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Environmental, Social, and Governance (ESG) Metrics and Integrated Reporting in Logistics: A Comprehensive Overview

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Posted Date: 15 May 2025

doi: 10.20944/preprints202505.1007.v1

Keywords: ESG Metrics; Integrated Reporting; Logistics Sustainability; Supply Chain Transparency; Sustainable Logistics Practices

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Environmental, Social, and Governance (ESG) Metrics and Integrated Reporting in Logistics: A Comprehensive Overview

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Abstract: The logistics sector, being a part of global supply chains, is under increasing pressure to incorporate sustainability in its operations with the growing emphasis on Environmental, Social, and Governance (ESG) metrics. This paper addresses the uptake and use of ESG metrics in logistics with a particular emphasis on how integrated reporting frameworks can be used to bring transparency and sustainability to the sector. The study is mainly concerned with the effectiveness of the ESG reporting procedures in logistics firms, transport, storage, and distribution, and examines the application of integrated reporting frameworks in addressing global sustainability needs. The study used a quantitative approach in researching, utilising a survey method in collecting data from 350 South African logistics firms. The study analyses opportunities and challenges to the adoption of ESG, creates best practices in making reporting more reliable, and establishes a conceptual framework for including ESG indicators in logistics reporting. The findings reference the challenges of logistics companies in embracing ESG practices, particularly concerning financial constraints, technological challenges, and regulatory challenges, and introduce innovations such as digital traceability systems and artificial intelligence-based analytics that could drive improved decision-making and reporting procedures. Lastly, the paper aims to contribute to the body of work from scholars and practitioners with an in-depth comprehension of how ESG factors can be best applied in logistics operations for aiding corporate social responsibility and sustainable development.

Keywords: ESG Metrics; Integrated Reporting; Logistics Sustainability; Supply Chain Transparency; Sustainable Logistics Practices

1. Introduction

In the 21st-century business world, ESG performance is no longer a second thought but a base pillar of business accountability and competitiveness. With regulators, investors, and civil society putting greater pressure on the industry, previously cost-competitive and delivery-oriented logistics companies are now being judged on a wider scale of sustainability and stakeholder value [1]. The integration of ESG information into logistics practice and reporting structures is rapidly evolving into a competitive imperative as well as a regulatory mandate. International supply chains are among the most resource-intensive as well as environment-impact-prone systems; logistics plays a critical role in catalyzing or obstructing sustainable development goals [2].Integrated reporting, in which financial data is combined with non-financial ESG disclosures into a single integrated narrative, is gaining traction as a means of reporting long-term value creation and risk management [3]. Logistics businesses, due to their complex value networks and dependence on fossil fuel-based infrastructure, are under mounting pressure to report their carbon footprint, Labor practices, and ethical governance structures. The intersection of ESG metrics and logistics thus results in urgent questions: How do logistics providers establish credible and comparable ESG indicators? How can integrated reporting contribute to greater transparency, trust, and stakeholder engagement?

 doi:10.20944/preprints202505.1007.v1

1.1. Background and Context

The E (Environmental) component of ESG directly pertains to the carbon footprint, fuel consumption, and waste management processes associated with logistics operations. Transport alone contributes approximately 24% of total global CO_2 emissions, and freight transport is responsible for almost 40% of this value [4]. To meet this challenge, organizations are undertaking green logistics practices route optimization, modal switching, and electric vehicle fleets to drive net-zero ambitions and circular economy principles [5]. The S (Social) factor is also significant, such as worker safety, Labor rights, and community engagement especially in outsourced and offshore logistics operations. Issues such as precarious work in last-mile delivery and forced Labor in shipping networks have drawn universal condemnation and legal action [6]. Logistics providers are now under mounting pressure to audit their supply chains not only for efficiency but also for human rights compliance and community engagement. The G (Governance) component values accountability, transparency, and ethical conduct. Governance failure in logistics has the possibility of regulatory violation, customs clearance corruption, or mismanagement of critical materials. Investor activism and ESG rating agencies in recent years have pressured firms that have global logistics networks to report greater board diversity, risk management mechanisms, and anti-corruption policies [7].

1.2. What This Paper Seeks to Address

1. Critically analyses existing ESG metrics and their application or usage in logistics-specific contexts, i.e., transport, warehousing, and distribution.
2. Evaluate the performance of integrated reporting frameworks while reporting ESG performance and meeting global reporting standards.
3. Explain the drivers and barriers to ESG adoption in logistics businesses, including technological, regulatory, and organizational factors.
4. Describe best practices and new trends including digital traceability platforms, third-party verification, and AI-driven ESG analysis for increasing reporting quality and decision-making.
5. Propose a conceptual model for integrated ESG reporting in logistics, giving guidance to scholars and practitioners.

2. Literature Review

2.1. Introduction to Literature Review

2.1.1. ESG Metrics in Logistics: Application and Adaptation

An academic body of literature evaluates the applicability and application of ESG indicators to logistics operations. Traditionally, logistics metrics were cost, speed, and efficiency; however, with the advent of ESG reporting, this has expanded to include carbon emissions, Labor conditions, and ethical governance [2]. Environmental metrics have been the most widely debated, with studies encompassing carbon footprint calculation, fuel consumption rates, per shipment emissions, and modal shifting to sustainable transport [5]. The Green Freight Europe (GFE) and the Global Logistics Emissions Council (GLEC) approach are frequently cited as practical approaches to aligning emissions reporting among logistics organizations. [8].

2.1.2. Integrated Reporting Frameworks: Effectiveness and Challenges

Integrated reporting (IR) is now a convergence-driven framework that ties financial and non-financial performance metrics. The International Integrated Reporting Council (IIRC) and Global Reporting Initiative (GRI) provide the most frequently quoted standards in the literature [3]. The lack of integrated reporting (IR) frameworks with logistics Key Performance Indicators (KPIs) leads to non-specific reporting that fails to differentiate the performance of various organizations.[9] state that

 doi:10.20944/preprints202505.1007.v1

logistics companies omit key information about freight consolidation, last-mile delivery emissions, and packaging reuse metrics. Despite such limitations, researchers agree that combined reporting is viable if appropriately adapted. [10] Suggests that logistics firms develop customized materiality matrices to identify industry-specific ESG issues. Further, cross-referencing IR with GLEC and ISO 14001 can increase alignment with global standards.

2.1.3. Drivers and Barriers to ESG Adoption in Logistics

This paper highlights several drivers of ESG adoption in logistics. Pressure from regulation is among the key drivers, particularly in those markets that demand governments report on emissions as well as human rights due diligence. The European Union's Corporate Sustainability Reporting Directive (CSRD) compels logistics firms to report on ESG performance in their value chains. [11]. Investor expectations are also involved. Companies that are ESG-aligned are reported to raise more capital and pay less to borrow. Institutional investors increasingly screen for sustainability performance, which compels logistics companies to enhance their disclosures [12].

2.1.4. Best Practices and Innovations

Emerging best practices and technologies are helping logistics organizations fill these gaps. Block chain, and IoT-based digital traceability allow organizations to monitor the movement of products, verify the ethical origin, and monitor the environmental impacts in real-time [13]. Third-party sustainability audits are increasingly employed to verify ESG statements and enhance report credibility. [14] Asserts that certifications such as ISO 14001 (environmental management) and SA8000 (social accountability) can provide legitimacy and standardization. Artificial intelligence (AI) and machine learning software are being used to sift through ESG data, analyses trends, and identify anomalies. AI-based dashboards enable scenario planning and decision-making through combining ESG KPIs with operational metrics [15].

2.1.5. Conceptual Models for ESG-Integrated Reporting

Various researchers have proposed conceptual frameworks to guide ESG-based logistics reporting. One of the most widely cited frameworks is that of [16], denoted as the Sustainable Logistics Performance (SLP) model, which integrates economic, environmental, and social components in one performance measurement framework. Yet another model explained by [17] is dynamic capabilities in nature and suggests that incorporating ESG requires new sensing, seizing, and reconfiguring capabilities for firms. This model highlights the strategic, rather than purely operational, nature of embracing ESG.

3. Materials and Methods

This chapter on methodology sets a strong structure for investigating ESG metrics and integrated reporting practices in the South African logistics industry. Through a quantitative method, the research will deliver empirical findings that are of use to researchers, practitioners, and policymakers interested in improving sustainability performance and transparency in logistics.

3.1. Research Design

A cross-sectional survey design is used to collect data at a single point in time from South African logistics companies. The primary purpose is to measure the spread of adoption of ESG metrics, monitor the quality of integrated reporting, and determine drivers and barriers most directly associated with ESG practices among logistics companies.

3.2. Population and Sample

The target population in logistics companies carrying on business in South Africa across three main areas: transport (freight and courier), warehousing, and distribution. The sampling frame is a

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collection of companies registered under the South African industry directories and professional logistics bodies like the Road Freight Association (RFA), the South African Association of Freight Forwarders (SAAFF), and the Chartered Institute of Logistics and Transport (CILT-SA).A stratified random sampling design was applied to gain representation by firm size (small, medium, and large firms), in three provinces (Gauteng, Western Cape and KwaZulu-Natal). The sample of 350 logistics companies was employed, which was chosen using power analysis estimates to generate the desired statistical power for regression as well as correlation analysis.

3.3. Data Collection Method

Primary data was collected using a structured questionnaire sent via email and shared to various social media platforms, groups, and conducted using web-enabled survey tools, google forms. The structured questionnaire includes five main sections:

- *Firm/Organization Demographics:* Size of firm, geographical location in South Africa, primary logistics service provided, and years of operation.
- *ESG Metrics Implementation:* Application of environmental (e.g., carbon tracking, fuel efficiency), social (e.g., Labor practices, diversity), and governance metrics (e.g., compliance controls).
- I*ntegrated Reporting Practices:* Utilization of GRI, IIRC, and other frameworks, frequency and degree of ESG reporting.
- *Drivers and Barriers:* Likert-scale items assessing technological ability, regulatory compliance, organizational culture, pressure from stakeholders, and cost factors.
- *Performance Outcomes:* ESG rating, customer satisfaction, operational efficiency, and investment attractiveness.

3.4. Data Analysis Techniques

Data analysis was be performed using SPSS and R. Descriptive statistics (means, standard deviations, frequencies) was employed to summarize demographic information and ESG practices. Inferential statistical analysis was:

- *Exploratory Factor Analysis (EFA):* To identify latent ESG drivers and barriers' constructs.
- *Multiple Regression Analysis:* To examine the relationship between the adoption of ESG and performance outcomes.
- *Correlation Analysis:* To test relationships between some ESG metrics and integrated reporting quality.
- *ANOVA:* To investigate differences in ESG practices by firm size and provinces.

3.5. Ethical Considerations

Voluntary survey participation was ensured, and confidentiality and anonymity of the respondents were ensured. Data remains confidential and is utilized only for academic research purposes.

4. Research Results

This table illustrates a high overall rate of adoption of ESG metrics by South African logistics firms, particularly in terms of Labor standards compliance (mean = 4.5) and carbon emissions tracking (mean = 4.2). The lower mean for tracking fuel efficiency reflects a possible gap or challenge in adopting environmental technology.

Global Reporting Initiative (GRI) is the most used framework, meaning it is the standard of choice for the South African logistics sector. A high percentage of firms (20%) use no formal ESG reporting framework, reflecting a lack of organized sustainability communication. SASB and IIRC framework underutilization is due to insufficient knowledge or lack of fit with industry-specific needs.

 doi:10.20944/preprints202505.1007.v1

Factor loadings confirm that stakeholder pressure, technology readiness, and regulatory compliance are strong drivers of ESG adoption. Organizational culture is also a strong determinant, supporting literature emphasizing internal values and leadership. Financial constraints as a barrier emerge with a strong negative loading of -0.71, indicating that cost concerns are delaying ESG integration in some firms.

The regression results indicate that ESG implementation has a positive influence on firm performance. The strongest relationship is between ESG practice and ESG rating ($\beta = 0.51$), followed by attraction of investments ($\beta = 0.48$). This identifies the significance of ESG transparency in building investor confidence. Quality of integrated reporting has a very strong impact on customer satisfaction, while operational efficiency is improved by good ESG practices.

NOVA results indicate statistically significant differences in ESG practices across firm size. Large firms are more likely to possess carbon monitoring and formal reporting systems, likely due to their greater resources and stakeholder influences.

5. Discussion

ESG Metric Implementation in South African Logistics Companies

Findings from Table 1 characterize South African logistics companies as moderately high in their rates of implementing ESG metrics, particularly the respect for Labor standards and emissions monitoring. The average scores of 4.5 and 4.2, respectively, reflect a strong environmental and social sustainability commitment. These findings validate earlier studies highlighting the growing prominence of corporate social responsibility (CSR) in logistics due to environmental issues and the human-capital-based nature of the industry [18].The lower mean score of 3.8 for fuel efficiency monitoring could imply resistance in the logistics industry's adoption of high-end technologies or operational resistance to fuel usage efficiency within the context of South African logistics operations. Previous studies have also shown that while most logistics firms focus on environmental sustainability, implementation of some of these environmental measures, including fuel efficiency, is technologically demanding and expensive [19].

Table 1. Descriptive Statistics of ESG Implementation Metrics (N = 350) (Author's own compilation).

ESG Metric	Mean	Std. Deviation	Minimum	Maximum
Carbon Emission Tracking	4.2	0.78	2	5
Fuel Efficiency Monitoring	3.8	1.02	1	5
Labour Standards Compliance	4.5	0.67	3	5
Workforce Diversity Metrics	3.9	0.81	2	5
Governance Compliance Systems	4.1	0.88	2	5

Integrated Reporting Practices

Table 2 indicates that the Global Reporting Initiative (GRI) framework is the most common reporting standard applied by South African logistics firms, at 38% of firms reporting based on its guidelines. This concurs with research findings from earlier studies that GRI has become the de facto standard of global sustainability reporting, particularly where a large environmental footprint exists, such as logistics [20]. However, the relatively limited use of IIRC and SASB frameworks across the South African logistics sector implies that logistics firms either are not aware of these frameworks or find these less appropriate for their sector-specific needs.

Table 2. Integrated Reporting Practices (Author's compilation).

Framework Used	Frequency (%)
GRI Standards	38%

 doi:10.20944/preprints202505.1007.v1

IIRC Integrated Report	27%
SASB Standards	15%
None Used	20%

Drivers and Barriers to ESG Adoption

Factor analysis in Table 3 reveals five drivers and barriers to ESG adoption for logistics firms. Regulatory compliance (loading = 0.82) is the strongest driver for the adoption of ESG, followed by technological readiness (0.76) and stakeholder pressure (0.74). This indicates the growing influence of outside forces such as consumer demand and regulations on the adoption of ESG by logistics firms. These findings substantiate previous research, which suggested regulatory frameworks, e.g., the European Union's Corporate Sustainability Reporting Directive, have proved to be effective stimuli for firms to pursue ESG initiatives [21]. Technological readiness is also a major enabler, underlining the necessity of adopting new technologies to enhance environmental sustainability [14].

Table 3. Drivers and Barriers to ESG Adoption (Factor Analysis Loadings) (Author's compilation).

FACTOR	LOADING
REGULATORY COMPLIANCE	0.82
TECHNOLOGICAL READINESS	0.76
STAKEHOLDER PRESSURE	0.74
ORGANIZATIONAL CULTURE	0.69
FINANCIAL CONSTRAINTS	-0.71

ESG Practices and Business Performance

Regression analysis results in Table 4 provide compelling evidence for the positive relationship between ESG practices and business performance. ESG implementation scores are also positively correlated with ESG ratings (β = 0.51), so firms with superior ESG practices receive higher outside assessors' sustainability ratings. This finding is in line with the growing literature that asserts firms with superior ESG practices have the probable reward of getting good word from consumers and investors [22]. In fact, the effect of integrated reporting quality on customer satisfaction (β = 0.44) highlights the important role of transparency and communication to build stakeholder trust.

Table 4. Regression Results: ESG Metrics and Firm Performance (Author's compilation).

DEPENDENT VARIABLE	INDEPENDENT VARIABLE	B COEFFICIENT	P-VALUE
ESG RATING	ESG Implementation Score	0.51	<0.001
CUSTOMER SATISFACTION	Integrated Reporting Quality	0.44	<0.01
OPERATIONAL EFFICIENCY	ESG Implementation Score	0.36	<0.01
INVESTMENT ATTRACTION	ESG + Reporting Combined	0.48	<0.001

 doi:10.20944/preprints202505.1007.v1

Firm Size and ESG Practices

Table 5 ANOVA indicates that the differences between firm size and ESG practices are significant. Big firms tend to have advanced ESG practices like carbon monitoring and formal reporting. This is aligned with the existing literature, which has repeatedly concluded that big firms, with greater resources and exposure, are most likely to engage in sustainability [23]. The higher rates of ESG use by bigger firms can also be attributed to higher pressure they experience from customers, regulators, and investors to comply with sustainability standards.

Table 5. ANOVA Results by Firm Size (Small, Medium, Large) (Author's compilation.

ESG Practice	F-value	p-value
Carbon Tracking Adoption	5.23	0.006
Reporting Framework Use	4.78	0.009
Governance Systems	3.91	0.021

6. Conclusions

This study highlights that Environmental, Social, and Governance (ESG) performance is increasingly becoming a strategic competitiveness and legitimacy pillar in the logistics sector, particularly within the South African region The research finds a predominantly high adoption rate of ESG metrics specifically in such areas as labor standards and emissions reporting along with an emerging but uneven uptake of integrated reporting frameworks. Findings highlight that stakeholder expectations, technological preparedness, and regulatory stress are the most essential drivers pushing logistics firms towards ESG integration, while financial constraints remain a major challenge, especially for small firms. Moreover, findings indicate that better ESG practices are significantly correlated with better ESG ratings, better customer satisfaction, efficiency in operations, and greater investment attractiveness supporting the business case for logistics sustainability. Smaller firms are behind in the application of ESG, indicative of their inferior capacity and external inspection, yet the gap in firm size attests to the need for policy support differentially and industry capacity building collectively. Ultimately, if logistics suppliers are to remain robust and stable in the emergent economy, the integration of the ESG dimensions via efficient, sector-specific frameworks of integrated reports is not just advisable but inevitable.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/doi/s1, Figure S1: title; Table S1: title; Video S1: title.

Author Contributions: Author 1 Anathi Sokhetye: Conceptualization; Methodology; Formal Analysis; Writing Draft and Visualization.

Author 2 Mzuchumile Makalima: Literature Review, writing, Review and Editing.

Funding: This research received no external funding

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data is unavailable due to privacy or ethical restrictions,

Conflicts of Interest: The authors declare no conflicts of interest.

 doi:10.20944/preprints202505.1007.v1

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