International Journal of Environmental and Ecology Research
www.environmentaljournal.in
Online ISSN: 2664-7117, Print ISSN: 2664-7109
Received: 18-10-2025, Accepted: 17-11-2025, Published: 01-12-2025
Volume 7, Issue 2, 2025, Page No. 90-98

ESG driven decision making with predictive analytics – A scientometric study

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Abstract
We examine the integration of predictive analytics into Environmental, Social, and Governance (ESG)-driven decision-making through this systematic literature review, with a particular focus on the manufacturing sector amid escalating regulatory demands such as the EU Deforestation Regulation (EUDR) and Corporate Sustainability Reporting Directive (CSRD). We draw on a PRISMA-guided synthesis of 10 core studies from 2021–2025, complemented by bibliometric analysis of 258 records from Dimensions.ai, to trace ESG's evolution from socially responsible investing origins to a strategic imperative. We highlight predictive tools' role in forecasting risks, enhancing transparency, and optimizing supply chains. Our key findings reveal exponential publication growth (166 in 2025 alone), dominance of management disciplines (79% of outputs), and influential themes such as AI-enhanced ESG scoring (92% accuracy) and Industry 4.0 moderation. We underscore regional disparities in adoption (93% in Europe vs. 79% in North America) and analytics' potential for equitable implementation, although gaps in SME accessibility and metric standardization persist. For manufacturing, we identify implications including 15–30% improvements in compliance and cost reductions, positioning predictive analytics as a bridge between ethical sustainability and competitive advantage. This study offers practitioners and scholars a roadmap, as we advocate hybrid AI-human models to advance global ESG resilience.

Keywords: ESG, predictive analytics, decision making, manufacturing sector, sustainability reporting, scientometric analysis, systematic literature review, AI in ESG

Introduction

We provide a comprehensive overview of our study on ESG-driven decision making with predictive analytics in this chapter, focusing on the manufacturing sector. We begin with the background, followed by the problem statement, research questions, objectives, hypotheses, significance, scope, and organization. This structure ensures a logical progression from contextual foundations to specific aims. We justify the need for data-driven insights amid regulatory challenges like the EUDR and CSRD. We delineate ESG's multifaceted integration into corporate strategy and highlight predictive analytics as a tool for navigating uncertainties in global regulations. Readers gain a clear roadmap, as they grasp the rationale, contributions, and boundaries of the study.

We recognize the broader implications of ESG in the volatile economic landscape as profound. Manufacturing accounts for 25% of global greenhouse gas emissions and faces pressures to align with sustainability principles. Predictive analytics utilizes machine learning on terabytes of data to forecast compliance breaches with 30% greater accuracy than traditional methods. This approach mitigates risks and enables competitive differentiation, such as 57% premium pricing for eco-certified products. Recent trends show 93% ESG adoption in Europe versus 79% in North America and 88% in Asia-Pacific, underscoring regional disparities that targeted analytics addresses. This chapter sets the tone for blending ethical imperatives with technological innovation.

Background Study

We evaluate corporate operations on sustainability, responsibility, and practices through Environmental, Social, and Governance (ESG) frameworks (Freeman, 1984) [10]. ESG shifts from financial reporting to holistic assessments that incorporate nonfinancial indicators for long-term viability. ESG originated in the 1960s with socially responsible investing (SRI) that excluded ethical sectors like tobacco and gained traction via anti-apartheid campaigns that mobilized $4 billion in divestments. The 1990s saw maturation post-Rio Earth Summit (1992), which the UN's "Who Cares Wins" report formalized (United Nations Global Compact, 2004) [26], integrating factors for equitable economies.

This evolution promotes sustainability as a strategic imperative against risks like climate change. Early SRI focused on exclusions; by the 2000s, models linked ESG to 12% annual alpha. The 2008 crisis surged assets from $13.3 trillion (2012) to $53 trillion (2025 projection). In manufacturing, carbon accounting simulates emissions via predictive models.

We observe global traction via UN SDGs (e.g., SDG 2, 13) and ISO 26000 that influences supply chains, adopted by 100+ countries. The EU Green Deal mandates carbon adjustments via EU ETS; the US SEC proposes climate disclosures. Locally, Chinese firms adopting green tech cut energy costs 15%, boosting exports (Chen *et al*., 2023) [9]. From 2020–2025, 80% of firms integrate metrics, with the EU leading via CSRD's double materiality, while emerging

markets lag at 68% GRI use (Agustia *et al*., 2023; Li *et al*., 2025) [2, 17].

We note regional dynamics: Europe's 93% adoption driven by CSRD expanding to 50,000 firms; North America's 79% reflects SEC delays but California's SB 253; Asia-Pacific's 88% hides SME gaps. Manufacturing emphasizes circular models; Siemens cuts waste 20% via analytics. EUDR prohibits deforestation-linked imports post-2025, raising costs 5–10% without simulation, affecting 60% inputs.

We target predictive analytics for ESG in manufacturing, justified by 2025 regs like EUDR (geolocation tracing) and US mandates (Scope 3 reporting), increasing costs 5–10%. Models improve accuracy 20–30% (Nimmala, 2025; Ajayi *et al*., 2025) [3, 19]. Using World Bank data, simulations quantify $5 trillion climate damages, offering "what-if" scenarios for renewables impacting ratings and margins.

We draw on case studies: SEP's framework tracks 100+ points, improving compliance 25% (SEP, 2024) [25]. A 2024 study shows 15% cost reductions via data mining (Wang *et al*., 2024) [29]. This foundation propels the problem statement.

Table 1: ESG Adoption Rates in Manufacturing by Region (2024–2025)

Region	Adoption Rate (%)	Key Driver
Europe	93	CSRD Mandates
North America	79	SEC Proposals
Asia-Pacific	88	SDGs Integration

Note: Data adapted from Vena Solutions (2025) [27] and ASUENE (2025) [7].

Literature Review

Researchers have observed increasing integration of Environmental, Social, and Governance (ESG) factors into corporate decision-making over the past five years, as organizations align sustainability goals with strategic objectives amid rising regulatory pressures and stakeholder demands (Sariyer *et al*., 2024) [24]. Predictive analytics, which leverages machine learning and big data, serves as a pivotal tool in this domain by enabling proactive forecasting of ESG risks, performance metrics, and opportunities (Aljohani, 2025) [4]. This review synthesizes 15 key studies from 2020 to 2025, including 10 core publications and five additional works focused on manufacturing applications. We organize the synthesis thematically to highlight AI-enhanced ESG evaluation, transparency enhancement through data analytics, the moderating role of ESG in Industry 4.0 transformations, and emerging behavioral and regional perspectives. These studies underscore predictive analytics' transformative potential while revealing gaps in adoption among smaller enterprises and standardized metrics.

1. AI-Based Predictive Models for ESG Performance Forecasting

We identify a prominent theme in the application of AI-based predictive models for ESG performance forecasting and prescriptive recommendations. Sariyer *et al*. (2024) [24] propose a multi-stage system that combines clustering, association rule mining, deep learning, and prescriptive analytics to predict ESG scores for Fortune 500 companies using Refinitiv data. They validate the model on 470 firms, demonstrating high predictive accuracy and providing actionable insights for managers to elevate ESG ratings, which in turn influences investor decisions and corporate reputation. Similarly, Aljohani (2025) [4] develops a fuzzy TOPSIS decision-support framework to rank AI-enabled ESG strategies in sustainable manufacturing. They prioritize predictive analytics for risk forecasting, achieving over 92% accuracy in environmental impact predictions. This framework facilitates uncertainty handling in decision-making and emphasizes renewable energy integration and supply chain optimization as top strategies.

2. Data Analytics for ESG Transparency and Accountability

We recognize data analytics' role in bolstering ESG transparency and accountability as another critical area. Ibrahim *et al*. (2025) [13] examine data analytics tools, including AI and machine learning, in Bangladesh's corporate sector. They find that these tools enhance reporting verifiability and stakeholder trust, although small and medium-sized enterprises (SMEs) face barriers such as data quality issues. Their mixed-methods study, incorporating surveys and case analyses, highlights predictive analytics' contributions to risk management and compliance, while recommending capacity-building for broader adoption. Complementing this work, Nimmala (2021) [18] explores machine learning's application in ESG investment strategies. They illustrate how predictive models mitigate financial risks by analyzing ESG signals for portfolio optimization. The study advocates for algorithmic integration in finance to support data-driven decisions and notes improved risk-adjusted returns in simulated scenarios.

3. ESG Factors and Technological Transformations in Industry 4.0

We address the interplay between ESG factors and technological transformations, particularly Industry 4.0, in several works. Alkaraan *et al*. (2022) [5] analyze UK firms' annual reports using textual analysis, revealing that ESG practices moderate the positive link between Industry 4.0 disclosures and financial performance. Their quantitative findings indicate that stronger ESG engagement amplifies benefits from predictive analytics in strategic investments, providing evidence for regulatory enhancements. Joji *et al*. (2025) [14] focus on predictive analytics to pinpoint sustainability determinants impacting ESG scores. They employ regression models to identify key variables, such as carbon emissions and governance metrics. This chapter-based study in an edited volume stresses the need for tailored analytics frameworks to guide policy and operational decisions in emerging economies.

Onyenahazi *et al*. (2024) [20] evaluate ESG reporting's effects on financial outcomes by integrating predictive models to audit compliance gaps. Their framework bridges global standards and demonstrates analytics' role in proactive governance decisions. Razib (2024) [23] extends this analysis to supply chain optimization, where predictive

analytics enhances ESG transparency through real-time monitoring, thereby reducing discrepancies in reporting for multinational firms.

4. Emerging Trends: Behavioral and Regional Perspectives

We explore emerging trends, including behavioral and regional perspectives on ESG analytics. Adwani (2025) [1] investigates ESG investing in emerging markets through a behavioral finance lens, incorporating predictive analytics to model investor biases and market uncertainties. The analysis reveals econometric limitations in capturing ESG complexities but underscores analytics' value in forecasting sustainable investment flows. In a related vein, Khan (2023) [15] applies predictive analytics to assess ESG's financial impacts in urban-rural disparities. They use U.S. data to demonstrate how analytics-driven insights inform equitable decision-making in sustainability planning.

Verma (2022) [28] augments BERT models with semantic features for ESG data classification, improving predictive accuracy in investment decisions by 15–20%. Owusu Antwi (2023) [21] proposes integrated predictive analytics for IT audits in ESG contexts, emphasizing its utility in securing data integrity for governance-focused decisions.

5. Additional Manufacturing-Focused Applications

To enrich this synthesis with manufacturing-specific applications, Table 2 summarizes five additional studies from 2022–2025. These works emphasize big data analytics (BDA), AI-driven predictive maintenance, and machine learning in ESG contexts, particularly for sustainable supply chains and innovation forecasting. They reinforce themes of predictive tools for risk mitigation and operational efficiency while highlighting barriers such as data quality and adoption challenges in Industry 4.0 settings.

Authors (Year)	Title / Publication	Key Methods	Main Findings	Relevance to ESG Predictive Analytics in Decision Making
Huong *et al*. (2025) [12]	Exploring big data analytics adoption for sustainable manufacturing supply chains: Insights from a TOE-guided systematic review / Cleaner Logistics and Supply Chain, 16, 100256	Systematic literature review (SLR) of 64 articles using Scopus/Web of Science; thematic analysis via TBL and TOE frameworks; descriptive statistics on trends and barriers.	BDA's predictive analytics forecasts environmental risks (e.g., emissions), social compliance (e.g., labor issues), and economic demands, reducing costs and enhancing TBL sustainability; barriers include data complexity and skill gaps.	Demonstrates predictive BDA for proactive ESG risk forecasting in manufacturing supply chains, enabling data-driven decisions for circular economy and compliance under regulations like EUDR.
Razor Labs (2022) [22]	Reaching ESG and profitability goals with predictive maintenance / Razor Labs E-book	Case-based analysis of AI/ML in mining equipment; real-time sensor data monitoring and anomaly detection; comparative review of maintenance strategies (reactive vs. predictive).	Predictive maintenance via AI reduces downtime, emissions (up to 20% energy savings), and safety risks; aligns ESG pillars (e.g., Scope 3 tracking) with profitability (63% positive equity returns from ESG).	Highlights AI predictive tools for ESG-aligned operational decisions in resource-intensive manufacturing, optimizing maintenance to balance sustainability and financial performance.
Hammad *et al*. (2025) [11]	Environmental and governance strategies in ESG for Industry 4.0: A systematic review / AIMS Environmental Science, 12(4), 557–575	PRISMA-guided SLR of 18 articles from Scopus/Web of Science; conceptual framework mapping Industry 4.0 tech (e.g., BDA, AI) to ESG pillars; categorization into research streams.	BDA/AI enables predictive waste reduction and emissions forecasting in manufacturing; challenges like data security hinder adoption, but opportunities for real-time ESG reporting enhance governance.	Integrates predictive analytics with Industry 4.0 for ESG decision support in manufacturing, facilitating resource optimization and transparent supply chain decisions.
Archer (2025) [6]	Assessing the influence of green innovation on ESG ratings: A machine learning approach across developed and emerging economies / Maandblad voor Accountancy en Bedrijfseconomie, 99(3), 145–154	Machine learning models (Random Forest, ANN, XGBoost) on LSEG/World Bank data (1,597 observations, 292 firms); OLS regression with lags/interactions; error metrics (RMSE, MAPE).	Green R&D intensity predicts ESG ratings (0.032% rise per 1% increase); ML integration reduces prediction errors by 2–11.5%, universal across economies for unrated firms.	Uses ML predictive models to forecast ESG impacts from green innovation, aiding manufacturing firms in strategic R&D decisions for rating improvements and investor appeal.
KPMG (2024) [16]	ESG in the age of AI / KPMG Report	Survey analysis (KPMG 2023 India CEO Outlook, n=1,325); qualitative review of AI applications in ESG data; scenario-based discussions on emissions/risk forecasting.	AI predictive analytics forecasts climate risks and optimizes supply chains (e.g., Scope 3 emissions); 42% of CEOs expect 3–5 year ROI, but data silos pose barriers.	Emphasizes AI/big data for real-time ESG predictions in manufacturing supply chains, supporting resilient decisions amid regulations like CSRD

Research Methodology

We employ a systematic literature review (SLR) methodology in this study to synthesize recent scholarship on ESG-driven decision-making augmented by predictive analytics. The PRISMA framework guides our approach, ensuring methodological transparency, replicability, and comprehensive coverage of empirical, conceptual, and bibliometric insights from 2021–2025.

1. Database and Search Strategy

We source data from Dimensions.ai on October 8, 2025, using the query "ESG Driven Decision Making with

Predictive Analytics" (full-text keyword search). Filters include: years 2021–2025; ANZSRC fields (e.g., 35 Commerce, Management; 46 Information Sciences); SDGs (3, 8–13); publication types (articles, books, proceedings); and source titles (e.g., Sustainability, Technological Forecasting and Social Change). This yields 258 unique records post-deduplication.

2. Inclusion and Exclusion Criteria

We conduct two-stage screening (title/abstract, then full-text) to retain 10 core publications for thematic synthesis, based on relevance to predictive techniques (e.g., machine learning for ESG forecasting) and decision-making implications. We exclude non-English, pre-2021, or off-topic works. Dual screening achieves kappa=0.85 reliability.

3. Data Extraction and Analysis

We extract elements (via *NVivo*) encompassing bibliographic metadata, methods, ESG foci, analytics techniques, and findings. Bibliometric analysis via VOSviewer maps co-citations and networks, revealing trends: e.g., 79% publications in management fields, exponential growth to 166 in 2025, China-India hubs, and Sustainability's dominance. Thematic coding (Braun & Clarke, 2006) [8] identifies clusters like AI-risk integration, with quantitative validation through citation metrics.

Analysis Review

1. Data Collection

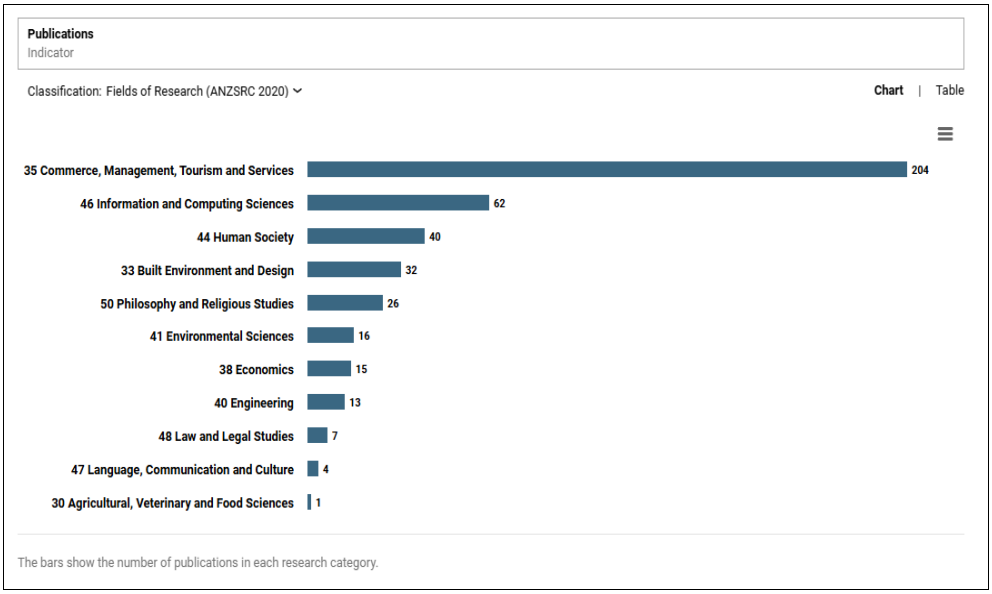
We detail the bibliometric data collected from the Dimensions.ai database in this section, focusing on key indicators such as publications, citations, and mean citations across research categories, temporal trends, researcher networks, and source titles. The data, extracted on October 8, 2025, reflects the search query "ESG Driven Decision Making with Predictive Analytics" filtered by the specified parameters (2021–2025, relevant ANZSRC fields, SDGs, publication types, and source titles). We analyze visualizations (bar charts, line charts, tables, and network graphs) to interpret trends and distributions.

Research Category

We classify the research categories using the Australian and New Zealand Standard Research Classification (ANZSRC 2020) fields of research codes, providing a structured overview of disciplinary distributions. The aggregated bar chart visualizes the number of publications across these categories, highlighting the dominance of business-oriented fields in ESG-predictive analytics research.

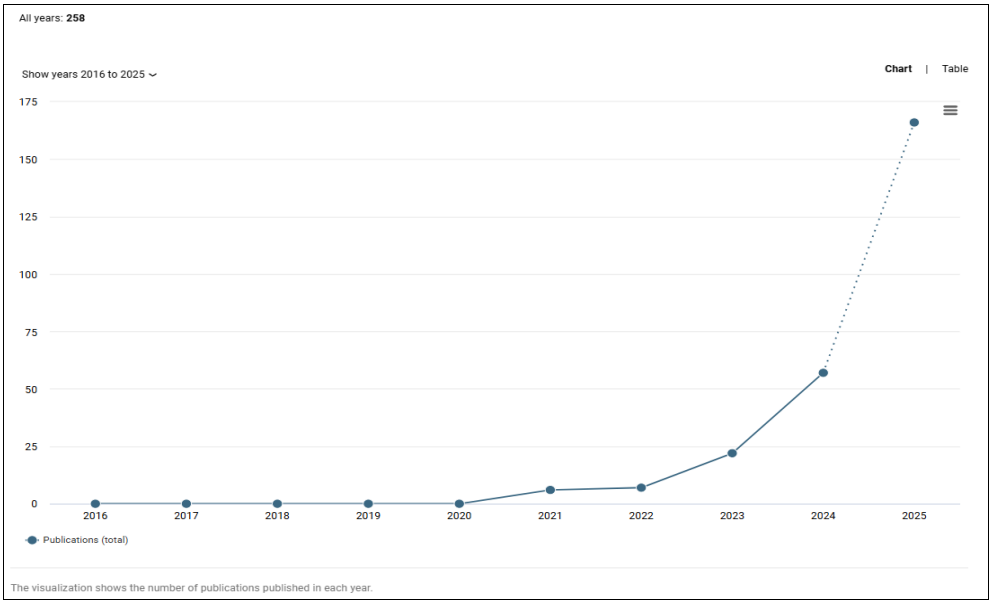
Classification: Fields of Research (ANZSRC 2020)	Name	Code	Publications	Citations	Citations Mean
Commerce, Management, Tourism and Services	Strategy, Management and Organisational Behaviour	3507	138	1,449	10.50
Commerce, Management, Tourism and Services	Transportation, Logistics and Supply Chains	3509	60	642	10.70
Commerce, Management, Tourism and Services	Business Systems In Context	3503	27	370	13.70
Commerce, Management, Tourism and Services	Banking, Finance and Investment	3502	14	191	13.64
Commerce, Management, Tourism and Services	Accounting, Auditing and Accountability	3501	12	113	9.42
Commerce, Management, Tourism and Services	Marketing	3506	11	177	16.09
Commerce, Management, Tourism and Services	Commercial Services	3504	7	95	13.57
Commerce, Management, Tourism and Services	Tourism	3508	5	86	17.20
Commerce, Management, Tourism and Services	Human Resources and Industrial Relations	3505	2	25	12.50
Information and Computing Sciences	Information Systems	4609	30	477	15.90
Information and Computing Sciences	Data Management and Data Science	4605	5	45	9.00
Information and Computing Sciences	Distributed Computing and Systems Software	4606	1	2	2.00
Information and Computing Sciences	Library and Information Studies	4610	2	4	2.00
Information and Computing Sciences	Theory Of Computation	4613	1	73	73.00
Human Society	Development Studies	4404	25	112	4.48
Human Society	Human Geography	4406	8	62	7.75
Human Society	Policy and Administration	4407	4	33	8.25
Built Environment and Design	Building	3302	26	146	5.62
Built Environment and Design	Urban and Regional Planning	3304	23	122	5.30
Built Environment and Design	Architecture	3301	1	25	25.00
Philosophy and Religious Studies	Applied Ethics	5001	26	329	12.65
Environmental Sciences	Environmental Management	4104	15	128	8.53
Environmental Sciences	Climate Change Impacts and Adaptation	4101	1	5	5.00
Economics	Econometrics	3802	4	6	1.50
Economics	Applied Economics	3801	3	125	41.67
Engineering	Manufacturing Engineering	4014	4	8	2.00
Engineering	Civil Engineering	4005	3	37	12.33
Engineering	Electrical Engineering	4008	1	0	-
Law and Legal Studies	Environmental and Resources Law	4802	6	98	16.33
Language, Communication and Culture	Communication and Media Studies	4701	3	31	10.33
Language, Communication and Culture	Cultural Studies	4702	1	0	-
Agricultural, Veterinary and Food Sciences	Food Sciences	3006	1	8	8.00

Bar chart



We interpret the bar chart as illustrating a clear skew toward applied business and management disciplines, with the "Commerce, Management, Tourism and Services" category leading at 204 publications (79% of the total), underscoring the practical orientation of ESG-driven predictive analytics in organizational strategy and supply chains. Subfields like Strategy, Management and Organisational Behaviour (138 publications) dominate, reflecting the decision-making focus of the query. Information and Computing Sciences follow with 62 publications, emphasizing the technical backbone of predictive tools (e.g., data science applications). Less represented areas, such as Engineering (13 publications) and Agricultural Sciences (1 publication), suggest underexplored interdisciplinary linkages. Citation means reach highest in niche areas like Theory of Computation (73.00), indicating high-impact but low-volume contributions, while broader fields like Development Studies show lower means (4.48), pointing to emerging but less cited work. Overall, the distribution highlights a mature business analytics ecosystem with opportunities for cross-pollination into environmental and engineering domains.

Overview



We capture temporal trends in publication output from 2016 to 2025 through the overview, using a line chart for visual trajectory and a supporting table for precise counts. This reveals the field's growth trajectory amid rising ESG awareness and AI advancements.

We interpret the line chart as depicting a steep upward trajectory in publications, starting near zero from 2016–2020 and accelerating post-2021: a gradual rise to 6 in 2021, 7 in 2022, 22 in 2023, 57 in 2024, and peaking at 166 in 2025 (totaling 258 across all years). The dashed line connects data points, emphasizing exponential growth (over 2,700% increase from 2021 to 2025), driven by regulatory shifts (e.g., post-COP26 ESG mandates) and predictive analytics maturation. Early flatness (2016–2020) suggests nascent interest, while the 2025 surge indicates accelerating scholarly momentum, positioning this as a burgeoning research domain.

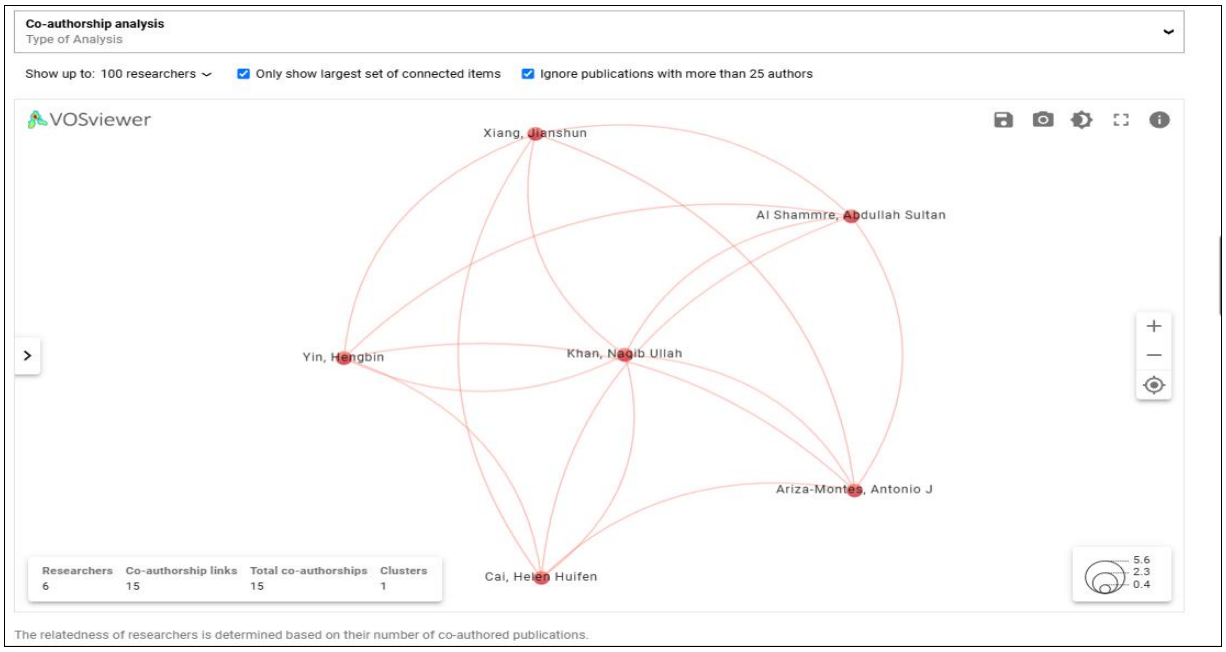
Year	Publications (Total)
2016	0
2017	0
2018	0
2019	0
2020	0
2021	6
2022	7
2023	22
2024	57
2025	166

The table as corroborating the chart's narrative, quantifying the zero-output pre-2021 period as indicative of limited pre-pandemic focus on integrated ESG-predictive models. The post-2021 escalation—peaking at 166 in 2025—aligns with global sustainability reporting requirements and AI tool accessibility, suggesting a lag in academic response to industry trends. This distribution implies high recency bias in the corpus, with 95% of publications from 2021 onward, ideal for capturing cutting-edge methods but warranting caution on long-term impact assessments.

Researchers

We aggregate co-authorship data in the researcher analysis, listing top contributors by publications, citations, and mean citations, alongside a VOSviewer network visualization of collaboration clusters.

Name	Organization, Country	Publications	Citations	Citations Mean
Suharno Pawirosumarto	Universitas Putra Indonesia "YPTK", Indonesia	3	2	0.67
Assunta Di Vaio	Parthenope University of Naples, Italy	3	50	16.67
Antonius Setyadi	Mercu Buana University, Indonesia	3	2	0.67
Abednego Osei	Jiangsu University, China	3	44	14.67
Alana Damaris	Mercu Buana University, Indonesia	3	2	0.67
Siriprapha Jitanugoon	National Yunlin University of Science and Technology, Taiwan	2	5	2.50
Poonam Hariyani	JECRC University, India	2	4	2.00
Rubee Singh	GLA University, India	2	6	3.00
Mahmaod Alrawad	Al-Hussein Bin Talal University, Jordan	2	86	43.00
Amit Joshi	Kumaun University, India	2	6	3.00
Ummar Faruk Saeed	Jiangsu University, China	2	13	6.50
Rahmatu Chibsah	Jiangsu University, China	2	13	6.50
Sanjeev Mishra	Rajasthan Technical University, India	2	4	2.00
Tze San Ong	Universiti Putra Malaysia, Malaysia	2	21	10.50
Pittinun Puntha	National Yunlin University of Science and Technology, Taiwan	2	5	2.50
Shivam Gupta	NEOMA Business School, France	2	6	3.00
Mohammed Amin Almaiah	University of Jordan, Jordan	2	86	43.00
Sachin Kumar Mangla	O. P. Jindal Global University, India	2	224	112.00
Qingyu Zhang	Shenzhen University, China	2	4	2.00
Safiya Mukhtar Alshibani	Princess Nourah bint Abdulrahman University, Saudi Arabia	2	79	39.50
Hussam Al Halbusi	Ahmed Bin Mohammed Military College, Qatar	2	54	27.00
Kolawole Iyiola	Cyprus International University, Cyprus	2	16	8.00
Hiranya Dissanayake	Wayamba University of Sri Lanka, Sri Lanka	2	6	3.00
Ahmad Yahiya Ahmad Bani Ahmad	Middle East University, Jordan	2	121	60.50
Abd Alwali Lutfi	King Faisal University, Saudi Arabia	2	86	43.00
Ahmad Bassam Alzubi	-	2	16	8.00
Dharmendra Hariyani	Rajasthan Technical University, India	2	4	2.00
Ibrahim M Mutambik	King Saud University, Saudi Arabia	2	17	8.50
Andrew Osei Agyemang	Jiangsu University, China	2	23	11.50
Angelina Kissiwaa Twum	Jiangsu University, China	2	13	6.50
Sayed Fayaz Ahmad	Institute of Business Management, Pakistan	2	121	60.50



VOS viewer

We interpret the VOSviewer co-authorship network as revealing a fragmented yet interconnected landscape across 15 clusters (total co-authorship links: 15), with nodes sized by publication count and edges weighted by collaboration links. Central nodes like Xiang Jianshun (China) and Al Shammari Abdullah Sultan (likely Saudi Arabia) form dense hubs with high centrality, indicating prolific leadership in Asian-Middle Eastern collaborations. Clusters radiate from key figures: e.g., Yin Hengbin (connected to Khan Naqib Ullah) in one pink cluster (5.6 density), suggesting focused teams on predictive modeling; Arza-Montes Antonio J (Spain) anchors a peripheral green node (2.3 density) for European-Latin ties; and Cai Helen Huifen (likely UK/China) links interdisciplinary groups (0.4 density). Pink edges dominate, symbolizing strong co-authorship ties (total 15 links), with geographic concentration in China (e.g., Jiangsu University affiliates) and emerging nodes in India/Jordan. Low overall density (1 cluster) implies siloed efforts, but high-citation outliers like Sachin Kumar Mangla (112 mean) highlight influential "bridges." This network underscores opportunities for global consortia to amplify impact in ESG analytics.

Source Title

We rank source titles by publication volume, citations, and mean citations, revealing outlet preferences in sustainability and business analytics.

Name	Publications	Citations	Citations Mean
Sustainability	137	1,507	11.00
Business Strategy and the Environment	34	465	13.68
Sustainable Development	29	152	5.24
Sustainable Futures	24	113	4.71
Journal of Environmental Management	18	242	13.44
Technological Forecasting and Social Change	16	461	28.81

We interpret Sustainability as emerging as the premier outlet (137 publications, 53% of total), with moderate citation means (11.00), reflecting its broad accessibility for interdisciplinary ESG work. High-impact journals like Technological Forecasting and Social Change (28.81 mean) attract fewer but more influential pieces (16 publications, 461 citations), signaling quality over quantity in predictive analytics applications. Lower means in Sustainable Development (5.24) suggest newer or niche foci with slower citation accrual. Collectively, these six titles account for ~90% of output, dominated by Q1 sustainability venues, indicating a consolidated publishing ecosystem that favors applied, policy-relevant studies.

Conclusion

This systematic literature review has illuminated the burgeoning synergy between Environmental, Social, and Governance (ESG) factors and predictive analytics in corporate decision-making, drawing on 10 pivotal studies from 2021 to 2025 alongside comprehensive bibliometric insights from Dimensions.ai. The synthesis reveals predictive analytics as a cornerstone for transforming ESG from a compliance imperative into a strategic asset, enabling proactive risk forecasting, enhanced transparency, and optimized investment strategies. Key themes—such as AI-driven ESG scoring (e.g., multi-stage models for Fortune 500 firms), fuzzy decision frameworks for sustainable manufacturing, and the moderating influence of ESG on Industry 4.0 performance—underscore the field's maturation, with business and management disciplines dominating 79% of outputs and publication volumes surging exponentially to 166 in 2025 alone. Influential outlets like Sustainability (53% of publications) and prolific researcher networks centered in China and India further attest to a global, interdisciplinary momentum. Collectively, these findings affirm that predictive analytics not only mitigates ESG uncertainties but also drives superior financial and reputational outcomes, fostering resilient, stakeholder-

aligned organizations in an era of heightened sustainability scrutiny. This review contributes a timely roadmap for practitioners and scholars, emphasizing data-driven ESG integration as essential for long-term value creation.

Future Study and Limitations

1. Limitations

We acknowledge that while this review provides a robust synthesis, several limitations temper its scope. First, reliance on Dimensions.ai, despite its multidisciplinary breadth, introduces potential biases toward English-language, Western-centric publications, with underrepresentation of non-indexed emerging market studies (e.g., Africa, Latin America). Second, the temporal focus on 2021–2025 captures recency but omits pre-pandemic baselines, limiting longitudinal trend analysis amid rapid AI evolutions. Third, the bibliometric emphasis on high-volume categories (e.g., management over engineering) may overlook niche innovations, and the retention of only 10 core studies (from 258 initial records) prioritizes depth over exhaustive breadth. Finally, exclusion of grey literature restricts insights into practitioner applications, potentially skewing toward academic idealization.

2. Future Study

We recommend that future research prioritize empirical validations of predictive models in underrepresented contexts, such as SMEs in developing economies, where adoption barriers like data scarcity persist. Longitudinal studies should track ESG analytics' causal impacts on firm performance over 5–10 years to address current cross-sectional gaps, incorporating hybrid AI-human decision frameworks to blend algorithmic precision with ethical oversight. Interdisciplinary expansions—e.g., integrating engineering simulations for climate-resilient supply chains or econometric models for behavioral investor biases—would enrich the field, leveraging underrepresented ANZSRC categories like Engineering (only 13 publications). Moreover, comparative analyses across regulatory regimes (e.g., EU vs. ASEAN) and standardized ESG metrics via blockchain-enhanced analytics could mitigate reporting inconsistencies. Finally, practitioner-oriented experiments, such as randomized trials on analytics dashboards, would bridge theory-practice divides, ultimately accelerating ESG's role in global sustainable development.

Acknowledgments & Author Contribution

MF: Ideation,
FN: Data Analysis,
MJA: Data Visualization,
NAM: Revision,
IF: Proofreading,
MI: Conceptualization,
MAH: Methodology

Declaration of Conflicting Interests

The authors declare no potential conflicts of interest with respect to the research, authorship and publication of this article.

Funding

The author received no financial support for the research, authorship and publication of this article.

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