 49500	2011	90	40	Universidade Federal do Rio Grande do Sul	Brazil
14	Ghobakhloo, M.	2	361415 76300	2010	130	47	Uppsala Universitet	Sweden
15	Grybauskas, A.	2	572020 08113	2018	25	9	Kaunas University of Technology	Lithuania

Table 4 below shows the influential author in the field of AI application and corporate ESG performance based on Scopus data. The table highlights that scholars have made significant academic contributions through multiple citations and publications. The most influential author is Parida, V. from Lulea University of Technology, Sweden. He made 6 publications from 2020-2025, and had H-index of 69, showing considerable citation impact and productivity. Another influential author is Lin, B. from Xiamen University, China who has gained popularity having total publications 895 and H-index 113 showing strong reputation and experience.

Co-author Country Analysis

Figure 3(a)

Co-author Country Analysis

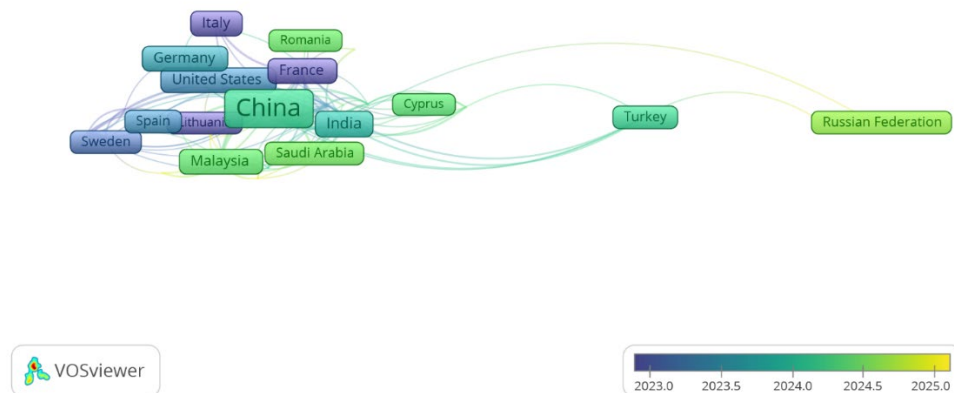


Figure 3(b)

Co-author Country Analysis

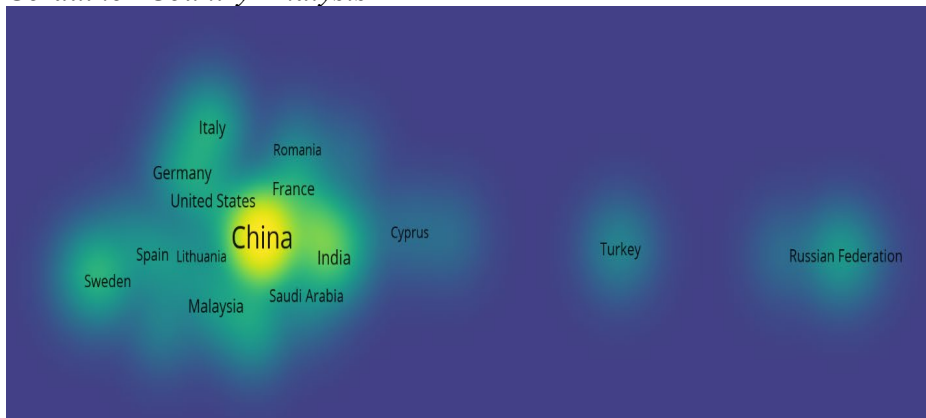


Figure 3(a) shows that VOS-viewer facilitates to understand co-author country analysis and geographical wise arrangement of collaboration in the domain (Cobo et al., [2011](#); Moral-Muñoz et al., [2020](#)). Bibliometric co-author country analysis shows collaboration of different authors with other countries globally. Graph that is made using VOS viewer shows countries' collaboration network, representing co-authorship (Gao et al., [2022](#); Guleria & Kaur, [2021](#); Shahmoradi et al., [2021](#)). Countries with larger nodes and connections indicate stronger relation and connection between authors. According to Figure 3, China is the leading country in collaboration with rest of the countries. Other countries, such as India, USA, and Spain are more influential in this domain.

Figure 3(b) depicts co-author density analysis with most influential countries to collaborate in this field. Figure highlights that China, India, USA, and France are more influential in this collaboration after leading collaboration of China in the field. This figure also shows that the field is emerging and spreads continent-wise in the world.

Figure 4(a)

Co-author with Keywords Analysis

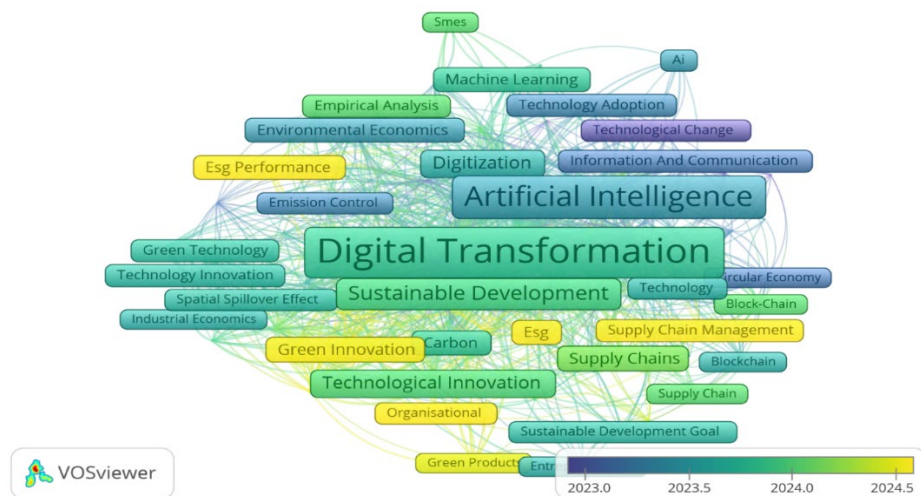


Figure 4 (a) shows keywords related to the domain. According to figure, digital transformation, AI, technological innovation, and sustainability are more influential and evolving keywords in this domain. Moreover, ESG,

ESG performance, green technology, and green innovation are also influential and evolving keywords in this area.

Figure 4(b)

Co-author with Keywords Analysis

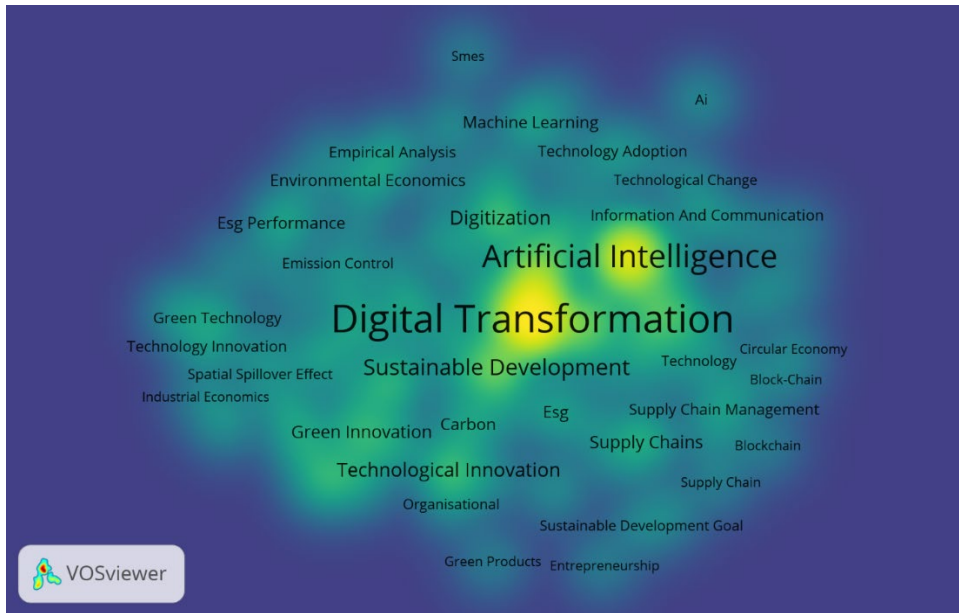


Figure 4(b) depicts core and influential keywords. These include digital transformation, AI, and sustainability of AI application and corporate ESG performance to show the influential and evolving nature. Digital transformation, AI, and sustainability in bright yellow areas display high density and most frequently-used keywords. Whereas, blue areas show lower density keywords in the field.

Keyword Cluster Analysis

Table 5 provides the data related to the co-occurrence analysis of keywords used by author. The primary themes generated through Vos viewer can be discerned related to AI adoption and corporate ESG performance.

Cluster-1 (Red) Digital Transformation and AI-driven Sustainability

This cluster depicts “digital transformation” and “AI-driven sustainability” practices as core themes of the bibliometric network. The

table shows that the most persuasive keyword is digital transformation (Links = 90; total link strength = 542; occurrence = 144). This reflects the important role of digital transformation in reshaping corporate strategies and ESG performance. This shows that high digital transformation leads to improve ESG responsibilities. The other keywords, such as “digital technologies” and “decision-making” highlight efficient managerial and operational side of the organizations using digital technologies. The keywords, such as “blockchain”, “circular economy”, and “Internet of Things (IoT)” are emerging keywords. These highlight that digital transformation has become an important tool for strategic management for achieving ESG performance in future.

Cluster-2 (Green) Sustainable Innovation and Green Economic Development

Green cluster shows the keywords, such as “innovation”, “green economy”, and “technological progress”. This shows how these activities facilitate to improve sustainability and economic development. The main keyword is “innovation” (Occurrence =54; total link strength 282). This is closely linked with green economy, green development, and digital economy, explaining that these themes move around eco innovation and digitalization in economic system. This cluster also shows that management of corporate sector is not moving towards traditional profit maximization goal but towards sustainability leaderships. Meanwhile, keywords, such as “digital economy”, “decentralized finance”, and “green technology” are emerging themes that reflect sustainable innovation using rapid digital progress. Moreover, digital transformation (Cluster-1) and sustainable innovation (Cluster-2) show digital integration and ESG strategies in combination.

Cluster-3 (Blue) Environmental Regulation, Technology, and ESG Performance

Cluster 3 highlights the relationship between environmental regulations and ESG performance using digital transformation. Total link strength of environmental technology and investment are (103) and (89), respectively. This explores the relationship between AI adoption and corporate ESG performance. Link strength of keywords, that is, “economics (87)” and “empirical analysis (64)” shows that different studies in this cluster are quantitative in nature to measure the impact of economic and ESG practices

on environmental policies. Keyword ESG shows that management of the corporations emphasizes the accountability in connection with sustainability and aligns managerial accountability with ESG. This cluster also shows that companies are moving from reactive plan to proactive plan. Furthermore, they are trying to adopt technologies in order to improve energy efficiency and reduce pollution for checking ESG performance.

Cluster-4 (Brown) Digital Sustainability and Corporate Adaptation

This cluster highlights the relationship between digital sustainability and practices of management. The influential keywords in this cluster are sustainability (Link = 67; total link strength = 206; occurrence = 37) and digitization (Link = 64; total link strength = 170; occurrence = 27). This highlights how digitization helps to create corporate sustainability in the organizations. Moreover, keywords, such as machine learning (ML), technology adoption, and corporate strategies highlight strategic dimensions of the organizations. While, performance assessment, value chain, and risk assessment show the management perspective of the organizations. Keyword, corporate strategy, indicates that management is aligning corporate aims with sustainable objectives. Keyword “ML” that is machine learning shows that organizations used machine learning for best utilization of resources to handle with ESG risk. The emerging theme in this cluster is ML and value chain, indicating checking performance and improving production system.

Cluster-5 (Purple) Technological Innovation and Sustainable Development Goals (SDGs)

This cluster highlights the relationship between technological innovation and sustainable development growth (SDG). The occurrence of these two keywords indicates how digital advancement addresses different issues related to ESG performance. Keywords, such as ESG, green products, and entrepreneurship emphasize technological innovation and responsible management. Keyword, SDG, indicates that management is inquisitive to align corporate goals with United Nations SDGs to ensure global ESG performance. Keyword, such as AI indicates the intention of management to calculate risk and best utilization of resources. Furthermore, keyword, “green products”, indicates the intention of management in producing environment-friendly products. Keywords, such as “ESG innovation”, “AI”, and “entrepreneurial sustainability” indicate the

intention of management to streamline reporting mechanism and change business model according to ESG perspectives.

Cluster-6 (Sky blue) Technological Change and AI-driven Transformation

This cluster has few keywords; however, it is conceptual in nature according to theme of other five clusters. The main theme of sky-blue cluster is how rapid changes in digital innovation play an important role in changing business models, producing capacity and improving innovation process. Keyword, “technology innovation”, indicates that management continuously forecasts technological development trends and investment in new technological tools and systems to take competitive edge in complex business environment. Keyword, “AI”, indicates that management is curious to calculate risk, make decision-making processes, and forecasting processes using AI adoption in the businesses. Keyword, “technological development”, highlights operational aspect of the organization as well as achieving operational efficiency and cost reduction in manufacturing processes. Cluster five and cluster six indicate that digitalization is not separate from ESG performance and innovation goals. Moreover, rapid digital innovation is shifting the society towards digitization and green economies.

Table 5

Keywords’ Co-occurrence Analysis

Cluster and Color	Keywords	Links	Total Link Strength	Occurrence
1. Red	Digital Transformation	90	542	144
	Artificial Intelligence (AI)	77	286	95
	Digital Technologies	59	124	24
	Decision-making	36	67	15
	Digitalization	38	60	15
	Information And Communication Technology (ICT)	34	60	10
	Technology	18	31	8
	Dynamics Capability	26	37	6
	Policymaking	26	36	6
	Electronic Commerce	23	32	6
	Efficiency	17	23	6
	Blockchain	26	37	5
	Circular Economy	22	30	5
	Blockchain	19	29	5

Cluster and Color	Keywords	Links	Total Link Strength	Occurrence
	Emerging Technologies	19	24	5
	Internet of Things (IoT)	13	20	5
2. Green	Innovation	74	282	54
	Green Economy	48	118	19
	Green Development	45	133	20
	Digital Economy	41	70	13
	Corporates	40	82	11
	Economic and Social Effects	40	56	10
	Green Innovation	35	77	19
	Green Technology	35	67	10
	Green Manufacturing	34	66	12
	Technology Innovation	32	58	9
	Total Factor Productivity	32	49	9
	Spatial Spillover Effect	31	41	6
	Decentralized Finance	28	42	7
	Economic Development	25	29	5
	Finance	25	36	6
3. Blue	State-owned Enterprise	21	26	5
	Industrial Economics	20	28	5
	Environmental Technology	51	103	13
	Economics	50	87	14
	Environmental Regulations	46	86	13
	Carbon	42	75	14
	Investments	42	89	15
	Empirical Analysis	37	63	11
	Digital Storage	35	49	7
	Performance	31	43	7
	ESG Performance	28	49	14
	Energy Utilization	27	38	6
	Industrial Research	27	37	9
	Organisational	25	33	6
	Carbon Emissions	22	35	7
4. Brown	Pollution Control	22	28	5
	Commerce	21	26	5
	Industrial Enterprise	20	29	6
	Manufacturing Enterprise	14	21	5
	Sustainability	67	206	37
	Digitization	64	170	26
	Environmental Economics	39	83	12
	Machine Learning	33	51	13
	Performance Assessment	30	41	5
	Small and Medium-sized Enterprise	28	49	8

Cluster and Color	Keywords	Links	Total Link Strength	Occurrence
5. Purple	Technology Adoption	28	48	10
	Corporate Strategy	27	45	9
	Risk Assessment	24	27	5
	Value Chains	20	27	5
	Digital Technology	18	21	5
	Future Prospect	14	20	5
	Sustainable Development	68	199	40
	Technological Innovation	52	118	24
	Sustainable Development Goals (SDGs)	27	39	6
	Sustainable Development Goals (SDGs)	24	36	6
	ESG	23	32	13
	Green Products	23	34	5
	Entrepreneurship	19	33	5
	Twin Transition	19	31	6
	Artificial Intelligence (AI)	16	26	8
6. Sky-Blue	Technological Development	55	105	19
	Technological Change	18	27	6
	AI	10	15	7

Discussion

The results of bibliometric analysis suggested the growing association between AI adoption and ESG performance for the data of last five years. The trend of the topic shows that this is the strategic level decision to incorporate AI in the organization for sustainability and ESG performance. The results showed that AI is not only the matter of operational aspects but it is also a supportive tool for ESG aspects in order to enhance sustainability.

The analysis of results from mapping techniques showed that most studies rely on how AI adoption increases ESG performance, sustainability, and green innovation. However, this study focused on large companies in developed economies. Furthermore, the study stressed that there is a need to expand the research to small and medium enterprises, emerging markets, and non-profit making organizations. The results also showed that collaboration among countries and authors is limited. The majority of influential work is done in China, USA, and European regions, and Asia is an underrepresented region. There is a need to explore how AI adoption can ensure fairness to report ESG efficiently and effectively. Moreover, longitudinal work can trace how future directions for research can explore

different aspects of emerging trends.

The main objectives of the current study were attained through bibliometric analysis. The results showed that scientific research, growth, and volume increased for the time period 2020-2025, which is more than 130 publications. Moreover, for the time period 2024-2025, more than 30 papers were published in the field. This result showed that it is an emerging field. Mapping structure and basic themes showed that this topic is crucial and geographically-collaborated around research world. Hence, the second objective was achieved. The result of co-author's keywords also showed that these words are more influential, and bright yellow color shows that these words are condensed in nature and influential in field. Hence, the third objective was achieved.

The current study provided insights of AI application and corporate ESG performance, however, there are more dimensions that are open for further research. Moreover, this study focused on emerging trend. However, long-term growth of the field can be achieved by increasing the dataset. The results showed that the collaboration of countries is advanced in nature and there is less work in emerging economies. This is because there may be issue of AI application or ESG concerns.

Limitations

AI application and corporate ESG performance provide essential insights and intellectual structure but these two have some limitations for better understanding. Firstly, this study was based on one subject area, that is, business management and accounting. The results may be shuffled if more subject area is included during filtering level in Scopus. Secondly, this work was also based on journals only, a source type in Scopus. The results may be changed if more source-types are included, such as books, peer reviews, and systematic literature reviews (SLRs) in the study. Thirdly, this study accommodated the data of five years only, that is, for the time period (2020-2025). This may show the emerging trend and current advancement of the topic but it may ignore the long-term trend and basic foundational work that tend to shape this relationship. Fourthly, this bibliometric study was only based on quantitative aspect as article count. These points are useful for quantitative analysis but may not capture a full picture of association without using qualitative aspects of the field. Furthermore, this study provided general understandings of AI application and ESG

performance. However, future study may be conducted on specific sectors, such as finance sector, manufacturing sector, and health sector for better understanding of AI application and ESG performance in more depth. Finally, Scopus is a comprehensive database that updates data on a regular basis. This result is based on data extraction time but may differ if new publications appear in the database.

Conclusion

This bibliometric analysis described the extensive overview of emerging relationships between AI and ESG performance. The results showed that this is an emerging concept reflecting AI-based sustainability in organizations over the last few decades. Two most influential journals, *Technological Forecasting and Social Change* and *Journal of Cleaner Production* are shaping this emerging field. The results also showed that the most prominent countries and leading authors tend to show keen interest in the topic. Furthermore, findings also revealed that AI application is useful for refining environmental change, increasing managerial effectiveness, transparent corporate strategies, and social responsibility. Improving worldwide collaborations networks shows that this research is interdisciplinary and cross-country in nature, which are key drivers of innovation. Overall, this study explained the topic in an effective way and depicted valuable information for researchers and organizations' management to take serious steps in order to apply AI tools for sustainability of businesses.

Author Contribution

Hafiz Khurram Shahzad: writeup, review, analysis. **Fouzia Hadi Ali:** review, and analysis. **Sabra Munir:** bibliometric analysis workshop & review/

Conflict of Interest

The authors of the manuscript have no financial or non-financial conflict of interest in the subject matter or materials discussed in this manuscript.

Data Availability Statement

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