Intelligent ESG Infrastructure: AI-Powered Data Integration for RealTime SDG-Aligned Corporate Reporting

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Abstract

Sustainability accounting has evolved from voluntary corporate disclosures to an integrated, data-driven discipline that aligns with global Sustainable Development Goals (SDGs). The emergence of Artificial Intelligence (AI) offers transformative opportunities to automate, validate, and contextualize sustainability data for real-time decision-making. This chapter introduces the concept of Intelligent ESG Infrastructure—a cohesive ecosystem where AI-powered data integration supports SDG-aligned corporate reporting. Through an analysis of technological enablers, implementation strategies, and case illustrations, the chapter demonstrates how organizations can enhance transparency, comparability, and stakeholder trust while reducing reporting burdens.

Keywords: AI, ESG, SDG, Sustainability Accounting, Corporate Reporting, Data Integration, Real-Time Reporting.

1. Introduction

Sustainability has moved from a peripheral concern to a strategic imperative for corporations. Stakeholders—including regulators, investors, and consumers—demand transparent, verifiable, and timely environmental, social, and governance (ESG) disclosures that align with global SDG

targets (UN, 2015). Traditional sustainability reporting suffers from manual data collection, delayed reporting cycles, and inconsistent frameworks.

AI-driven tools provide a solution by integrating structured and unstructured data sources, automating carbon footprint calculations, detecting anomalies, and aligning outputs with multiple reporting standards such as GRI, SASB, ISSB, and CSRD. The concept of Intelligent ESG Infrastructure emerges as a scalable model that combines AI, IoT, big data analytics, and cloud platforms to achieve real-time SDG-aligned reporting.

2. Literature Review

2.1 AI in Sustainability Accounting

Recent studies highlight AI's role in enhancing environmental accounting precision and timeliness (Lee et al., 2024; Kumar & Singh, 2025). AI algorithms can process multimodal data—from satellite imagery for deforestation tracking to NLP-based sentiment analysis of sustainability reports (Zhang et al., 2024).

2.2 ESG Data Integration Challenges

The heterogeneity of ESG data—originating from utility bills, supplier reports, IoT devices, and regulatory filings—creates integration challenges (IFRS Foundation, 2024). AI-powered data lakes and ontology-based frameworks address these issues (Miller & Jones, 2023).

2.3 Real-Time SDG Alignment

Studies (UNEP, 2024) show that real-time reporting enables corporations to adjust operational strategies in near real-time to meet SDG targets, such as reducing greenhouse gas (GHG) emissions or improving workforce diversity metrics.

3. Conceptual Framework: Intelligent ESG Infrastructure

The Intelligent ESG Infrastructure model consists of five interlinked layers:

1. **Data Acquisition Layer** – IoT sensors, ERP integrations, supplier portals, and satellite data streams.

2. **AI Processing Layer** – ML algorithms for carbon accounting, NLP for unstructured data parsing, anomaly detection models.

3. **Standards Mapping Layer** – Automated crosswalks between GRI, SASB, ISSB, CSRD frameworks.

4. **Visualization & Insights Layer** – Dashboards showing KPI trends and SDG performance in real time.

5. **Governance & Compliance Layer** – AI explainability protocols, ethical data handling, audit trails.

4. AI Technologies for ESG & SDG Reporting

4.1 Machine Learning for Predictive Sustainability Analytics

ML models forecast Scope 1–3 emissions, predict resource consumption patterns, and model the ROI of green investments.

4.2 Natural Language Processing (NLP)

NLP extracts ESG-relevant metrics from annual reports, sustainability disclosures, and news coverage, reducing manual review times by up to 80% (Accenture, 2024).

4.3 Computer Vision for Environmental Monitoring

Computer vision models analyze satellite imagery to track deforestation, urban heat islands, and pollution dispersion.

4.4 Knowledge Graphs for Standards Alignment

Knowledge graphs dynamically map corporate ESG data to SDG indicators and regulatory frameworks.

5. Implementation Challenges & Solutions

Challenge	AI-Enabled Solution
Data fragmentation across silos	Deploy centralized ESG data lakes with AI-driven data harmonization.
Lack of standardization	Use AI mapping tools to align metrics with multiple reporting standards.
Data accuracy & auditability	Implement anomaly detection and blockchain-based immutable audit trails.
High adoption cost	Use scalable cloud-based AI tools to reduce infrastructure costs.
Ethical & transparency concerns	Adopt explainable AI (XAI) frameworks for decision-making transparency.

6. Case Illustrations

Case 1: AI in Carbon Accounting – Global Manufacturing Firm

A European automotive company deployed AI to integrate supplier emissions data, automate Scope 3 calculations, and publish quarterly ESG dashboards aligned with SDG 13 (Climate Action). The result: 28% faster reporting cycles and improved investor confidence.

Case 2: NLP for Multi-Framework Reporting – Asian Energy Utility

Using NLP, the utility company converted raw operational data into ESG reports that complied simultaneously with GRI, SASB, and CSRD—cutting manual report preparation time by 70%.

7. Future Directions

- AI-Blockchain Synergy – Secure, verifiable ESG reporting with immutable audit trails.
- Generative AI for Narrative Disclosures – Drafting SDG-aligned sustainability narratives.
- Decentralized ESG Data Marketplaces – Enabling small suppliers to share verified sustainability metrics.
- Edge AI for IoT Sustainability Monitoring – Real-time energy and emissions tracking at the source.

8. Conclusion

AI-driven Intelligent ESG Infrastructure transforms sustainability accounting from static, retrospective reporting into a dynamic, predictive, and SDG-aligned system. By integrating diverse data sources, applying advanced AI analytics, and ensuring governance compliance, organizations can achieve both regulatory alignment and strategic sustainability outcomes. The convergence of AI, ESG, and SDGs marks a pivotal evolution in corporate accountability, setting the stage for real-time, impactdriven decision-making.

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