

DOI: https://doi.org/10.48009/3_iis_2026_134

The importance of artificial intelligence's impact on CSR indicators for creating non-financial reports

Ewa Stawicka, *Warsaw University of Life Sciences*, ewa_stawicka@sggw.edu.pl

Abstract

The increasing integration of artificial intelligence (AI) into sustainability reporting reflects a broader digital transformation in corporate disclosure practices. AI-enabled systems support organizations in automating key stages of ESG reporting, including data acquisition from heterogeneous sources such as Enterprise Resource Planning (ERP) systems, Human Resources (HR) platforms, environmental monitoring systems, and unstructured external data sources. Machine learning and natural language processing (NLP) techniques facilitate the extraction, classification, and aggregation of ESG-related information, thereby improving the accuracy, consistency, and efficiency of non-financial reporting processes. In parallel, the adoption of ESG dashboards enables near real-time visualization of sustainability indicators, supporting a transition from periodic, retrospective reporting toward continuous ESG reporting models. This shift represents a fundamental change in sustainability disclosure, moving from static annual reporting to dynamic, data-driven monitoring systems that support proactive risk management and decision-making. AI-driven analytics enhance organizations' ability to detect environmental, social, and governance risks earlier and respond more effectively to emerging challenges. The aim of this study is to examine the role of artificial intelligence in enhancing the efficiency of information systems used in non-financial reporting. Using a bibliometric perspective, the paper identifies key application areas of AI in ESG reporting and outlines emerging research trends, with particular emphasis on the development of continuous reporting frameworks and the integration of AI into sustainability management systems.

Keywords: artificial intelligence, sustainability, risks, report.

Introduction

The concept of corporate social responsibility (CSR) is constantly evolving and poses a significant challenge to business practice (Haywood & Boihang, 2021). Knowledge on CSR remains highly fragmented, with contributions from various disciplines and levels of analysis (Alcadipani & Medeiros, 2020). This constant evolution of the concept has made CSR, and the way businesses implement it in society, extremely problematic. This has led to a more substantive critique of CSR, with some authors focusing on greenwashing related to perceived gaps between CSR communication and actions (Ordóñez-Ponce et al. 2021), while others present more fundamental challenges to CSR, promoting ideas of corporate social irresponsibility or emphasizing the structural and functional limitations of CSR (Latapí et al. 2019). Waddock (2020) argues that companies are unlikely to transform unless the surrounding ecosystem demands it. However, a more inclusive approach to stakeholder understanding and engagement is emerging, with a greater emphasis on global social risk analysis, greater attention to the rights and needs of workers exposed to risk in supply chains, and a reconceptualization of business (conceptualizing operations in new, different ways, often in response to market changes, crises, or the desire to leverage new technologies) as

an essential element of global-local social transformation. In response to the complexities and challenges of CSR, companies may seek guidelines and tools to help them develop or standardize reporting, especially since CSR contributes to sustainable development. There is a shift in corporate attitudes and understanding of CSR as a strategy for improving performance, adding value to products or services, and achieving competitive advantage. Organizations typically strive to achieve a competitive advantage to increase their market share. In this case, organizations focus on control systems in all their forms to identify, address, and leverage weaknesses and strengths (Mahmood et al. 2025). One of the goals organizations focus on is controlling non-financial performance and linking it to the organization's strategic goals, such as quality, reliability, on-time delivery, and many others (Albuhisi & Abdallah, 2018). Therefore, non-financial performance indicators refer to the organization's performance in other, typically non-financial, areas, such as inventory, customer satisfaction, competitive advantage, service or product delivery time, quality, and many others (Nyarku & Ayekple, 2019). Gharpure (2025) note that non-financial performance indicators are important issues comparable to financial indicators, as a digital organization's profits and investment returns may not be indicative of its overall performance, but rather customer satisfaction and loyalty, as well as product or service delivery time and quality standards, may be crucial for achieving indicators assessing the organization's overall performance. The impact of artificial intelligence (AI) on CSR and ESG metrics is increasingly significant, as it changes how they are defined, measured, and reported. AI not only improves data collection and analysis but also influences the quality, comparability, and reliability of indicators. The use of AI in organizations' production, administrative, and accounting processes is crucial. This stems from the introduction of technology to a wide variety of business processes, which has led to the development and improvement of all aspects of organizational work (World Economic Forum, 2025; Primec et al. 2026). Therefore, the aim of this study is to determine the impact of AI on the creation of social responsibility metrics across environmental, social, and corporate governance. It also highlights the importance of AI in improving the efficiency of IT systems and maximizing non-financial results in organizations. The study provides a bibliometric perspective, identifies key elements of AI-supported ESG reporting, and suggests directions for further research. The study was conducted using bibliometric analysis methods and a literature review procedure compliant with the PRISMA 2020 guidelines. The aim was to identify, evaluate, and analyze scientific publications on artificial intelligence, CSR indicators, and non-financial reports. Bibliographic data was obtained from the Scopus and Web of Science databases. Publications meeting the following criteria were included in the analysis: scientific articles published in peer-reviewed journals, publications on AI, CSR tools, non-financial reports, publications in English, and publications published between 2024 and 2026. During this time, the importance of sustainability reporting/non-financial reporting has increased due to the CSRD (Corporate Sustainability Reporting Directive). The initial search identified 40 records. After applying the eligibility criteria, 19 publications were considered for final analysis. The analysis included an assessment of the number of publications over time, the most influential journals, institutions, and countries conducting research in the analyzed area. Additionally, a keyword co-occurrence analysis and bibliometric network mapping were conducted to identify dominant research topics and trends.

Specifically, this study focuses on the following research question:

1. How is AI being used in ESG reporting?
2. How does AI shape ESG indicators in the environmental, social, and governance areas?

Given the still-limited number of empirical studies on the use of artificial intelligence and IT tools in non-financial reporting, this study focuses on an introductory review of the literature. This area is currently in its early stages of scientific development, and available publications are often conceptual, review, or exploratory in nature, with a concomitant paucity of studies that empirically verify the effectiveness and real-world applications of AI solutions in ESG reporting.

The Impact of AI on the Environmental Area

Recent research increasingly highlights the dual role of artificial intelligence (AI) in advancing environmental sustainability while simultaneously introducing new environmental pressures. A substantial body of literature demonstrates that AI technologies contribute to improved environmental management through applications such as smart energy systems and intelligent grid optimization. Machine learning-based forecasting models are widely used to predict energy demand, enabling more efficient resource allocation and reducing energy waste.

In the domain of climate science, AI has been extensively applied to enhance predictive modelling of extreme weather events and to support climate change monitoring and mitigation strategies (Coovadia et al., 2025). Similarly, in agriculture, AI-driven precision farming techniques enable more efficient use of water, fertilizers, and pesticides through the integration of satellite imagery, sensor data, and drone-based monitoring systems. These applications contribute to reduced environmental degradation and improved resource efficiency. Further studies emphasize the role of AI in biodiversity conservation, where computer vision and sensor-based systems are used to monitor endangered species, analyse ecological data, and detect illegal environmental activities. In industrial and logistics systems, AI supports supply chain optimization and production planning, reducing overproduction and minimizing material waste. At the same time, the literature highlights the increasing adoption of energy-efficient computing paradigms, including green data centers and “green AI” approaches aimed at reducing the computational footprint of machine learning models (Sahoo & Sahoo, 2024). Despite these benefits, an emerging stream of research also addresses the environmental costs associated with AI. High computational requirements, particularly in large-scale machine learning and deep learning models, contribute to increased energy consumption and carbon emissions from data centers. As a result, recent studies have proposed a set of emerging environmental indicators for AI systems, including energy consumption (kWh), CO₂e emissions, water usage, Power Usage Effectiveness (PUE), life cycle assessment (LCA), and electronic waste generation (Moodaley & Telukdarie, 2023).

However, a consistent finding in the literature is the lack of standardized methodologies for measuring and reporting the environmental impact of AI systems. This absence of harmonized frameworks limits comparability across studies and organizations and poses a significant challenge for integrating AI-related metrics into ESG reporting practices. Consequently, although AI is widely recognized as a key enabler of environmental optimization, it simultaneously introduces new governance and measurement challenges that remain insufficiently addressed in current research. Overall, the existing literature positions AI as a dual-impact technology within the environmental dimension of ESG, offering both significant opportunities for sustainability enhancement and new risks related to resource consumption and reporting standardization.

The Impact of Artificial Intelligence on the Area of Indicators Related to the Social Area

The existing literature increasingly highlights the positive role of artificial intelligence (AI) in the social dimension of ESG, particularly in relation to education, healthcare, labor markets, and organizational workforce management. In education, AI enables personalized learning pathways and improved accessibility to educational resources. In healthcare, AI contributes to faster, more accurate diagnostics and enhanced data-driven decision-making. Within organizational and labor market contexts, AI is widely associated with task automation and productivity improvements. At the same time, recent studies highlight the emergence of AI-related social indicators for ESG reporting. These include metrics such as the number of jobs automated by AI, the creation of new AI-related roles, the level of employee reskilling and upskilling, and employee turnover rates. Such indicators reflect the growing need to assess the socio-economic impact of AI-driven transformation in organizations. A significant stream of research focuses on

fairness, accountability, and transparency in AI systems, particularly in human resources, finance, and insurance domains. Commonly discussed fairness metrics include equality in recruitment decisions, outcome disparities across demographic groups (e.g., gender and age), and the number of reported discrimination cases (Perdana & Tan, 2024). In addition, AI is increasingly used to monitor data security and compliance, including the number of data breaches, incident response times, and the share of AI systems compliant with regulatory frameworks such as GDPR. From a workforce development perspective, AI supports measuring and managing training-related indicators, including average training hours per employee, the proportion of employees receiving training, and investments in digital skill development. These applications demonstrate how AI contributes to more structured and data-driven social reporting practices (Rodriguez & Cruz, 2023). Methodologically, the literature identifies several key approaches to AI-enabled ESG social reporting. These include automated data integration from HR, CRM, and IT systems, which reduces manual reporting efforts and improves data consistency. Natural language processing (NLP) techniques are applied to analyze employee surveys and customer feedback, enabling the identification of issues such as discrimination, dissatisfaction, or organizational stress. Furthermore, algorithmic auditing methods are used to detect bias, evaluate decision fairness, and ensure regulatory compliance. In addition, predictive analytics is increasingly used to assess social risks, including employee turnover, burnout risk, and the social consequences of automation. AI also supports automated ESG report generation, visualization of social indicators, and compliance with reporting standards such as GRI and ESRS. These developments indicate a shift toward more automated, continuous, and data-driven ESG reporting systems. Despite these advantages, the literature also emphasizes significant challenges associated with AI in social ESG reporting. These include difficulties in quantifying qualitative social dimensions such as trust, the risk of “AI washing,” and ethical and legal concerns. In particular, the use of AI raises issues related to data privacy, personal data protection, and algorithmic bias. Since AI systems are trained on historical datasets that may reflect existing social inequalities, they risk reproducing or amplifying these biases in decision-making processes. Moreover, the “black box” nature of many AI models limits transparency, making it difficult to explain decisions and assign responsibility for potential errors or discriminatory outcomes (Pathirana et al., 2022). Overall, the literature positions AI as a dual-impact technology in the social dimension of ESG: it significantly enhances data collection, analysis, and reporting capabilities, while simultaneously introducing complex ethical, methodological, and regulatory challenges that require further investigation.

The Impact of AI on Corporate Governance Metrics

The impact of artificial intelligence (AI) on corporate governance has been widely recognized as both transformative and challenging. Existing literature emphasizes that AI is reshaping governance structures across multiple dimensions, including decision-making, accountability, transparency, risk management, ethics, and regulatory compliance. A central issue concerns decision-making and accountability in algorithm-driven environments. When AI systems are used in high-impact decisions, such as credit scoring or human resource management, questions arise regarding responsibility for erroneous or biased outcomes (Almadadha, 2024). This challenge is closely linked to the problem of transparency, as many AI models operate as “black boxes,” limiting the ability to explain or justify automated decisions. Another important research stream focuses on risk management in AI-enabled governance systems. Studies highlight risks related to algorithmic bias, model errors, cyber threats, and systemic vulnerabilities, which require continuous monitoring and robust oversight mechanisms (Xu, 2024). In this context, governance frameworks increasingly emphasize the need for structured AI risk management systems.

Ethics and regulatory compliance constitute another critical dimension of AI governance. The literature highlights the growing importance of aligning AI systems with emerging regulatory frameworks, such as the EU AI Act, and implementing internal ethical principles that govern the development and deployment of AI technologies. This includes establishing AI ethics policies, monitoring compliance, and

integrating ethical standards into organizational processes. From an ESG reporting perspective, governance-related AI metrics are increasingly used to assess organizational maturity in managing AI systems. These metrics include the existence of an AI strategy, the proportion of projects governed by formal AI policies, the presence of AI ethics committees, and the extent of employee training in AI ethics. In addition, algorithm auditing practices—such as regular model reviews and bias detection procedures—are considered essential components of responsible AI governance (Xu & Liu, 2023). Security and cybersecurity represent further key concerns in the governance of AI systems. The literature emphasizes the importance of monitoring AI-related security incidents, conducting resilience testing (e.g., adversarial attacks), and ensuring appropriate access control mechanisms. These elements are critical for safeguarding AI systems against misuse and ensuring operational integrity.

Recent studies also underline the importance of organizational structure in AI governance. This includes establishing dedicated AI governance teams, board-level oversight, involving AI experts in executive management, and adhering to international standards and regulatory requirements, such as ISO standards and the EU AI Act (Al-Daoud & Abu-AlSondos, 2025). Overall, the literature suggests that effective AI governance requires a combination of transparency, accountability, ethical oversight, and technical robustness. Ensuring data quality, mitigating algorithmic bias, improving model explainability, and maintaining human oversight are identified as key prerequisites for enhancing the credibility and reliability of AI-driven ESG reporting systems.

Summary

In summary, the answer to the first question: How is artificial intelligence used in ESG reporting? Based on an analysis of available academic texts, taking into account the new CSRD directive, and initial results of analyses in theory and practice. Artificial intelligence supports ESG reporting primarily by automating the collection, processing, and analysis of large data sets from various sources. AI algorithms enable the identification, classification, and integration of environmental, social, and corporate governance data, which increases the accuracy, consistency, and timeliness of reports. AI is also used to monitor compliance with regulations, detect irregularities, forecast ESG trends, and generate reports compliant with applicable reporting standards. Furthermore, natural language processing (NLP) technologies enable the analysis of corporate documents, reports, and communications, supporting the assessment of the quality of non-financial disclosures.

The second question: how does artificial intelligence shape ESG indicators in the areas of environmental, social, and corporate governance? This issue pertains to the practice of companies as they develop. Artificial intelligence (AI) supports ESG reporting primarily by automating the collection, processing, and analysis of large data sets from various sources, such as ERP systems, IoT sensors, corporate documents, and social media. Artificial intelligence (AI) algorithms enable the identification of relevant ESG indicators, anomaly detection, regulatory compliance monitoring, and the generation of non-financial reports. Furthermore, natural language processing (NLP)-based tools analyze report content and automatically generate ESG performance descriptions, increasing the efficiency, accuracy, and timeliness of the reporting process.

Conclusion

The importance of AI for non-financial reporting includes increased accuracy and reliability of CSR indicators, automated reporting, the ability to analyze quantitative and qualitative data, and improved identification of ESG risks. Reports are becoming more proactive rather than just descriptive. However, AI is introducing new areas of reporting and increasing the complexity of reports, which requires new standards and regulations. AI enables the analysis of employee opinions, customer comments, and trust

levels. Automated report creation shortens report preparation time and increases consistency, enabling the automatic generation of ESG reports, summaries, and conclusions, and data visualization. Thanks to AI, CSR reports are more accurate, data-driven, updated more frequently, and more comparable. But they are also more complex, requiring technological competencies, and, above all, dependent on data quality. The importance of AI for non-financial reporting is primarily demonstrated by increased accuracy and reliability of CSR indicators, automated reporting processes, the ability to analyze both quantitative and qualitative data, and more efficient identification of ESG risks. Reports are no longer merely descriptive but are becoming more analytical and proactive, enabling organizations to identify environmental, social, and governance risks earlier. At the same time, artificial intelligence is introducing new areas of reporting and increasing the complexity of the data analyzed, requiring the development of new standards and regulations for non-financial reporting. This particularly concerns the transparency of algorithms, data quality, and accountability for decisions made using AI systems (Without AI, 2023).

AI enables the analysis of large text data sets, such as employee reviews, customer comments, and social media communications, allowing for the assessment of stakeholder trust and the identification of potential social issues within the organization. Automation of reporting processes shortens report preparation time and improves consistency, enabling the automatic generation of ESG reports, the creation of summaries and conclusions, and the visualization of data in charts and analytical dashboards. As a result, CSR reports are becoming more data-driven, updated more frequently, and more comparable across organizations. At the same time, the growing role of artificial intelligence is making reports more complex, requiring new technological skills and largely dependent on the quality and completeness of the data used in analyses. The literature (Liu et al. 2026) emphasizes that the use of artificial intelligence tools in ESG reporting can significantly improve data analysis efficiency. According to some studies, natural language processing (NLP) algorithms can analyze thousands of non-financial reports and identify key ESG indicators in a significantly shorter time than traditional document analysis methods. Research also indicates that AI systems can detect inconsistencies in CSR reports that are difficult to spot with manual analysis (OECD, 2024). An interesting research direction is the use of artificial intelligence to assess the credibility of non-financial reports. Some machine learning models are used to identify potential instances of greenwashing or inconsistencies between company declarations and actual data regarding emissions or social policy. In recent years, the concept of AI-assisted sustainability reporting has also been developing, in which artificial intelligence supports the report creation process by automatically collecting data from various organizational systems (ERP, HR, environmental systems), aggregating it, and preparing preliminary analyses for managers. In some organizations, ESG reports are already partially generated in real time via digital management panels (ESG dashboards). Research also indicates that in the future, non-financial reporting may evolve towards continuous ESG reporting, i.e., continuous reporting of sustainability indicators, instead of publishing them solely in annual reports. Solutions based on artificial intelligence and real-time data analysis can enable organizations to continuously monitor ESG indicators and quickly respond to emerging risks (Hoang et al. 2026).

Limitations and Future Research Directions

This study has several methodological limitations. Bibliometric analyses are characterized by citation lags, potentially underrepresenting recent developments in AI. Co-occurrence methods can introduce topic bias due to keyword selection and publication norms. Using online databases as a single source introduces linguistic and regional bias, limiting the representation of research in languages other than English. Efforts were made to incorporate practical insights and industry reports. However, given the rapid evolution of AI and ESG standards, the results reflect a snapshot of a dynamic field rather than definitive knowledge structures, emphasizing the need for continuous updates as the field matures. Looking ahead, future research should assess the long-term credibility, reliability, and regulatory robustness of AI-based ESG disclosures

across various market contexts. Particular emphasis should be placed on developing standardized metrics and taxonomies that will enable global harmonization of machine-readable ESG data.

Furthermore, empirical research demonstrating the impact of AI-enhanced ESG disclosures on investor behavior, credit ratings, and company valuations will help strengthen the case for AI integration. There is also a key opportunity to explore how generative AI can automate the creation of investor-facing ESG narratives, assurance statements, and visual summaries while maintaining transparency and compliance. Interdisciplinary approaches combining AI ethics, sustainability science, and financial regulation should be encouraged to address emerging issues such as model accountability, data privacy, and algorithmic equity. Policymakers, in turn, must accelerate the development of regulatory sandboxes, AI audit standards, and ESG disclosure requirements that reflect the new digital reality. Providing incentives for ESG-AI adoption, particularly among SMEs, can democratize access to intelligent sustainability reporting. As climate risks, inequalities, and governance challenges intensify, incorporating AI into ESG frameworks will be key to building more resilient, trustworthy, and inclusive capital markets.

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