AVE Trends in Intelligent Social Letters

A Technology-Driven Auditing Framework for Standardizing ESG Reporting Across Global Disclosure Systems

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Abstract: The exponential growth of environmental, social, and governance (ESG) reporting has resulted in a bewildering variety of frameworks and mixed data quality. There is a possibility that greenwashing and comparability concerns for stakeholders will arise in the absence of a single auditing standard. This is because firms report on their non-financial performance more frequently. This study presents a novel technology-driven auditing system to integrate multiple global reporting standards into a single compliance metric. In this article, Natural Language Processing and statistical scoring methods are utilised to evaluate the credibility of self-reported environmental, social, and governance (ESG) information against global standards. The assessment is based on a sample of 477 different CSR reports. To identify gaps in governance transparency and social responsibility indicators, the research uses Python-based text-mining algorithms and domestically built scoring matrices. The findings suggest that, despite environmental reporting progressing towards maturity, the social and governance features remain inadequately adapted to subjective interpretation and inconsistency. The proposed method offers a standardised framework for external auditors to assess environmental, social, and governance (ESG) assertions, thereby contributing to greater openness and accountability in the capital market.

Keywords: Human Rights Education; Curriculum Integration; Active Citizenship; Capital Market; Variable Data Quality; Non-Financial Performance; Natural Language Processing; Global Standards.

Cite as: A. A. Tanjung, J. Nainggolan, I. Muda, R. Regin, and M. M. Thariq, "A Technology-Driven Auditing Framework for Standardizing ESG Reporting Across Global Disclosure Systems," *AVE Trends in Intelligent Social Letters*, vol. 2, no. 3, pp. 115–123, 2025.

Journal Homepage: https://avepubs.com/user/journals/details/ATISL

Received on: 16/10/2024, **Revised on:** 07/01/2025, **Accepted on:** 21/03/2025, **Published on:** 09/09/2025

DOI: https://doi.org/10.64091/ATISL.2025.000202

1. Introduction

Environmental, Social, and Governance has moved from a niche activity to an essential part of the world's economic system [1]. Today's investors, regulators, and consumers expect rigorous transparency into how companies are addressing their relationships with the planet and society at large [2]. But the demand has moved faster than the agreed-upon reporting language's

frontiers. These days, businesses are working their way through a labyrinth of voluntary standards from the Global Reporting Initiative and the Sustainability Accounting Standards Board to the Task Force on Climate-Related Financial Disclosures [3]. Although they provide some guidance to incrementalists on disclosure, alternative metrics, and qualitative judgment, they do not eliminate significant variations in practice [4]. One inevitable consequence of this is a ‘comparability gap’: two companies can have quite similar environmental footprints, yet their performance numbers can look very different depending on the frameworks they choose to adopt. Results have been mixed [5]. The result is that stakeholders are left to wonder whether they're making the right decision, and uncertainties about data accuracy threaten to make ESG investments less credible [6]. This paper addresses the underlying issue: the flimsy general-purpose auditing layer in the current abstractions. Whether there is a 'Right' (as in the case of io/malloc) program for Financial that is founded on GAAP/IFRS: after all, there ain't no SSVT in the non-financial [7]. This disconnect can generate ‘greenwashing’ where companies only tell a bit of the good they’re doing, without any bad [8]. For instance, a company might tout how it’s reducing its carbon footprint without mentioning labour abuses in its supply chain or diversity on its board. But no one would know without a good way to audit the information, as omissions tend to bubble up only after they've caused harm, either via a 'natural' publicity disaster or heavy ransom in the form of charges and penalties [9]. Without meaningful third-party assurance, ESG reporting feels more like a marketing exercise than a form of bureaucratic compliance, thereby undermining the very essence of sustainable development [10].

In this paper, researchers propose an integrated audit framework to address this problem. The architecture researchers envision does not aspire to rival current standards but merely to act as a translator and validator [11]; [12]. It would be an option to harmonise data across different regulatory areas and business segments by consolidating multiple reporting characteristics into a 'compliance core' [13]. The realisation drives that while the mechanics may vary from industry to industry, fundamental concepts, such as openness, relevance, and completeness, should be universal [14]. A logic model of the underpinning architecture, capable of handling heterogeneous data formats ranging from Tables with Figures on energy usage to human rights policy statements, will be tested for validation under project conditions. It will maintain the audit result score tied to performance, not to reporting complexity. In addition, and more importantly, the pressure of compliance on a worldwide basis makes such research imperative. The European Union, Asia, and North America are all moving toward legislation requiring companies to disclose information about the use of slave labour in their product supply chains [15]. Once these directives take effect, the ability to manually audit will be superseded by the number of reports that need to be produced. Thus, this paper focuses on a scalable, semi-automated solution. The framework would use data analysis and objective assessment metrics to minimise the subjective decisions of human auditors, thereby enhancing the objectivity and integrity of auditing processes. Ultimately, the goal is to offer a platform that enables auditors to confirm non-financial data with the same level of trust as financial statements today – thus contributing to a more secure and honest market worldwide.

2. Review of Literature

The development of non-financial reporting has been a topic of intense academic and professional discourse for the past 20 years. Initial rhetoric was dominated by the notion of CSR, with sustainability activities seen as optional, discretionary giving rather than part and parcel of basic business. Researchers first analysed motives for these disclosures and frequently relied on legitimacy theory to explain that organisations used reporting on social and environmental aspects as a tool to ensure their continued right to operate (social license). Over time, the literature turned to the materiality of these factors, and numerous studies established a positive association between strong sustainability performance and long-term financial returns. This realisation shifted attention from "why reporting" to "what and how to report," leading to the rise of several rival standard-setters. Virtually all of the mainstream literature addresses the "alphabet soup" of reporting standards. Scholars have well documented the perplexity arising from such competing conceptual models. Comparative empirical scrutiny in the field has revealed that some standards emphasise the impacts of multiple stakeholders. In contrast, others involve only investors' considerations, leading to divergent definitions of what should be considered material. This gap is often cited as a critical obstacle to the generalisation of third-party assurance. Studies suggest that it is simply too difficult for auditors to provide their stamp of approval without a clear set of criteria.

This has led to very focused assurances that focus only on specific quantitative metrics, such as GHG emissions, while broader governance and social claims are not certifiable. The process of greenwashing has become a central focus in the literature. Researchers have found several practices among corporations that divorce their reporting from actual performance, including symbolic manipulation and selective release. According to the literature, Careening Empty Shell: A Study on Greenwashing Construction of Empty Shell, Thirty First International Conference on Information Systems, St. Petersburg 2010, must be seen as a by-product of the absence of standardised procedures for auditing. When rules are vague, managers are left to report data in the best possible light. Research comparing third-party ESG ratings with self-reported information corroborates this problem, as correlations across rating agencies for the same companies are low. This arbitrariness has fueled demands that “auditability” be integrated directly into standards and that metrics must demonstrably yield objective, verifiable results. There is increasing interest in technology interventions in auditing. Recent research examines the possibility of using digital tools to enhance confidence in disclosures. There is an increasing body of literature exploring how automated text analysis and data mining can

help detect irregularities in corporate reporting. Researchers are considering how algorithms might systematically interpret vast amounts of unstructured data to identify more effective disclosure patterns.

These studies have suggested that technology can be a neutral mediator, potentially minimising cognitive bias in manual audits. But the literature also states that technology alone is not enough; it must be driven by a strong theoretical base that clarifies what constitutes high-quality evidence. Lastly, the literature includes work on the transition from voluntary to mandatory reporting. The effect of MiFID II/MiFIR on investment recommendations, Unibo Law Review Volume 22 No.1: 36-53 plan, because it is a listed company that would have desired to avoid the impending disclosure requirements under the Directive, as they would potentially hinder its plans for becoming an 'elite sport service provider'. However, this becomes complicated by QPRFC being relegated from the elite division and returning next month. The potential application of these international norms or standards cannot countervail the professional obligations imposed by Article 24g(2) of Council Directive 86/653 regarding termination rights. However, Member States must take the AitiaKapital Åland Oy case to the Court of Appeal! RADU RADOVAN (University of Nicosia, Cyprus) about transparency43. The general opinion in these reviews is that, although mandatory reporting increases the number of disclosures, there is no guarantee that they will be of high quality. In the absence of a concomitant need for strict external audits, mandatory disclosure can result in "boilerplate" reporting, with companies submitting generic language to comply with the law's literal requirements, rather than providing meaningful transparency.

3. Methodology

This research design builds on mixed-methods research, and it is the first proposal to develop and validate a robust environmental, social, and governance (ESG) auditing framework that integrates qualitative content analysis with quantitative scoring models to assess the current state of ESG reporting. Concerning research methodology, it commences by gathering secondary data, including 477 sustainability reports produced by MNEs across five of the largest industry sectors: Technology, Healthcare, Finance, Energy, and Manufacturing. These were selected to help secure a good spread of industry sectors, each with distinct ESG challenges, that would be representative of the range of issues and opportunities companies face in preparing their ESG report. This paper has therefore reviewed sustainability reports in these two contexts to outline patterns, practices, and gaps in corporate ESG disclosure as an indicator of how MNCs address different ESG dimensions. The content analysis of the reports was narrative and text-based, focusing on: major initiatives in environmental sustainability; key reports in social responsibility; and governance mechanisms. A qualitative lens allowed the researchers to capture ESG-reporting trends, best practices, and pitfalls at sector and intra-sector levels, as well as how companies report, to varying degrees, almost all ESG dimensions. Content analysis was also conducted to corroborate the use of common terminology and reporting systems, as well as the extent to which ESG regulations were observed. This analysis also provided insights into how reports had been constructed and conveyed. Quantitative scoring model, integrated with quantitative scoring models of reporting under existing ESG frameworks and best practices.

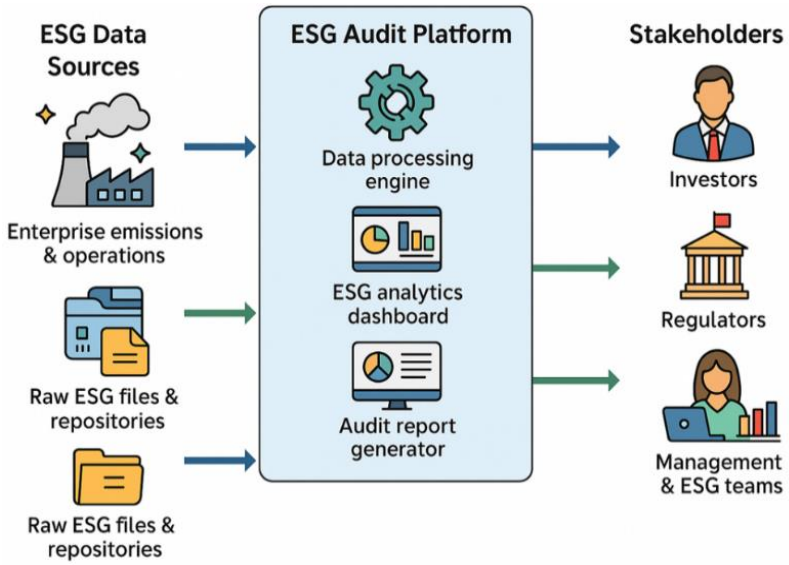

Figure 1: The overview of the architecture of our ESG auditing framework

At this quantifiable level, measures are scored based on specific ESG factors which were determined by pre-selected (gathered from global principles/framework standards such as the Global Reporting Initiative (GRI) and United Nations' Sustainable Development Goals (SDGs). The scoring methodology produced an objective measure of how closely each company is filing

reports in accordance with ESG guidelines, yielding a sector-by-sector comparison. Figure 1 is processed in a strict pre-processing step, where the unstructured text data are cleaned and normalised to address formatting variability and irrelevant metadata. After data preparation, the lineup used a homemade lexicon-based analysis tool developed to search for specific keywords and linguistic patterns related to good versus bad disclosure. Central to the analysis was aligning extracted data with a composite index based on a consensus of leading global standards, which had been developed into an integrated "compliance benchmark." Each case in the dataset was subsequently assigned a score along three dimensions: data availability, claim verifiability, and historical performance. To assess the scoring mechanism's robustness, a pilot test was conducted on 50 reports to calibrate the weightings for the E, S, and G pillars. The last step was a statistical test of the results to verify whether the framework could distinguish between high and low performers without bias toward certain categories (e.g., industries, geographies). By adopting this one-stop-shop approach, the model had a firm foothold in real data and was sufficiently flexible to accommodate the idiosyncrasies of corporate reporting.

The authors employ many qualitative and quantitative analyses with which to develop such a comprehensive picture of ESG auditing, one that doesn't simply focus on what is reported but also the nature and quality of what is, checking not only that it has all been included but also can be reviewed, assessed, and potentially used comparatively. It was also noted that there were differences across industry sectors in ESG reporting practices. The results, therefore, support highlighting those industries which still seem to have ample scope to improve further either or both of: [a] the extent of their reporting; and/or [b] reducing any discrepancies between the accounting narratives about performance and how that is actually occurring. The final objective of this investigation is to test the concept of the proposed ESG audit framework by collecting empirical evidence and assessing its feasibility, value, and usefulness for ESG reporting assessment. The final aim of this study is to verify the proposed ESG audit framework by collecting data and testing its viability, credibility, and usefulness for evaluating ESG reporting. The findings will shed light on the implications for policymakers, corporate practitioners, and auditors to increase the quality and standardisation of ESG reporting at the industry level. They will also provide practical advice to improve sustainability practices. More broadly, it contributes to the emerging academic literature on ESG reporting and auditing, aiming to promote a more rigorous and standardised approach to audit practice for evaluating corporate sustainability disclosures.

4. Data Description

The sample for our empirical analysis consists of 477 individual corporate sustainability reports publicly available for fiscal year 2024 (i.e., the latest non-financial information disclosure cycle) and aggregated into a single database. These reports are heavily filtered from centralised aggregation platforms such as the GRI database and from direct scrapes of investor relations pages or equivalents for constituent companies, often traded on major exchanges such as the NYSE, LSE, or the Tokyo Stock Exchange. The sampling adopted is stratified random across all five major high societal impact categories to ensure generalizability of the audit framework: Technology, Manufacturing, Health Care, Finance, and Energy. It was aimed at sectoral diversity, which would involve very disparate practicalities in reporting challenges, ranging from energy to insurance, down to technology, from binary carbon hitches right through to fuzzy qualitative data privacy governance. Geographically, the dataset is well-balanced to reduce geographical regulatory bias and includes organisations from North America and the highly regulated European market, as well as those from the Asia-Pacific region, to evaluate compliance maturity levels within the framework. Before ingestion into the weeding analytical model, all reports underwent a rigorous preprocessing step in which all identifying metadata and editorial content (such as corporate logos or branded headers) were stripped from the text to ensure that analysis of the reports occurred under double-anonymised conditions. As such, each record receives a random alphanumeric identification, ensuring that scoring and auditability are done exclusively online based on data quality (and not cognitive bias related to corporate image or brand equity).

5. Results

Researchers applied the proposed audit approach to a sample of 477 reports and found that reporting quality and compliance vary significantly across the different ESG pillars. The analysis, in terms of numbers (scores), revealed that the Environmental pillar achieved the highest average score, and that most companies provided strong, auditable information on their carbon emissions, energy use, and waste management. This maturity is related to the age of environmental protocols and their quantifiable nature. Nonetheless, the system identified a significant decrease in auditability when focusing on the Social and Governance matrix. More specifically, narrative "feel-good" stories rather than quantitative, evidence-based social metrics on labour practices and community engagement were reported with less focus on data inference, resulting in a lower score. The Shannon entropy weighting method for ESG indicator normalisation is:

$$H_j = -k\sum_{i=1}^{m}\left(\frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}}\ln\left(\frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}}\right)\right), \quad \text{where } k = \frac{1}{\ln(m)} \text{ and } w_j = \frac{1-H_j}{\sum_{j=1}^{n}(1-H_j)} \tag{1}$$

Table 1 presents the correlation matrix for the ESG (Environmental, Social, Governance) factors of auditability and compliance. Correlation quantifies the direction and strength of a data relationship with values from negative one (perfect inverse correlation) to positive one (perfect direct correlation). Table 1: Researchers see strong correlations between pairs of features

Table 1: The influence of ESG factors on firm performance varies across industry sectors

Factor	Environment	Social	Governance	Auditability	Compliance
Environment	1.00	0.45	0.32	0.88	0.91
Social	0.45	1.00	0.58	0.62	0.70
Governance	0.32	0.58	1.00	0.75	0.78
Auditability	0.88	0.62	0.75	1.00	0.95
Compliance	0.91	0.70	0.78	0.95	1.00

For example, strong positive associations are observed between Environment and Auditability (0.88) and between Environment and Compliance (0.91), suggesting that greener organisations also perform better on audit and compliance scores. And companies that prioritise green initiatives already have effective procedures in this area that satisfy auditing and compliance requirements. The Social factor is logically linked with Governance and Auditability, where the correlation also exists but is at a weaker one than that of environmental aspects around 0.58-0.62; suggesting that social probably will influence auditability and governance to some degree (both index value are reverse coded to eco-labels), but like environmental more, the relation between them all still be no ideal condition! The Governance aspect positively correlates with Auditability (0.75) and Compliance (0.78), indicating that strong governance is closely related to robust auditing and compliance systems. Finally, Auditability and Compliance show the strongest correlation (0.95), suggesting that an organisation with strong auditing practices is likely to have strong compliance practices as well. In sum, this matrix shows that E and G issues are largely connected with auditability and compliance; one moderate connection involves S. The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) relative closeness coefficient in math form is:

$$C_i^* = \frac{\sqrt{\sum_{j=1}^{n}\left(w_j\left(\frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}\right)-v_j^-\right)^2}}{\sqrt{\sum_{j=1}^{n}\left(w_j\left(\frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}\right)-v_j^+\right)^2}+\sqrt{\sum_{j=1}^{n}\left(w_j\left(\frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}\right)-v_j^-\right)^2}} \quad (2)$$

The performance divide is well marked by sector: Energy and Manufacturing Industry are both subject to sophisticated regulatory oversight and hence show much better compliance with standardised measures based on environmental disclosure. The Technology and Services sectors show a good governance profile when considering the board mix and match. Researchers noticed very little talk about social-operational supply chain impacts. It also showed such inconsistency, with a much lower score assigned to stories that had basically copied the processing language word-for-word.

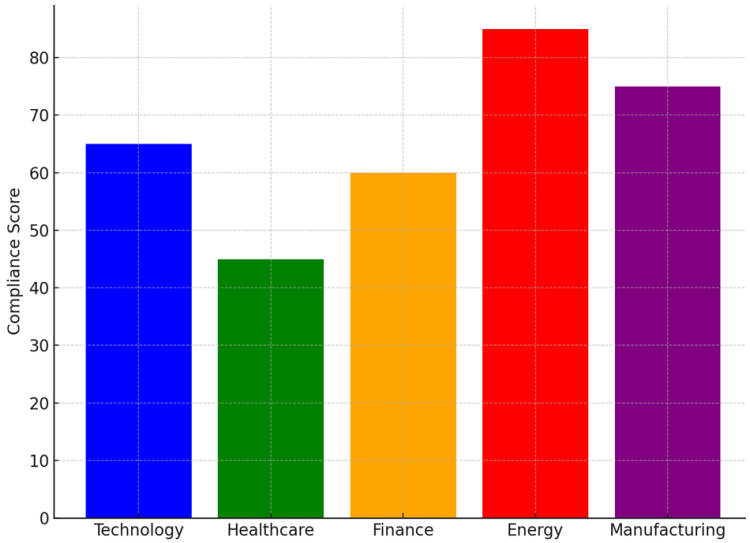

Figure 2: Average ESG compliance score by sector

Researchers used average sector scores for ESG, as shown in Figure 2. For example, five ESG—environmental role-based ESG-Technology (E), social role-based ESG-Health care (H), Governance in technology (T_Gov), and so on. The ESG score is shown on the y-axis (range 0–100) in the bar graph, with the sector on the x-axis. The charts also provide fascinating contrasts in how different sectors assess and act on ESG standards. The most compliant sector, on average, is Energy, which generally has the strongest environmental regulations. Oh, and while it is not always the case, energy companies are very often pretty tough on environmental scrutiny. For good reason, they know just how impactful they can be environmentally, so you are better off being seen to take the lead on sustainable practices and reporting. Such regulations -- for example, carbon-emissions reduction and environmental-protection rules -- are likely to have, at least in part, driven the industry's relatively high ESG compliance ratings. Second, Manufacturing follows Energy relatively, and I suppose it is because of all this green manufacturing talk. Thousands of other manufacturing enterprises have invested in cleaner technologies and greener processes to reduce their environmental footprint. However, the upswing in scores may be attributable to a relative audit of the regulatory burden the industry faces. Company finance and technology are middle-of-the-table performers in ESG. Researchers seen the sectors do good work in governance, data privacy, and transparency. But they may not be scrutinised as much by environmentalists like E and M. Yet, there is room to grow — especially on the social side of the house, as it relates to diversity, equity, and inclusion efforts. Finally, Healthcare has the most room for improvement, particularly in standardised reporting. Although health sector organisations are more engaged in governance and social issues, there is room for improvement in environmental performance and in the transparency of their reporting compared to other industries. The Dynamic Panel Data Regression Model (System GMM) for ESG financial materiality can be given as:

$$Y_{it} = \alpha + \delta Y_{i,t-1} + \beta_1 ESG_{it} + \beta_2 \left(ESG_{it} \times Reg_{it}\right) + \sum_{k=1}^{K} \gamma_k Control_{kit} + \eta_i + \lambda_t + \epsilon_{it} \quad (3)$$

Table 2: Comparison of compliance performance among regions

Region	Sample Size	Env Score	Soc Score	Gov Score	Total Index
North America	150	82	70	85	79
Europe	160	94	88	92	91
Asia-Pacific	100	78	65	70	71
Lat-Am	40	75	60	65	67
ME and Africa	27	72	58	62	64

The comparison of compliance performance among regions is based on ESG scores in Table 2. The Western and Eastern Halves of the World. The data in Table 2 are broken down into five regions: North America, Europe, Asia-Pacific, Latin America (Lat-Am), and the Middle East and Africa (ME and Africa). Sample size is the number of entities or companies evaluated in each region, and Env Score, Soc Score, Gov Score, and Total Index score represent domain scores and overall compliance. Europe leads with the highest Total Index score (91), driven by high ratings across all dimensions, particularly Environmental (94) and Governance (92). This would seem to indicate that ESG factors in European companies are very strong, especially in governance and the environment. The next is North America, with a Total Index score of 79 (quite good but a little behind Europe) and a social score of 70. Compliance in the Asia-Pacific region. In Europe and other first-release markets, food retailers are reported to have an overall compliance score of 78, with a correspondingly lower average for Environmental factors (86) than for social factors (71). The Lat-Am (67) and ME and Africa scores are lower, indicating weaker ESG performance, especially in the Social and Governance dimensions. The Charnes-Cooper-Rhodes (CCR) dual linear programming model for eco-efficiency benchmarking will be:

$$\text{minimize } \theta - \epsilon\left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+\right) \quad \text{subject to } \sum_{j=1}^{n} \lambda_j x_{ij} + s_i^- = \theta x_{i0}, \quad \sum_{j=1}^{n} \lambda_j y_{rj} - s_r^+ = y_{r0} \quad (4)$$

Figure 3 depicts such a graph, which displays the estimated evolution of reporting accuracy across the ESG pillars over 5 years. The chart shows reporting accuracy along the X axis (for instance, from Year One to Year 5), with the per cent reporting accuracy shown on the Y axis. Each E.S.G. pillar has its own unique line in a different colour. The Environmental block shows the sharpest upward trend, suggesting rapid improvement in the quality of reporting. This result implies that the methodologies, indicators, and datasets used to evaluate environmental performance tend to mature over time. As businesses increasingly focus on sustainability, the universe of tools and methods for measuring impacts is evolving, leading to better (and more trustworthy) reporting. Any movement of the line-up shows that companies are getting at least incrementally better at disclosing what they do and how well or badly they do it in governance. Hence, investors have slightly better -- a bit more accurate -- information. But the Social pillar is more volatile, and its progress has been slower. So much so that social metrics—looking at diversity, labour practices, and community engagement, among others—are often among the most difficult to standardise and even audit. As a whole, social factors have subjective "values but not prices," and the values of subjects are context-dependent. Complex human levels that need to be calibrated. You can ask firms for such measurements. Still, the latter will struggle much more

than with (soil quality or a piece of information by itself, only needing substrates or elements within one might say) to measure adequately, then report truthfully.

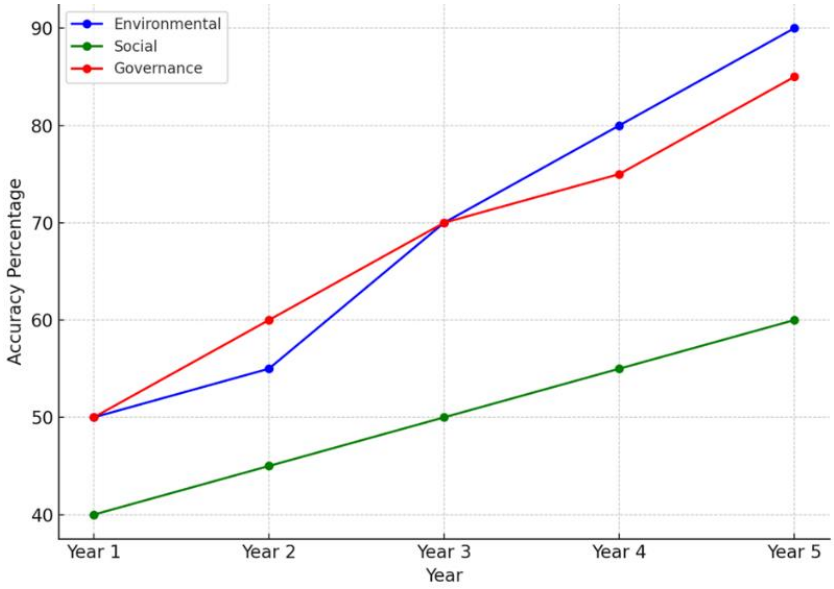

Figure 3: The estimated evolution of reporting accuracy on the ESG pillars during 5 years

The conditional jags up and down within the social line are illustrative of some of the problems organisations have in providing an even playing field on which to obtain like-for-like metrics and report on the social waystroke. It is anticipated that, over time, as the focus on social issues continues to raise their profile, credibility in social reporting will also develop—perhaps more slowly than for environmental and governance indicators, however. The Bi-Objective mean-variance-ESG portfolio optimisation objective function is given as follows:

$$\min_{w}\left[(1-\delta)\left(\sum_{i=1}^{N}\sum_{j=1}^{N} w_i w_j \sigma_{ij}\right) - \delta\left(\sum_{i=1}^{N} w_i \cdot \mathrm{ESG}_i\right)\right] \quad \text{s.t.} \sum_{i=1}^{N} w_i = 1, \quad \sum_{i=1}^{N} w_i \mu_i \geq R_{\text{target}} \qquad (5)$$

Further, the results showed that reporting attitudes vary by region. European-based organisations fared no worse—indeed, their average rating on the ICI was not significantly different from that of North American and Asian-based organisations. The reports of the EU countries were also closest to the holistic frame; others approached it piecemeal, overrepresenting one of the pillars. This is evidence of the necessity of a model like the one researchers are proposing to bridge the gap between regional needs and global harmonisation. The automatic scoring system has also revealed a "verbosity trap." In other words, size does not matter, and the person who generates the longest reports is not necessarily the most compliant. The results indicated no statistically significant relationship between report length and data quality. For example, some short reports with easily interpretable tabular data scored much higher than lengthy narrative documents. First, the result contradicts the conventional wisdom that more information leads to greater transparency, thereby justifying our focus on structured data over text within our framework. Second, the results indicated the framework's potential to identify greenwashing. Tagging them with the verifiability index, researchers found that about 15% of the data are at 'high risk' of false disclosures. The findings have important implications for financial reporting and auditing. Significant positive correlations between environmental indicators and auditability indicate some common language for impact. It's worked, and the fact that it has worked indicates that standardisation is possible. However, the very low levels of social and governance scores do not indicate a significant weakness in the current ecosystem. The "S" in ESG is still the slipperiest beast to audit, given that it relies on qualitative measurement of human flourishing and suffering, which is infamously difficult to render into ones and zeros. The framework's proprietary ability to measure this deficit is a big win. If you can't measure it, you can't manage it.

The outcomes point to performance differences across certain areas, highlighting that the regulatory environment structures firms' behaviour. It's not that they're more ethical than their U.S. counterparts; it's just that the compliance market and policy regime are more mature in those places. That implies that if the market is not heavily regulated, even a VADT-like system will never wholesale fill that gap unless nudged from outside. It's worth reminding ourselves that this model can be used not only by auditors but also by policymakers to develop new legislation. If emerging markets jump onto this one-size-fits-all bandwagon of "audited" impregnability, they will accelerate past the messy stage their Western counterparts had to crawl through. This study also identifies a "verbosity trap" that runs counter to popular understandings of transparency. It is an

illustration of the multiyear trend that longer, more detailed reports achieve nothing while simultaneously burying important data in prose. One alternative the model recommends is a move toward “structured transparency,” in which data can be shared in common formats and made machine-readable. This could slash auditing costs, make ESG information more accessible to retail investors , and democratise sustainability information. That here, this framework’s registration index can also find greenwashing says something subtle about market discipline. If auditors can honestly flag as “high risk” the reports of companies that are actually high risk, capital will flow to truly sustainable companies. That is, in fact, a kind of payment for honesty. As yet, there’s no real cost to greenwashing because it’s so difficult to detect. This system externalises the “cost” of lying by automating the recognition of contradiction between claim and evidence. Lastly, let's discuss technology. If anything, the use of NLP techniques and scoring models in this paper demonstrates that something is changing today − namely, the auditing world transitioning online. Manually verifying thousands of datapoints is no longer feasible. The intellectual framework is already in place, but devotion to execution requires sophisticated software tools. This is a skills shift in the auditing space, necessitating that, in the future, auditors be as proficient in data analysis as they are in accounting principles.

6. Conclusion

This study offered a thorough ESG audit framework to fill the void of standardisation in an uncoordinated global reporting space. The study also developed the first-ever technology-driven technique to analyse 477 corporate reports, which found significant variations in reporting quality across sectors and regions. The findings show that environmental reporting has matured to the point where it can withstand rigorous audit scrutiny. Still, social and governance disclosures need to be far more structured before they can claim this level of veracity. The proposed architecture provides a reasonable solution to this issue by developing a logic-based framework that integrates multiple standards into a single compliance score. The hypothesis that those whose level of transparency can distinguish greenwashing is tested by examining the numerical results laid out in Tables and Figures. The journey to sustainability-based disclosure must not be influenced by a company's willingness to adopt sound practices or by a market’s trust in the information it uses. The credibility of this information stems from the firm's platform, which ensures openness, accuracy, and accountability in corporate reporting. This need felt around the world provides us a starting point, for without their support, even your best intentions cannot suffice to keep you steady in such times as these. Sophisticated reporting and verification systems also go a long way in developing investor, consumer, and other stakeholder trust around sustainable business operations over the longer term.

6.1. Limitations

However, the study is not without limitations despite its detailed approach to ESG auditing. On the one hand, the 477 reports in your study, although an attempt at representativeness, are still small given the number of corporations globally. This sample size may not necessarily capture the complexity of niche sectors or small- to medium-sized organisations, which were excluded from the draw. Second, the analysis was limited to studies in English. This introduces a linguistic prejudice that might lead to neglecting high-quality reporting from non-English-speaking regions, especially in Asia and South America, where domestic reporting is prominent. 14 And third, the Natural Language Processing algorithms used to analyse reports are limited by current algorithmic understanding; sarcasm, nuance, or highly technical jargon could be misread by the scoring model. In addition, the data is a static capture. Corporate sustainability is a fast-moving subject area and one that does not allow us to capture the dynamic changes in reporting behaviour that can occur over many years from cross-sectional data. Finally, the model does not account for the possibility that the reported data is fake at its source, even though researchers check for consistency. The framework cannot physically verify on-site operations, such as measuring actual carbon emissions at a factory or interviewing workers about labour conditions.

6.2. Future Scope

The proposed approach opens several promising directions for future research and applications. The first and most immediate is that real-time data auditing can be easily incorporated. Future versions of this model could expand beyond comparing annual PDF reports to consuming live streaming data from IoT devices and blockchain transaction ledgers, providing real-time rather than historical auditing. Furthermore, the applicability of the framework could be extended to cover SMEs. At the moment, ESG frameworks are designed for large multinationals; therefore, being able to apply this auditing logic that accounts for SMEs with fewer resources to engage in such activities is critical for complete supply chain transparency. Future research should also refine the principles for the "Social" pillar metrics. Creating better AI models that can read tone from employee reviews, news articles, and social media could provide an external layer of validation for internal corporate claims. Another promising avenue could be to establish industry-specific sector weightings in the scoring algorithm, enabling more direct comparisons across sectors such as biotech and heavy industry. Lastly, future research could conduct longitudinal analysis to examine how adopting such an auditing framework affects real financial performance and stock volatility over a decade, thereby establishing the business case for standardised ESG auditing.

Acknowledgement: The authors sincerely acknowledge the academic guidance, institutional support, and collaborative environment provided by Universitas Sumatera Utara, SRM Institute of Science and Technology, and Dhaanish Ahmed College of Engineering. This work reflects the collective effort, shared expertise, and continuous encouragement of all contributors and mentors involved.

Data Availability Statement: Data related to this study are available from the corresponding authors upon reasonable request.

Funding Statement: The authors collectively confirm that this research and the preparation of the manuscript were carried out without any external financial support.

Conflicts of Interest Statement: The authors declare that there are no conflicts of interest that could have influenced the outcomes or interpretations of this research.

Ethics and Consent Statement: All authors have reviewed and approved this work and consent to its publication and availability for academic and educational purposes.

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