

The Role of Artificial Intelligence and Blockchain in Mitigating Greenwashing: The Mediating Role of Sustainability Disclosure Quality

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Abstract

The credibility of corporate sustainability reports is undermined by greenwashing, which provides a false sense of how effectively a company is implementing its claimed environmental efforts. Both Artificial Intelligence (AI) and blockchain are complementary digital tools that can help address greenwashing. AI has the potential to analyze large volumes of sustainability-related data to identify false claims or inconsistencies in statements made in reports, while blockchain provides transparency, traceability, and accountability for the data used to support those claims. However, neither of these technologies alone guarantees accurate reporting. AI systems may generate biased or uninterpretable outcomes, and blockchain systems cannot verify the validity of the data entered them. Consequently, the present study develops a simplified conceptual model showing how the application of AI and blockchain technologies affect the potential for greenwashing, while sustainability disclosure quality acts as a mediator. In addition, the model illustrates that the use of both technologies together can have a greater effect than if they were applied independently, and that the quality of external assurance strengthens this relationship. To test the proposed model, the study develops six hypotheses based on direct effects, mediation effects, synergy effects, and moderating variables. Ultimately, the model contributes to the current body of knowledge by demonstrating that sustainability disclosure quality serves as the main channel through which digital transformations can reduce greenwashing. Additionally, the model provides key boundary conditions such as data authenticity, algorithmic explainability, external assurance, and independent performance verification for future empirical studies.

Keywords: Artificial Intelligence, Blockchain, Sustainability Disclosure, Environmental, Social, And Governance (Esg) Reporting, Greenwashing, External Assurance, Digitalization, Financial Reporting, Sustainability Accounting, Reporting and Disclosure (Sard)

Introduction

Sustainability reporting is the process of reporting on an organization's environmental, social, and governance (ESG) impacts, practices, and overall performance to its stakeholders, including investors, regulators, and consumers (Hummel & Schlick, 2016). Sustainability reporting has become an essential part of corporate reporting due to the increasing demand for information that goes beyond financial metrics to provide an assessment of a company's broader economic, environmental, and social footprint (Hummel & Schlick, 2016; Michelon et al., 2015). However, the increased use of sustainability reporting has also led to growing concern about the reliability, credibility, and comparability of the data reported by companies. Organizations may report their positive sustainability achievements while providing limited or vague information about their deficiencies. These types of deceptive practices are often associated with greenwashing, which negatively affects stakeholder confidence in the information reported by organizations (Moodaley & Telukdarie, 2023). In addition to challenging traditional corporate reporting practices, ESG factors have created new challenges for accounting systems. In recent years, corporate reporting practices have moved from being based solely on historical financial data to including environmental and social performance metrics. The transition from historical financial data to environmental and social performance metrics presents unique challenges in emerging economies where there is no consistency in sustainability regulation, technology, institutional framework, or reporting practices among countries. In addition to these challenges, greenwashing presents a major threat to the credibility of sustainability reporting because organizations can falsely claim that they are making positive contributions to environmental protection when they are not. The Volkswagen emissions scandal provides an example of how damaging greenwashing can be to an organization's reputation and ability to comply with regulations (Siano et al., 2017). Finally, the rapid increase in ESG reporting has also raised concerns about the reliability, credibility, and comparability of the reported ESG data (Sneideriene & Legenzova, 2025).

Considering the success of sustainability reporting will depend less upon the amount of disclosed information than it will upon the quality, credibility, and reliability of the disclosed information. The opportunity for enhancement of these characteristics through digital transformation exists via the revolutionization of the processes used to collect, analyze, authenticate, store and disseminate sustainability data. Artificial intelligence (AI) and blockchain technology provide innovative methods for resolving several of the deficiencies associated with traditional reporting systems. However, the adoption of digital technologies alone will not guarantee the reliability of disclosures. Thus, a critical research question continues to exist, can the application of digital technologies improve the quality of sustainability reporting and help prevent greenwashing?

Sustainability Reporting

Sustainability reporting provides organizations with a means of communicating with outside parties about their ESG impacts, greenwashing risks, actions and improving their overall performance. Thus, by providing transparency regarding these issues, regulators, investors and other interested parties can assess how well an organization addresses social and environmental challenges (Hummel & Schlick, 2016; Michelon et al., 2015). Ultimately, the usefulness of this type of reporting depends upon the reliability of the data presented as opposed to merely the quantity of data.

The quality of sustainability disclosure is based on the extent to which the disclosed data can be verified, relied upon, is consistent with other disclosures, can be compared with disclosures made by similar organizations, is accurate, is balanced in terms of positive and negative disclosures, and contains all necessary disclosures. These criteria allow stakeholders to assess the organization's actual performance relative to ESG issues (Hummel & Schlick, 2016; Michelon et al., 2015). As such, the quality of disclosure should be distinguished from the quantity of disclosure. While an organization may produce a long sustainability report, the report may have limited usefulness to stakeholders if it emphasizes positive accomplishments of the organization while downplaying or ignoring significant negative outcomes; uses unclear language; or does not include enough evidence to support the claims made in the report. Thus, an organization's production of a greater quantity of disclosures will not necessarily increase the organization's credibility or transparency (Michelon et al., 2015).

Greenwashing can be defined as an organization's attempt to use selective, overstated, deceptive or inadequate information to produce a false impression of their commitment to the environment (Moodaley & Telukdarie, 2023; Siano et al., 2017). Therefore, greenwashing is directly related to the discrepancy between a firm's disclosure regarding their sustainability practices and how well they practice sustainability. Hummel and Schlick (2016), pointed out that it is essential to assess the relationship between a firm's disclosure regarding sustainability and their actual practice of sustainability, as opposed to merely assessing the quantity of disclosure provided. Assessing the relationship is particularly important as firms may provide large amounts of sustainability disclosure yet fail to provide sufficient evidence to support their claims. Moreover, for firms to provide credible disclosures regarding their sustainability practices, their claims must be based on traceable data, uniform measurement practices, and verifiable evidence. The difficulty in providing such evidence lies in the fact that sustainability accounting, reporting, and disclosure lags traditional financial reporting in terms of digitalization. Valentinetti and Rea (2025), distinguished between digitization - the process of simply converting analogy data into digital format and digitalization the use of digital tools to facilitate accessibility, comparability, integration, and utility of information. The following section discusses the relationship between digital transformation and accounting of sustainability.

Digital Transformation Is Accounting of Sustainability

Information digitization refers to the conversion of analogy data into digital format. Business digitalization refers to the use of digital technology in an intelligent manner to support improved decision-making and provide timely access to necessary information (Valentinetti & Rea, 2025). Digital transformation is a top-down approach to change the way businesses operate, and how they organize themselves. Digital transformation also provides opportunities for businesses to interact more effectively with both internal and external stakeholders, including employees and customers. Additionally, digital transformation provides businesses with many different types of advanced digital technologies, including Artificial Intelligence (AI) and blockchain (Hanelt et al., 2021; Verhoef et al., 2021). Digital transformation is when organizations use digital technologies as part of their business model. Digital transformations change how organizations use and manage information, processes, activities, and decision making. Moreover, for the field of sustainability accounting, digital

transformations will affect how organizations collect, process, integrate, verify, and share sustainability-related data.

Digital transformation does not simply convert data from analog format to digital format but rather uses additional digital capabilities to create better information systems and organizational workflow (Valentinetti & Rea, 2025). As digital sustainability accounting continues to emerge as a viable alternative to traditional reporting, there are many reasons why this is happening. Traditional reporting has historically relied upon multiple and disparate data sources, manual collections of that data, inconsistent measurements of those metrics and lack of traceability. Moreover, because of these challenges, it has been hard for stakeholders to assess whether a company's sustainability statements truly reflect its real-world performance. Digital technologies can assist organizations with closing the "information gap" that exists between companies and external stakeholders by providing them with the capability to improve the accessibility, integration, consistency and traceability of their sustainability data (Lodhia et al., 2025; Pizzi et al., 2024). However, simply implementing digital technologies is not enough to create better quality disclosures. Although digitalization may provide an organization with the ability to produce more information, produce that information faster, and produce more complex types of information, digitalization alone will not guarantee the accuracy, completeness, or reliability of that information. Therefore, the success of an organization's digital transformation will ultimately depend on its ability to utilize the digital technology provided to develop reliable data and reports (Appiah-Kubi et al., 2025; Lodhia et al., 2025; Pizzi et al., 2024). This distinction underscores the importance of examining individual digital capabilities rather than considering digitalization as a monolithic concept. The following section discusses the relationship between artificial intelligence and blockchain technologies.

Synergies Between Artificial Intelligence and Blockchain Technologies

The concept of artificial intelligence (AI) refers to the use of computers to complete activities which would otherwise require human thought processes; examples include, but are not limited to, learning from experience, making categories, projecting future trends based on past events, identifying trends within a large amount of information, and understanding written or spoken language. As applied to the field of sustainability accounting and reporting, AI has the Artificial Intelligence and Blockchain Technologies ability to process and evaluate large quantities of textual, numerical, visual, and external data. In doing so, AI assists in locating incorrect terminology, errors, irregularities, discrepancies, and relationships between different types of data. Therefore, with the assistance of machine learning and natural language processing, the evaluation and tracking of sustainability data can be streamlined, thereby improving the consistency and analysis of sustainability disclosure (Vishnoi et al., 2026).

Blockchain is a distributed, decentralized digital record-keeping system used to track transactions and other types of data across a network; it uses protocols that enable the traceability of data as well as the ability to prevent changes from being made to the data once it has been added to the blockchain. As such, when using blockchain for sustainability reporting, organizations can provide a clear history of where their data came from, establish an auditable trail for how data was collected and processed, create time-stamped documents for each transaction or event related to sustainability reporting, and allow only authorized

individuals to access sustainability performance metrics. Likewise, all these advantages will enable both organizations and other stakeholders to trace published sustainability performance indicators back to their original sources and therefore enhance the credibility of all the reported information (Nguyen et al., 2026). This study makes a distinction between a technology's capability to improve sustainability reporting and simply adopting the technology. Adoption of technology means that an organization utilizes the technology; whereas capability means that the organization has developed the skills required to successfully integrate the technology into its reporting and information management processes. This distinction is critical because simply adopting a technology will not necessarily result in better sustainability reporting (Lodhia et al., 2025).

In addition to offering independent benefits, AI and blockchain provide mutually reinforcing benefits. For example, AI primarily provides improved capability for analysis, categorization, comparison and tracking of sustainability data. On the other hand, blockchain primarily provides improved capability for origin tracking, traceability and security of the data infrastructure used to perform such analysis. Thus, AI will be most effective when the underlying sustainability data is reliable and traceable. Likewise, blockchain-based infrastructures will be most effective when organizations are equipped with the analytical tools necessary to analyze the stored data (Fiolka et al., 2026; Siyal et al., 2026).

Blockchain and AI technologies have limitations in resolving credibility issues alone. Artificial Intelligence (AI) systems may replicate bias from their training data, misinterpret ambiguous sustainability terminology, produce incorrect results, and generate outputs that lack transparency (Vishnoi et al., 2026). Although blockchain provides data security once entered the system, it does not provide independent verification of the accuracy of off-chain environmental, supply chain, or emission data prior to its input into the system a limitation often referred to as the blockchain oracle problem (Nguyen et al., 2026). Therefore, the ultimate benefit of using both AI and blockchain will depend on how effectively an organization translates its internal processes into reliable and verifiable sustainability disclosures using both technologies. The quality of sustainability reporting (or disclosures) is defined by the level of completeness, balance, precision, comparability, consistency, reliability, and verifiability that the reporting organization has achieved in presenting its reported sustainability information. By doing so, the reporting organization will allow its stakeholders to accurately evaluate their true environmental and social performance (Hummel & Schlick, 2016; Michelon et al., 2015). This study uses the quality of sustainability reporting as the main mechanism by which the use of digital capabilities impacts the potential for greenwashing.

The theoretical foundation for this study is that simply implementing artificial intelligence (AI) and/or blockchain will not necessarily result in the reduction of "greenwashing." Instead, the benefits of both types of technology lie in how they improve the quality and reliability of sustainability-related information. For example, AI allows organizations to evaluate, compare, and track various aspects of their sustainability performance, while blockchain provides organizations with a way to verify and track the origin of that same sustainability performance data (Lodhia et al., 2025). Organizations that integrate these two digital technologies into their existing reporting processes may also find that they are able to increase the level of detail provided in disclosures, which will make it easier to identify

differences between what an organization says about itself publicly and what it does. Therefore, improved transparency regarding sustainability helps reduce information asymmetries, which can lead to increased opportunities for "greenwashing." When environmental claims made by an organization are supported with accurate, consistent, verifiable and traceable data, stakeholders will be more capable of determining whether the organization's claims reflect its actual practices. However, large volumes of ambiguous, selected, or unverified information do not provide a strong defense against greenwashing, even when organizations use state-of-the-art digital technologies.

Thus, it is assumed by the present study that the level of sustainability reporting quality serves as the primary intermediary through which the relationship between AI and blockchain technology, and greenwashing risks can be established. In addition, the results of this study indicate that the integration of artificial intelligence (AI) and blockchain technology provides additive benefits. AI can conduct more advanced analysis of sustainability data that has higher levels of transparency and traceability; however, blockchain technology provides a secure environment for data storage which makes it more valuable with the addition of sophisticated analytical capabilities. Therefore, the developed conceptual framework will investigate the effects of both AI and blockchain technology as separate entities and as joint influences upon the quality of sustainability disclosure.

The focus of this study is on examining the way that AI and blockchain technologies affect the potential for greenwashing through their ability to provide high-quality sustainability reporting. There are two major contributions made by this paper; first, it considers AI and blockchain as distinct but complementary tools. Second, it identifies the quality of sustainability disclosures as the primary link between the use of digital technology (AI/blockchain) and the risk of greenwashing. Therefore, the focus of this study will be on answering the following research question: How will the combined use of artificial intelligence and blockchain affect greenwashing risks through the quality of sustainability disclosures, and what are the various ways that their combined use affects this relationship. The following section discusses the literature review.

Literature Review

The Relationship Between Greenwash and Quality of Sustainable Disclosure

The practice of greenwashing occurs when a company presents sustainability claims that exaggerate, misrepresent, or cherry-pick from its actual social or environmental accomplishments. Sustainability reporting can facilitate greenwashing when organizations provide superficial disclosures, emphasize only the positive aspects of their reporting and conceal negative aspects, or make broad statements without providing quantitative evidence. Previous studies have identified that deficient sustainability reporting continues to be an ongoing concern regarding communication practices of corporations (Moodaley & Telukdarie, 2023). Thus, it is important to distinguish between the quantity and quality of disclosures. Quality sustainability reporting involves more than just the amount of disclosure; quality reporting is characterized by being comprehensive, objective, consistent, accurate, credible, and applicable to stakeholders assessing a corporation's sustainability efforts (Hummel & Schlick, 2016; Michelon et al., 2015). Therefore, a long sustainability report does not necessarily mean it has high-quality reporting if the content of the report is incomplete, selective, purely symbolic, or lacks sufficient supporting evidence (Michelon et al., 2015). For

this study, greenwashing risk is defined as the difference between a corporation's sustainability disclosures and the corporation's actual performance represented in such disclosures. This definition is consistent with other research that emphasizes evaluating whether a corporation's disclosed claims are consistent with its actual performance instead of evaluating only the volume of information disclosed (Hummel & Schlick, 2016).

This distinction is particularly relevant in the context of digital transformation. Digital technologies may increase the amount, complexity, and access to sustainability data; however, they do not guarantee that the data will be complete, reliable, or verified. As such, digital technology does not necessarily equate to improved reporting quality. Rather, the role of digital technology on transparency depends upon how technology affects the generation, verification, integration, and distribution of fundamental data. Furthermore, to assess whether there is a risk of greenwashing, it is necessary to determine how much the sustainability claims made by the firm match up with what was reported, raw data, audit evidence, and if applicable, actual sustainability performance. Evaluating the difference between what was disclosed and what occurred provides a means to differentiate between authentic sustainability reporting and communications that have been developed for symbolic or legitimacy-oriented purposes (Hummel & Schlick, 2016; Michelon et al., 2015). Thus, the proposed model views the quality of sustainability disclosures as a tool to mitigate greenwashing as opposed to seeing them as one and the same. Technological capacity is required and important to improve the sustainability reporting disclosures (Ivanišević et al., 2025). The following section discusses the relationship between AI and sustainability disclosures.

The Relationship Between AI and Sustainability Information Disclosures

Artificial intelligence can help improve sustainability disclosure processes by automating the assessment of data that would be otherwise too large, diverse, or complex to analyze manually. AI-based tools can assess corporate sustainability reports, website content, press releases, social media posts, image-based content, and structured ESG data. NLP can identify confusing terminology, over-stated language, and inconsistencies between what is stated in the report and the actual performance reported. Recent research also shows that AI can combine information from different sources and compare a company's disclosure regarding sustainability to relevant external standards; therefore, enhancing the assessment of ESG transparency and the risks related to "greenwashing" (Zhao et al., 2026). Artificial intelligence has the capacity to improve the quality of sustainability disclosures through increased analysis of more types of disclosures and more frequent analysis than is possible with periodic manual reviews. Rather than relying entirely on manual audits at regular intervals, AI can monitor sustainability disclosures continuously. However, AI should only be used as an additional analytic resource and not as a replacement for human auditors who independently verify disclosures. In addition, the use of AI to process sustainability disclosure data significantly increases a company's analytic capabilities using large volumes of structured and unstructured data to better determine sustainability performance (S. Chen, 2024). There are currently many challenges to implementing AI effectively in this area. Several of these challenges include no common definition for sustainability terms; a shortage of labeled datasets for training AI systems; potential for biases within AI models; the continued evolution of sustainability terminology; and the inability of humans to understand why an AI model reached a particular conclusion (Vishnoi et al., 2026).

The limitations of AI will have a direct impact on how we can study greenwashing. For example, while AI can recognize language patterns associated with misrepresentation in communications, there is no proof that those who use this language intend to mislead people. Additionally, AI may mistakenly categorize complex yet accurate information as greenwashing, while also missing deceptive claims that are made through sophisticated means. Therefore, AI-based detection of greenwashing must be verified by professional reviews, independent audit results, regulatory findings and/or independently verified environmental data. In essence, the goal is not to eliminate greenwashing entirely with AI; rather it should increase the number of sustainability disclosures that are reviewed and improve the quality of those reviews. The following section discusses the relationship between Blockchain and sustainability information disclosures.

Blockchain Sustainability Information Disclosure

Blockchain technology provides unique benefits over AI with respect to data provenance, traceability, and the integrity of record keeping in sustainability disclosure. A reporting framework that is based on blockchain could link a given metric to its origin, validation process, reporting date, and subsequent modifications. Smart contract capabilities and permissioned access can enable collaborative reporting between organizations, auditors, suppliers, regulatory agencies, and investors through a single reporting infrastructure. Research regarding the relationship between blockchain and sustainability suggests that we are moving from simple supply chain traceability towards a more integrated approach to ESG reporting, AI, the Internet of Things (IoT), and big data analysis (Nguyen Van et al., 2026). Blockchain may improve the quality of disclosures by providing less doubt about where the data came from and what the history was for the reported data. Additionally, blockchain may provide greater auditability for the reporting process and help prevent retrospective changes to records (Caldarelli, 2025; Sheldon, 2021). However, blockchain technology cannot guarantee the accuracy of the information initially entered the ledger. If an organization submits inaccurate emissions data or makes unfounded sustainability claims, the blockchain will record those inaccuracies indefinitely rather than correcting them. Therefore, the "oracle problem" represents a significant theoretical limitation of using blockchain as a tool to fight greenwashing. In essence, blockchain should be viewed as a foundational structure for providing evidence of the chain of custody of information, as opposed to replacing traditional methods of measuring, auditing and governing. Blockchain can reduce "greenwashing" primarily through improving the traceability of information and the overall transparency of reporting. Ultimately, the more reliable the verification process for external inputs, and the more rigorous the validation process before data is entered into the system, the higher the probability that blockchain will produce disclosures that can be trusted, rather than just be unchangeable. The following section discusses how AI and Blockchain complement each other.

Artificial Intelligence (AI) And Blockchain Complement One Another

The vulnerabilities of sustainability reporting that each of the technologies can address differ. AI is good at understanding, organizing, finding anomalies and comparing information. On the other hand, blockchain is best suited for establishing origin, controlling access to information and keeping records secure from being altered. Thus, because of these differences, AI will allow companies to evaluate the quality and consistency of sustainability data while blockchain will provide a way to verify the evidence needed to make that

evaluation (Mustafa et al., 2025). Recent theoretical models describe how both technologies can work together as part of a larger framework. In such a framework, data is collected from many different types of networks, sensors, public databases, etc. Quality controls are applied to the collected data; the data is then placed onto a permissioned ledger; natural language processing and anomaly detection algorithms are used to analyze the data; and ultimately, the data is incorporated into formal reporting and auditing practices. Combining AI and blockchain provides additional value to both technologies, rather than simply combining their individual values. When analyzing data with clear origins and verifiable histories, the analyses performed by AI are naturally more trustworthy. At the same time, when AI systems continually check blockchain records for errors, inconsistencies or deviations from established external standards, those records become more useful (Ifedayo et al., 2025). Ultimately, both technologies benefit each other: blockchain provides the foundation of credible evidence used by AI to perform its analyses; AI derives more analytical insight from the data contained within the blockchain (Dillenberger et al., 2019).

However, although the combination of these two technologies will not automatically eliminate all the inherent risks associated with sustainability reporting; for example, generative AI can be utilized to produce very convincing sustainability stories that appear to demonstrate strong environmental performance but do so with little evidence of actual performance. This creates a potential for increased levels of AI-facilitated greenwashing (Dimes et al., 2026). On the other hand, while blockchain provides improved traceability and permanency of records, it does not provide any guarantee as to the initial accuracy of the data being inputted. Therefore, if incorrect or biased information is provided at the beginning of the reporting process, blockchain will simply record and preserve this error as an unalterable record, rather than providing a solution to the underlying problem (Nguyen Van et al., 2026). Thus, assessing the integration of AI and blockchain involves more than just verifying their existence in an organization. An evaluation must assess how these systems relate to the verification of data, analysis of analytical outputs, human oversight, and ultimately the inclusion of sustainability performance metrics in corporate reporting. The following section discusses relationship sustainability information disclosures and greenwashing mitigation.

Sustainability Information Disclosures and Greenwashing Mitigation

This study posits that the quality of sustainability disclosure will serve as the most significant mediator in this conceptual model. There are studies currently examining how AI and blockchain are improving sustainability reporting; however, there is no evidence to suggest that the use of these technologies can eliminate greenwashing. Rather, it appears that the quality of sustainability data (Nguyen et al., 2026; Sneideriene & Legenzova, 2025). Is being enhanced through greater reliability, transparency, comparability, and overall quality of sustainability data. When disclosure quality is high, the level of information asymmetry is low and thus, sustainability claims made by companies are more transparent and verifiable, thus limiting the ability of companies to make ungrounded or only positive claims (Saraswati et al., 2025). Therefore, although the direct relationship between digital tools and greenwashing remains largely unstudied, disclosure quality appears to provide a theoretically justifiable means by which digital tools may assist in reducing greenwashing.

Although the relationship between the degree of a company's disclosure quality and its actual environmental performance is considered to be a probabilistic relationship and not an absolute relationship; i.e., a company can produce high-quality disclosures even though they may continue to have poor environmental practices, similarly a company can make improvements in their environmental practices without making their reporting transparent. Blockchain allows for the tracking and validation of data; on the other hand, AI allows for the analysis of data to find patterns and anomalies that indicate potential fraud (Dillenberger et al., 2019). Thus, what is being examined is the difference between what a company reports about itself being sustainable versus what independent verification shows about how the company is performing in terms of being sustainable, and not simply whether the company is environmentally responsible. In addition, there is some evidence that suggests that there are limits to how effective these two types of technology can be in reducing greenwashing. Limitations to the effectiveness of reducing greenwashing using sustainability disclosures and AI/blockchain technologies have been documented. Hossain and Rana (2025) noted that since AI is often very opaque, it can lead to a lack of trust; therefore, it is important to develop transparent and well-governed applications of AI. Overall, the current body of literature indicates that although AI and blockchain technologies can help improve the quality of sustainability disclosures when implemented with strong governance, it is not clear whether these technologies can eliminate greenwashing entirely (Carriazo-Regino et al., 2026; Hossain & Rana, 2026). External assurance is essential for determining if digital evidence will lead to real accountability for organizations. When using AI generated alerts, there needs to be proper interpretation and escalation procedures in place. When using blockchain-based records, there needs to be strong governance in place to validate data and handle exceptions. High-quality assurance requires challenging output from models, investigating anomalies, evaluating the reliability of sources of data, and requiring corrections or qualifications where needed. On the other hand, low-quality assurance would simply verify that there was a technology driven reporting process in place without verifying the accuracy of the underlying process. The use of an external assurance provider will help to further enhance the positive effects of integrating AI and blockchain technology into the quality of disclosures. Additionally, the proposition will address several of the limitations of AI identified in previous studies; including those related to the interpretability of models, errors made by models and ambiguities associated with environmental claims (Vishnoi et al., 2026). The following section discusses research gaps in literature.

Research Gaps in Literature

In addition to the gaps identified in current research regarding the possible application of AI and blockchain technologies to sustainability disclosure practices; there are still five additional gaps that need to be filled. First, the existing research on this topic has been fractured by technology. Most of the work AI has focused on text analysis, anomaly detection, and classifying instances of "greenwashing." On the other hand, the work in Blockchain technology has emphasized traceability, data integrity, and supply chain transparency. There is currently no theoretical framework for how these two technologies interact with each other and their potential for reducing "greenwashing" (Moodaley & Telukdarie, 2023). Secondly, many organizations equate the use of technology with its effectiveness. The mere implementation of an AI tool or a blockchain network does not necessarily mean that the quality of disclosures will improve, or that "greenwashing" will decrease. Additional research is required to determine whether there is a difference between organizations using

technology as a superficial measure of sustainability versus organizations integrating technology into their daily business processes, demonstrating analytical accuracy, and ultimately changing their corporate reporting practices (Truant et al., 2023).

Lastly, the topic of authenticity has not been fully investigated. Blockchain provides a record of where the data came from, however it cannot provide validation for whether the off-chain data that was submitted into the system is accurate. Similarly, AI can identify potential problems with claims being made, but cannot determine if a claim was intentionally fraudulent, based on incorrect calculations or ambiguous reporting. Therefore, conditions such as the oracle problem, initial data quality, and human oversight should be defined as boundaries for the system (Nguyen Van et al., 2026; Vishnoi et al., 2026).

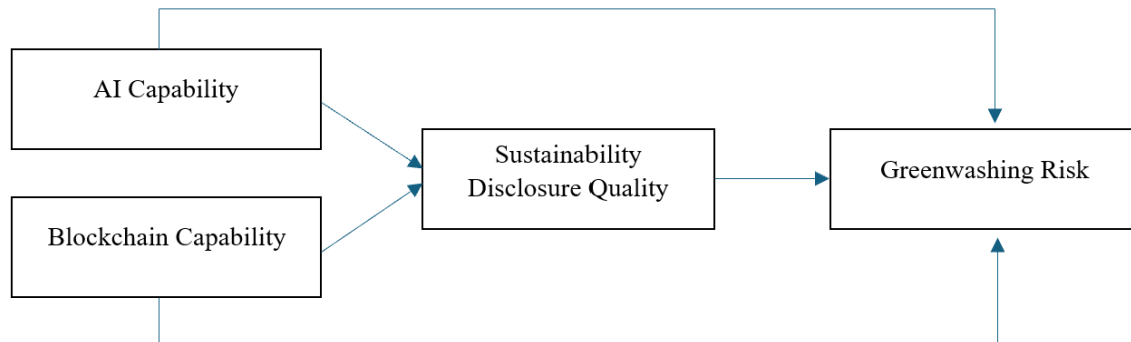
Fourth, the mediating factors that explain how digital transformation leads to outcome measures (e.g. transparency, trust, reduction of greenwashing) are generally not specified. Most studies transition from digital transformation directly to outcomes such as transparency, trust, or the reduction of greenwashing, without specifying what organization-level processes produce those outcomes. The current study fills this void by identifying sustainability disclosure quality as the key mediating variable (Lodhia et al., 2025).

Finally, the outcome measurements used are not sufficient. The use of AI to detect greenwashing is limited by the absence of a common definition for greenwashing and the lack of reliable data sets that can be used to train AI models. As a result, the effectiveness of the models should be validated through other means such as expert review, independent audits, regulatory decisions, and/or physical evidence of environmental impact, rather than relying exclusively on automated metrics (Vishnoi et al., 2026).

These identified gaps provide the basis for a streamlined framework. In this model, AI and blockchain capabilities are the two separate foundational drivers; their integration serves as a complementary capability; sustainability disclosure quality serves as the primary mediating variable; and external assurance quality serves as a moderating governance variable. The previous literature has produced useful insight into how to use AI to find out if companies are "greenwashing" their products. Also, the literature on using blockchain to track products from the farm to the consumer's hand is growing. However, both areas are being studied separately. For example, the focus of most AI literature is on how to make systems larger so that they can analyse more information. On the other hand, the focus of most blockchain literature is on how to provide evidence of where a product came from, how to make the supply chain visible, and how to protect the security of the information. There are many researchers who are calling for more integration between the two areas because they believe that even though blockchain can provide proof that a product was made by a farmer, it cannot verify whether the product is organic. The proposed model was purposefully kept simple. Instead of looking at each technological feature as an individual mediator, the model looks at only one theoretically important mechanism to the degree to which digital capabilities improve the quality and verification of sustainability disclosures. This simplifies the testing of the model empirically with survey data that are supported by disclosure scores derived from documents, assurance information, and environmentally related metrics that have been verified independently. The following section discusses research theoretical framework.

The Theoretical Framework

The three different theoretical frameworks that have been used to analyze the studies include: legitimacy theory, signaling theory, and information asymmetry theory. Conceptual Flow: AI Capability and Blockchain Capability lead to high quality of sustainability disclosures which in turn reduce the risk of greenwashing. The study draws on Legitimacy Theory, Signaling Theory, and Information Asymmetry Theory to explain how AI capability and blockchain capability may contribute to reducing greenwashing risk through improved sustainability disclosure quality. AI capability can enhance an organization's ability to collect, process, integrate, and analyze large volumes of sustainability related data, while blockchain



capability can strengthen the traceability, transparency, and integrity of such information. These capabilities may therefore improve the quality of sustainability disclosures by making sustainability information more complete, consistent, reliable, and verifiable. From an Information Asymmetry perspective, higher-quality disclosure can reduce the information gap between organizations and external stakeholders by providing more useful and transparent information about sustainability performance. From a Signaling perspective, credible and high-quality sustainability disclosure can provide stronger signals about an organization's actual sustainability practices and reduce the opportunity for selective or misleading environmental claims. Legitimacy Theory further suggests that organizations use sustainability disclosure to demonstrate conformity with societal and stakeholder expectations; however, the legitimacy value of such disclosure depends not only on the amount of information reported but also on its quality and credibility. Accordingly, this study proposes that AI capability and blockchain capability can contribute to higher sustainability disclosure quality, which in turn may reduce the risk of greenwashing. Thus, sustainability disclosure quality serves as the central mechanism linking digital capabilities with greenwashing risk.

Accordingly, the follow part will be the explanation of each theory.

Legitimacy Theory

Legitimacy theory states that organizations disclose sustainability information to align themselves with societal and environmental expectations. Prior studies indicate that organizations can use sustainability reporting to establish and maintain legitimacy, gain support from stakeholders, and reduce the level of information asymmetry (Ching & Gerab, 2017). Therefore, the quality and accuracy of such reporting is extremely important. Organizations that perform poorly in terms of sustainability may use vague or poor-quality reporting to cover up their actual performance yet continue to try and preserve their legitimacy (Hummel & Schlick, 2016). This process can result in a disconnect between surface-

level communications regarding sustainability performance and the true performance of an organization in terms of sustainability. Additionally, research on legitimation demonstrates that organizations can use sustainability-related messages for both legitimate and purely symbolic purposes (Eng et al., 2024). Organizations can use technologies such as artificial intelligence (AI) and blockchain to enhance substantive legitimacy by providing additional detail, traceability, and verification capabilities related to sustainability data. Conversely, organizations can use such technologies to enhance symbolic legitimacy if they merely provide the illusion of transparency, without improving their sustainability practices. For example, recent studies have demonstrated that while generative AI can produce sustainability reports that appear more positive and credible, it also produces the possibility of organizations engaging in AI-facilitated greenwashing (Dimes et al., 2026). The following section discusses the signaling theory.

Signaling theory

Signaling theory describes how organizations transmit information about previously unobserved characteristics to their outside stakeholders when there are differences in access to information. Sustainability reporting is an example of such transmission of information; reports are signals to stakeholders that describe an organization's social and environmental performance. Research has demonstrated that as organizations improve the quality of their sustainability reports, the effects of signaling will be enhanced due to reduced levels of information asymmetry and improved perceptions of organization legitimacy. However, whether a signal is viewed as credible depends not only upon its availability but also upon whether there is sufficient evidence that can be verified and relied upon. Assurance of sustainability reports influences stakeholders' perceptions of the credibility of a report. The level of assurance provided, and how the results of that assurance are communicated, will determine how strong the resulting signal is (Baier et al., 2022).

The importance of this idea is even more significant in the context of new digital technology. It is often cited as a tool that can help to increase the reliability of sustainability reports by increasing trust, transparency and accountability in reporting and assurance practices through embedding it into reporting and assurance practices (Bakarich et al., 2020). However, the "signal" provided by these technologies does not exist solely due to being used. Research on assurance indicates that credibility is based on the quality and depth of the verification process that underlies the reporting; not just whether an assurance report exists (Baier et al., 2022; M. Yan et al., 2022). As such, within the proposed model, AI and blockchain will be able to create a more credible signal regarding sustainability only when the characteristics of both are used as part of processes which improve the quality, traceability, analytical capability and verification of sustainability-related information. Thus, the quality of disclosure about sustainability is what provides a way to turn the use of technology into a trustworthy sustainability signal, rather than simply having the use of technology serve as a credible signal.

The theoretical framework of "information asymmetry" provides a logical structure to analyses the relationship between digital technology used in corporate sustainability reporting and the extent to which that reporting can be considered reliable; as well as the frequency at which corporate greenwashing occurs. As a rule, corporations have a significantly higher degree of knowledge about their own environmental activities than

outside stakeholders like investors and regulators. Therefore, corporations can choose to selectively report certain aspects of their environmental performance, withhold negative information, or exaggerate their accomplishments in reducing environmental impacts. New theoretical research views greenwashing because of a failure to communicate effectively due to an imbalance in access to information. Additionally, new theoretical research identifies verification costs and institutional requirements as significant determinants of continuing to make unsubstantiated claims about environmental performance (Simões et al., 2026).

The potential of digital technologies to transform the corporate world through increased availability, understanding, transparency, and accuracy of sustainability information should be viewed through the lens of digital technologies. Research around digital transformation has indicated that companies that are digitally transformed may reduce "greenwashing" primarily through reducing the information gap. The reduction in the information gap indicates that a higher quality information environment is a main component that links digital transformation with improved environmental reporting (T. Yan et al., 2026). Additionally, research on artificial intelligence (AI) has shown that AI can limit the manipulation of environmental reports and greenwashing through internal controls and minimizing information asymmetry (Yu et al., 2026). Specifically, blockchain technology can enhance the visibility and credibility of environmental data and enable organizations to precisely track all transactions related to their operations as well as carbon emissions (Bing et al., 2026).

However, the theoretical frameworks indicate that the mere adoption of new technologies will not inherently alleviate the problem of informational asymmetries. Rather, the ability of these new technologies to improve the informational environment is dependent upon how well they are integrated into all aspects of the data collection process (i.e., data collection, data verification, data evaluation, and data reporting). This study has therefore identified the quality of sustainability disclosure as the main mechanism by which the use of artificial intelligence (AI) and blockchain technology can reduce informational asymmetries and increase the credibility of sustainability reports prepared by corporations.

Theoretical Logic Integration

Theory explains why organizations report on sustainability and why there may be symbolic reporting. Signaling Theory shows us that reporting that is reliable and can be verified separates those who truly have sustainable operations from those who are just trying to manage people's impressions of them. Lastly, Information Asymmetry Theory illustrates how AI-enabled monitoring and blockchain-enabled traceability provide more reliable data on sustainability (Hahn et al., 2015). Together, these theories provide logical progression. Digital capacity leads to better data collection and oversight which results in improved disclosures and therefore decreases information asymmetries and increases the reliability of signal of credibility, leading to less greenwashing. An overall theoretical framework based on external assurance as a form of regulation will provide the basis for testing each of the four types of hypotheses (direct, mediated, complementary and moderating) developed in the literature review.

Hypotheses Development

This study uses the unified theoretical framework introduced above to propose eight hypotheses to assess the degree to which AI and blockchain technologies can improve the

quality of sustainability disclosures, thus reducing the risk of greenwashing. In addition, to distinguishing between the separate effects of AI and blockchain, the framework also identifies the synergistic effects of combining AI and blockchain; the mediating effect of sustainability disclosure quality; and the moderating effect of external assurance quality. These distinctions are important because simply utilizing technology does not necessarily lead to improvements in sustainability reporting. Rather, the potential value of digital technologies lies in how well they are integrated into the generation, analysis, verification, and reporting of evidence (Lodhia et al., 2025; Pizzi et al., 2024).

AI Capability and Sustainability Disclosure Quality

The use of artificial intelligence (AI) has allowed businesses to effectively collect, store, assess and make sense of large volumes of both structured and unstructured sustainability related data. AI-driven improvements in data gathering, analysis and assessment have significantly improved the speed, consistency, comparability, and value of sustainability reports. Existing empirical research indicates a positive association between the implementation of AI and improved ESG disclosure quality. Additionally, recent studies indicate that the use of AI increases the level of quality for corporate environmental reports (T. Yan et al., 2026; Yu et al., 2026). Therefore, it is expected that the development of AI capabilities will continue to raise the bar for the quality of sustainability-related data being shared with external stakeholders.

H₁: There is a direct correlation between an organization's use of AI and how well it reports on sustainability issues

Capability of Blockchain Technology and Quality of Disclosures on Sustainability issues.

The use of decentralized ledgers for transaction and history records enhances both the reliability and ability to track sustainability data with blockchain capabilities. The primary benefit of using blockchain in sustainability reporting is that it can provide assurance that the source, tracking, and validation of data is accurate. Studies conducted recently have found that blockchain technology can be used to address problems associated with collecting, integrating, and verifying ESG data; thus, improving disclosure standards (Bakarich et al., 2020). However, since blockchain does not inherently validate whether the original data entered the system is accurate, it is expected that the value of blockchain will come from increasing the integrity and traceability of the information workflow rather than simply providing a technical solution.

H₂: There is a direct correlation between a company's use of blockchain technology and the quality of their sustainability reporting

Integrating AI and Blockchain Technology to Improve Quality of Sustainability

Disclosures AI and blockchain provide complementary services that have potential to be used together. While AI is useful for collecting, analyzing and processing sustainability data; blockchain provides a verifiable record of where the data came from, a clear audit trail and security. The integration of both technologies would allow organizations to complete each step of the sustainability reporting process with greater efficiency and create a stronger technical foundation for high-quality disclosures than using either technology separately (Nguyen et al., 2026). Although some recent studies indicate that combining AI and

blockchains may be an emerging trend in sustainability and addressing greenwashing; systematic reviews indicate there are currently no empirical studies that demonstrate how organizations utilize both technologies in their sustainability reporting processes.

H₃: The use of artificial intelligence and blockchain technology has a positive correlation to the quality of sustainability disclosure

The Mediating Effect of Sustainability Disclosure Quality

Prior studies have shown that digital tools may not directly influence the potential for greenwashing; however, they may influence the potential for greenwashing indirectly by improving the quality of the information provided to outside stakeholders. The quality of sustainability disclosures reflects how well the reported information can be understood, trusted, made available to others, compared to other disclosures, and supported with evidence. Recent research has also demonstrated that disclosure quality is a major way in which digital technologies can affect environmental reporting practices. Artificial Intelligence will enable companies to assess and analyze sustainability data more quickly and accurately, which in turn will result in higher quality disclosures. Higher quality disclosures will reduce the likelihood of false or misleading statements about a company's environmental performance (Sneideriene & Legenzova, 2025). Therefore, it is expected that sustainability disclosure quality will act as a partial mediator in the relationship between AI capabilities and the risk of greenwashing.

H₄: Sustainability disclosure quality mediates the relationship between AI capability and greenwashing risk

Similarly, a company's ability to utilize blockchain technology allows it to track and verify sustainability-related information. As such, enhanced disclosure quality can help close the information gap that exists between companies and external stakeholders. This closure of the information gap should then reduce the opportunity for companies to make inaccurate or unsupported statements regarding their sustainability performance. The quality of sustainability disclosure is a mediating factor in the relationship between blockchain technology capabilities and the potential for "greenwashing."

H₅: Sustainability disclosure quality mediates the relationship between blockchain capability and greenwashing risk

How AI And Blockchain Support Each Other

While each technology has unique benefits, both technologies complement each other. Artificial intelligence allows for faster and more efficient detection, extraction, categorization, and assessment of sustainability-related information. Blockchain, on the other hand, provides a framework for verifying, tracking, and ensuring the credibility of the information used in making those assessments and reports. As such, both technologies provide a mutual benefit; that is, the use of AI as an analytical tool enhances the value of the underlying data infrastructure provided by blockchain. Empirical studies have supported this synergistic relationship, showing that the combination of analytical tools such as AI, cloud computing and big data analytics increases the efficacy of blockchain-based systems in reporting on Scope 3 carbon emissions (Y. Chen et al., 2025).

As opposed to simply using both types of technology simultaneously, this study defines the complementary relationship between AI and blockchain based on how effectively each type of technology's functions complement each other as part of the overall sustainability reporting process. In terms of providing a base for the data that will be used during the sustainability reporting process, blockchain creates a very traceable base for the data, while AI helps optimize the process of analyzing and interpreting the data that is contained within it. Therefore, part of what makes AI successful in the sustainability reporting process is the fact that there are also elements of blockchain that provide guarantees regarding the source and traceability of the underlying data. Moreover, the effect of AI capability on sustainability disclosure quality is stronger at higher levels of blockchain capability.

H₆: The interaction between AI capability and blockchain capability has a positive effect on sustainability disclosure quality

Sustainability disclosure quality; risk of greenwashing.

The purpose of quality sustainability reporting is to close the gap of understanding between a company and its external stakeholders, using detailed, reliable, and verifiable information about what the company is doing to promote sustainability (Thewissen et al., 2026). On the other hand, poor-quality reporting provides companies with the opportunity to use "selective messaging" and make "superficial" statements about their commitment to the environment. Recent research on the relationship between artificial intelligence (AI) and environmental, social, and governance (ESG) reporting has highlighted the need for high-quality reporting. Emerging research on the relationship between AI and greenwashing also emphasizes the need for transparency when distinguishing real environmentally friendly practices from those that have been intentionally presented as environmentally friendly (He et al., 2025). As such, it is expected that there will be a strong correlation between a company's disclosure quality of sustainability and the likelihood of greenwashing occurring.

H₇: A negative correlation exists between the quality of sustainability disclosure and the likelihood that an organization will engage in greenwashing

Evaluation of Critical Discussion

The proposed framework provides a good way to understand how digital innovation will assist in reducing greenwashing; however, there are concerns about the fundamental assumptions in the framework. One major concern is the distinction between technological transparency and genuine accountability. While AI can identify suspect language or inconsistencies and blockchain can provide a verifiable record of data production, neither technology provides any guarantee that a business has made real environmental progress. In fact, a system may become more transparent without necessarily being more truthful. Another issue is the possibility of digital legitimacy washing. Companies may use AI dashboards, blockchain networks or automated ESG scoring systems simply as outward signs of responsible governance, but without improving their environmental performance, reporting incentives or measurement methodologies. This is consistent with the legitimacy perspective: while digitalization may reduce the gap between symbolic and substantive actions, it may simply provide a more sophisticated means of superficial communication. Therefore, empirical studies should examine the actual use, validation procedures and

corrective actions associated with such systems, rather than simply documenting whether companies have adopted blockchain or AI technologies.

Thirdly, the framework considers sustainability disclosure quality to be an important mediator in determining the quality of disclosures regarding a company's environmental impacts. However, disclosure quality does not automatically translate into a measure of the quality of environmental practices. For example, a company could be very complete, comparable, and accurate in their reporting on their environmental impacts; however, they may continue to use poor environmental practices. Alternatively, a company may improve their environmental practices prior to developing more sophisticated methods of reporting on those practices. Therefore, future studies should separate out the quality of disclosures from a company's actual environmental performance and identify the differences in the quality of disclosures versus the actual performance. Separating these three components will allow researchers to evaluate the risk of greenwashing based upon more than simply the ambiguities associated with the text used in the disclosure.

Fourthly, this framework also addresses a governance issue concerning who controls the data, algorithms, and verification protocols. It should be noted that while blockchain technology is often considered to be an open-source decentralized system, there may exist permissioned networks controlled by a group of reporting companies or technology vendors. Artificial intelligence (AI) systems will likely reflect the same biases that existed in the minds of the people who created them, the way they labeled the data used to train the system, or the training dataset itself. Fifthly, the proposed synergistic relationship between AI and blockchain is based on assumptions about how the two technologies would interact. Specifically, integrating these technologies will provide greater assurance if there is access to authenticated data, if there are clear reporting standards established, if different systems can interact with each other in a seamless manner, and if regulatory bodies and auditors can respond to alerts. On the other hand, if the data used to create the AI model was unreliable, if organizations do not have enough technical expertise to implement the technology, or if digital records are not legally and institutionally recognized, then the advantages of integrating AI with blockchain will be negligible. Additionally, there are many challenges associated with the implementation of blockchain technology, including the oracle problem, scalability issues, interoperability problems, regulatory fragmentation, and obstacles to widespread adoption (Chavan & Girwalkar, 2026; Nguyen Van et al., 2026).

The first implication of these limitations is that instead of evaluating technology adoption using a simple binary measure, digital technologies need to be assessed as organizational capabilities. This means that their effectiveness depends upon how well they are integrated into an organization's reporting processes and day-to-day operations (Lodhia et al., 2025). The second implication is that assessments of greenwashing should be conducted using multiple types of evidence to prevent reliance on just one type of assessment. For example, some of the types of evidence that could be used include automated metrics, assurance reports, regulatory reviews, and independently verified environmental data (Peng et al., 2026; Sari et al., 2026). Lastly, the third implication is that external assurances should be evaluated based on their quality, scope, and direct relevance to greenwashing and sustainability concerns. It is not sufficient to simply note that an assurance report exists (Peng et al., 2026; Sari et al., 2026). Thus, the framework should be understood as a conditional

theory of digital assurance. The framework states that while AI and blockchain can reduce greenwashing through improved traceability, quality, and review of sustainability data, simply using digital technologies will not always lead to real environmental accountability (Bakarich et al., 2020; Lodhia et al., 2025).

Managerial Implications

Managers must see both artificial intelligence (AI) and blockchain as components within an overall evidence-based governance system, rather than as separate technological solutions. Investments in AI must focus on types of assurance activities, including, but not limited to, claim analysis, anomaly detection, cross-source validation, and ongoing monitoring. In contrast, investments in blockchain must emphasize the ability to demonstrate data origin, verify sources, provide a record of validations performed, and establish accountability for any modifications made to reported figures. Ultimately, the objective is to create a complete auditable path from original operating data to the final sustainability report, as opposed to simply increasing the technological complexity of ESG reporting (Chavan & Girwalkar, 2026). Companies can begin the process with an initial focus on the most important metrics that require both data provenance and independent validation. These would include but not be limited to greenhouse gas (GHG) emissions, renewable energy usage, waste management practices, water consumption, carbon credit use, and sustainability linked financing. A gradual implementation plan will enable companies to manage their costs while also enabling them to determine if digital alert systems are resulting in improved accuracy of reported data, increased confidence in the reliability of the reports produced, and/or reduced numbers of unverified claims made regarding company performance. Several recent studies that provide frameworks for firm-level implementation of ESG reporting systems support a phased implementation model. These studies recommend that firms test integrated systems on a limited basis within one or more defined asset classes utilizing actual ESG data rather than relying entirely upon simulation models (Chavan & Girwalkar, 2026).

The implementation of strong human controls is essential to the success of AI-based systems. AI-generated risk ratings for companies or claims must result in a manual review of each rating prior to being classified as fraudulent. In the manual review, personnel must provide clear documentation of the evidence reviewed, the subsequent decisions made, and any corrective actions taken. Additionally, the governance of blockchain-based systems must include specific definitions of who can validate data, how off-chain inputs can be authenticated, what constitutes error correction processes, and how disputes among multiple sources of data will be resolved. Human oversight is necessary due to the potential for false positive and false negative ratings produced by AI models and the inability of blockchain technology to correct incorrect data submitted to it from outside sources (Nguyen et al., 2026; Vishnoi et al., 2026). For an organization's use of technology to succeed, there must be independent certification and oversight by the Board of Directors. Audit Committees and Sustainability Committees must monitor model performance, data quality irregularities, assurance results, and speed of remediation. Organizations should evaluate system performance using independent verification of environmental results and disclosures as well as the number of processed reports rather than relying solely on the existence of a digital framework.

Policy implications

Uniform standards should be set by legislators regarding the minimal requirements for reporting of digital sustainability information. These standard definitions should include but are not limited to; where the information is sourced, how the sources were verified, metadata about the data, when the data was collected or updated (timestamps), documentation of the models used to collect or analyze the data, audit logs of changes made to the data, who can view/access the data, and how errors are corrected. By creating these types of shared standards, inconsistencies among different reporting methods will be reduced, as well as the ability to compare data between companies and geographic locations. The current literature on the integration of blockchain technology and sustainability suggests that interoperability of technologies, fragmentation of regulations, scalability limitations, and barriers to adoption remain as primary obstacles to implementation (Chavan & Girwalkar, 2026).

Regulatory agencies should establish a distinction between using artificial intelligence to detect possible violations of regulations (i.e., identifying anomalies) and taking regulatory action based upon these findings. For example, AI can identify disclosure irregularities, flag disclosures for review, and support regulatory oversight; however, if regulatory actions are to be taken, they must be supported by transparent evidence, procedural protections and either an individual's or organization's assessment. Additionally, policy makers should require that agencies clearly provide information regarding where the data used in models came from, how the models are to be used, how the models were validated, what limitations exist with respect to the model's accuracy, and what type of human oversight exists for the AI-driven sustainability verification process.

Companies that use blockchain as part of their sustainability reporting process should be required to provide information about where they obtained the off-chain data; who was responsible for verifying the data; what methods were used to measure the data; and how incorrect data could be corrected. The fact that companies are using a tamper-proof digital ledger does not mean that the first measurement of environmental conditions was accurate (Nguyen et al., 2026). The way we verify our reporting has changed with the advent of digital reporting. We need to develop new standards for external verification that fit the new landscape of digital reporting. Thus, we need to think beyond simply hiring accountants with traditional reporting skills. We will probably also need auditors with technical skills in data engineering; algorithmic validation; security of systems; control over smart contracts; and environmental metrics. Governments can help us transition to these types of audits through several mechanisms, including providing funding for pilots of new regulatory frameworks; creating "regulatory sandboxes" where companies can test innovative solutions without fear of being prosecuted; sharing testing datasets across jurisdictions; and cooperating internationally. There are also many recent articles calling for governments to cooperate on regulation, invest in making their systems compatible with each other, train their workforces to perform audits of digital reporting systems, and practice performing audits using real-time environmental, social and governance (ESG) data (Chavan & Girwalkar, 2026).

Stakeholder Implications

Investors, auditors and civil society organizations cannot confuse the high level of technology rating with true credibility regarding sustainability. On the contrary, investors, auditors and civil society organizations will have to confirm that all sustainability claims made are based

on primary data; that these claims have been subjected to an independent audit; that these claims are reflected in operational results; and that any errors in reporting are quickly addressed. In addition, developers of technology must concentrate on explaining systems, validating technology specifically within their respective industries, protecting privacy of data, and making systems compatible with each other, rather than providing users with automated environmental, social, and governance (ESG) metrics as the sole truth. All of these goals are consistent with the existing body of knowledge which states that AI systems used must be developed in a manner that is transparently governed and ethically sound (Vishnoi et al., 2026).

Limitations & Future Research

This research has no empirical tests to support whether the use of AI and/or Blockchain can help reduce Greenwashing. Therefore, the relationships proposed in this study are to be viewed as being based on theory and as hypotheses that need to be tested, rather than as established causal links. Future research should test these relationships using either longitudinal, quasi-experimental, or field-study designs, and compare the performance of organizations prior to implementing a complete digital assurance framework with their performance after implementing such a framework.

Another challenge relates to the measurement process itself. Because greenwashing is so difficult to measure directly, it is unlikely that automated tools will be able to distinguish between vague statements made by companies and their intention to mislead. Also, because there are no accepted definitions of greenwashing, no standard training data for machines to use, and no confirmed cases of greenwashing to learn from, it is extremely challenging to develop machine-learning models that can effectively identify greenwashing (Vishnoi et al., 2026). In the future, researchers should combine machine-generated measurements with evaluations performed by experts, audit reports, regulatory actions, feedback from stakeholders, and objective environmental performance data. Finally, although the model uses the quality of sustainability disclosures as a mediating variable, the quality of a company's disclosure may not represent the actual state of its environmental impact. Therefore, researchers need to examine disclosure quality, actual environmental performance, and the differences between what a company reports about itself environmentally and what it does as separate factors in subsequent research. Such studies would help determine whether digital systems really help improve environmental outcomes and communication or if they simply provide an appearance of transparency.

Fourthly, the model used in this study does not completely capture the impacts of various factors including national regulation, industry characteristics, company size, digital readiness, and stakeholder requirements. Studies comparing performance across different geographical regions or industrial sectors could determine if the model would perform better in environments with more developed reporting regulations, assurance mandates, data systems, and enforcement mechanisms.

Fifthly, while the framework considers the integration of AI and Blockchain to be a strategic advantage, it also recognizes that applying these two technologies could lead to some problems related to interoperability, scalability, cyber security, privacy, technical knowledge, and governance. The existing literature points out that these factors, along with regulatory

fragmentation and the oracle problem, represent major barriers to reliable sustainable solutions (Chavan & Girwalkar, 2026; Nguyen Van et al., 2026). Future studies will have to analyze the cost effectiveness of the integrated platforms and define the circumstances where their benefits in terms of reliability outweigh the costs of implementation.

Finally, research should address the potential negative outcomes of AI and Blockchain technology. AI may produce biased classifications or prevent people from reporting complex but true information, while Blockchain may promote excessive confidence in information that is unalterable, but fundamentally incorrect. Thus, future studies should examine false-positive rates, false-negative rates, model drift, explainability, and the long-term effects of digital assurance on corporate reporting. Future studies should re-examine the model by applying different technologies that affect the potential for greenwashing. Also, the future study can re-examine the model with different mediators.

Conclusion

AI and blockchain are presented in this paper as being complementary digital solutions to aid in reporting on sustainability. AI could provide deep analysis of large amounts of data, whereas blockchain provides verification of where the data came from and allows tracking of that data. Both AI and blockchain will indirectly help to reduce greenwashing; however, the overall quality of sustainability reporting must be improved prior to both being able to close the gap between what companies say they do and what can be proven by an objective third party. This model also recognizes that although digital transformation is occurring within businesses, it may not be sufficient if data remains unverifiable, if the findings of AI are not transparently available, or if auditing processes do not find and fix errors. In conclusion, the framework that was developed in this study will serve as a strong basis for future empirical research, while continuing to support the idea that just because a business implements new technology does not mean that the reporting of its sustainability efforts will be accurate.

Theoretical and Contextual Contributions

This study adds to the sustainability reporting literature by providing both theoretical and contextual contributions. Theoretically, this study combines information asymmetry, signaling theory, and legitimacy theory to provide a theoretical explanation of how artificial intelligence (AI) and blockchain can reduce greenwashing through improved quality of sustainability disclosure. This study positions disclosure quality as a mediating variable and examines the possible complementary nature of AI's analytical ability and blockchain's data traceability. In addition, the framework used in this study goes beyond technology adoption to identify those circumstances where digital capability can lead to more credible and verifiable sustainability reporting. Furthermore, the framework identifies external assurance and the reliability, transparency, and independent verification of underlying data as boundary conditions for future theoretical and empirical studies. Contextually, this study addresses the increasing difficulty in identifying real performance toward sustainability from symbolic corporate statements made in a digitalized reporting environment. This study highlights that although technology can be highly sophisticated, technology does not necessarily prevent greenwashing from occurring if disclosure is still unverifiable, algorithms are opaque, or independent assurance is insufficient. Therefore, the framework developed in this study provides a foundation for future research to determine how the relationships identified in this study exist within different organizational and regulatory contexts and whether

combining AI and blockchain into sustainability reporting practices creates increased credibility for disclosure. Since this study is conceptual, the contributions provided in this study represent theoretically based propositions rather than empirically tested causal relationships, requiring additional research using longitudinal studies, quasi-experimental studies, or field-based studies.

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