Optimizing Transparency and Accuracy: How Technology Revolutionizes Sustainability Reporting

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Abstract: This paper aims to provide the impact of technology in sustainability reporting anda how technology revolutionizes the company operations. In sustainability reporting, there are three important aspects that can be used to evaluate a company's performance, namely, first, environmental, which focuses on managing the company's impact on nature. Second, corporate social interaction with employees, communities and society at large. Third, the governance of a company includes the structure of the board of directors, transparency in reporting, business ethics and compliance with the law. With the increasingly rapid development of technology, it plays a crucial role in supporting sustainability reporting. Technology in sustainability reporting allows companies to collect, analyze and report data more efficiently and effectively. By using special software, companies can automate the process of collecting data from various sources, this can speed up the reporting process so that companies can more quickly assess and improve sustainability performance. Additionally, technologies such as big data and analytics enable companies to gain deeper insights into the environmental and social impacts of corporate performance. By analyzing large amounts of data, companies can identify trends and patterns that may not be visible with traditional methods. This helps in better and strategic decision making, and allows companies to set more measurable sustainability targets.

Keywords: Big Data, Artificial Intelligence, Cloud Computing, Sustainability Reporting, Technology.

1. Introduction

The issue of Sustainability Reporting has been a concern for many researchers in recent years (Hahn & Kühnen, 2013; Shad et al., 2019). The process of disclosing non-financial information by companies that includes environmental, social, and governance (ESG) performance is interesting to research because it is much needed by companies. The report aims to provide transparency to stakeholders about the impact of the company's operations on the environment and society. By reporting ESG performance, companies can improve their reputation, build consumer trust, and attract investors who care about sustainability (Emerick, 2024).

Sustainability Reporting also helps companies identify risks and opportunities related to sustainability aspects. These reports often include information on companies' efforts to reduce carbon emissions, efficient use of resources, and social initiatives such as employee well-being and contributions to local communities (Gep, 2024). In some regions, such as the European Union,

sustainability reporting has become mandatory for certain companies through regulations such as the Corporate Sustainability Reporting Directive (CSRD).

Sustainability Reporting has various significant benefits for companies. First, the report increases transparency and trust with stakeholders such as customers, investors, and local communities. By disclosing environmental, social, and governance (ESG) performance, companies can demonstrate their commitment to sustainable and responsible business practices (Koskela, 2023). It also helps in attracting investments and improving the company's reputation in the eyes of the public. Additionally, Sustainability Reporting helps companies identify risks and opportunities related to sustainability. By measuring and reporting on environmental and social impacts, companies can optimize their operations, reduce costs, and improve efficiency (Satuplatform, 2023). These reports can also motivate employees by showing that their company cares about sustainability issues, which in turn can increase employee loyalty and productivity (Brightest, 2023).

Seeing the importance of sustainability reporting with the rapid development of technology, this study will formulate several research questions including: What factors play a role in sustainability reporting? and what technologies are influential in sustainable reporting?

2. Literature Review

2.1 Key pillars of sustainability: Environmental, Social, and Governance (ESG).

The main pillars of sustainability, known as ESG (Environmental, Social, Governance), include three important aspects used to evaluate a company's impact and performance in terms of sustainability. Environmental focuses on how a company manages its impact on nature. This includes efforts to reduce greenhouse gas emissions, properly manage waste, use resources efficiently, and protect biodiversity. Companies that pay attention to environmental aspects usually seek to reduce their carbon footprint and contribute to climate change mitigation (Iec, 2023).

Social includes how a company interacts with employees, the community, and the wider public. This involves issues such as human rights, fair working conditions, diversity and inclusion, and contribution to the well-being of local communities (Proxsis, 2023). Companies that are strong in social aspects usually have policies in place that support employee well-being, participate in social activities, and ensure their supply chains are free from exploitative practices (Krantz & Jonker, 2024).

Governance refers to how a company is organized and managed. This includes the structure of the board of directors, transparency in reporting, business ethics, and compliance with the law. Good governance ensures that companies operate with integrity and accountability, which in turn increases the trust of investors and other stakeholders (Proxsis, 2023). By integrating these three pillars, companies can create sustainable and responsible long-term value.

The implementation of ESG (Environmental, Social, Governance) faces several major challenges that can hinder its effectiveness. First, the complexity of regulations and standards is a significant obstacle. Different countries and industries have different standards and regulations, such as the Global Reporting Initiative (GRI) and the Sustainability Accounting Standards Board (SASB), which make it difficult for companies to choose and comply with the most appropriate standards (Hanggoro, 2024). In addition, multinational companies must comply with various local regulations, which can add to administrative and operational burdens (Sakti, 2024).

Second, limited resources and expertise are also a big challenge. ESG implementation often requires significant investment in terms of environmental audits, employee training, new technologies, and expert consultation (Sakti, 2024). Many companies, especially small and medium-sized ones, may not have enough budget or in-house expertise to effectively manage ESG initiatives[3]. In addition, companies often rely on supply chains that may not meet ESG standards, which can pose reputational risks (Sakti, 2024).

Finally, changing business culture and effective communication are also challenges. Integrating ESG in business strategy requires significant cultural changes within companies, which often face internal resistance. Additionally, companies must be able to communicate the positive impact of their ESG initiatives to stakeholders in a clear and understandable manner. The risk of greenwashing, where companies give a false impression of their commitment to sustainability, must also be avoided to maintain public trust (Sakti, 2024).

2.2 Technologies Driving Sustainability Report Transformation

Technology plays a crucial role in supporting sustainability reporting. Technology in sustainability reporting allows companies to collect, analyze, and report data more efficiently and accurately. By using specialized software, companies can automate the process of collecting data from various sources, such as energy consumption, carbon emissions, and water use. This not only reduces human error but also speeds up the reporting process, so companies can more quickly assess and improve their sustainability performance.

Additionally, technologies such as big data and analytics allow companies to gain deeper insights into the environmental and social impacts of their operations. By analyzing large amounts of data, companies can identify trends and patterns that may not be visible with traditional methods. This aids in better and strategic decision-making, as well as allows companies to set more realistic and measurable sustainability targets.

Blockchain technology is also starting to be used in sustainability reporting to increase transparency and trust. By using blockchain, sustainability data can be recorded securely and immutable, ensuring the integrity of the information reported. This is crucial in building trust with stakeholders, including investors, customers, and regulators, who are increasingly demanding transparency and accountability in corporate sustainability practices.

This book chapter will discuss in more detail some of the technologies that play an important role in sustainable reporting.

2.3 Benefits of Technology in Sustainability Reporting

Technology has brought about significant changes in sustainability reporting and accounting, providing a range of benefits that support more efficient and transparent business practices. One of the main benefits is increased efficiency in data collection and processing. By using technologies such as cloud computing, companies can collect data from various sources in real-time and store it in one centralized place (Lodhia & Sharma, 2019). This allows for quick and easy access to data, as well as reduces the risk of human error in data processing (Petcu et al., 2024).

In addition, technology also increases transparency in sustainability reporting. Blockchain, for example, allows for the recording of transactions that cannot be changed and verified by all parties involved (Abhayawansa et al., 2023). This creates a clear and reliable audit trail, which is crucial in ensuring financial data integrity and sustainability. With greater transparency, companies can build trust with stakeholders and demonstrate their commitment to responsible business practices (Vărzaru, 2022).

The technology also allows for more sophisticated data analysis, which can be used for better decision-making. With analytics tools available in the cloud, companies can conduct predictive analytics to identify relevant trends and patterns for their sustainability strategies. For example, data from IoT sensors can be used to predict equipment maintenance needs or identify opportunities to reduce carbon emissions. This helps companies in planning more proactive and strategic actions.

In addition, technology supports more accurate and timely reporting. With the automation of the reporting process, companies can produce sustainability reports faster and with a higher level of accuracy. This is crucial in meeting regulatory requirements and increasing investor confidence. Research shows that companies that use technology in sustainability reporting tend to have better and more reliable report quality.

Finally, technology also helps in reducing operational costs. By automating many manual processes, companies can save time and resources that were previously used for data collection and processing. This not only improves operational efficiency but also allows companies to allocate their resources to other, more strategic areas. Thus, technology not only supports better sustainability reporting but also provides significant economic benefits for companies.

3. Research Methods

The research method used in this study is qualitative descriptive research on technology that supports sustainable reporting. A qualitative approach can be taken through document analysis to understand how technology is used and implemented in continuous reporting.

Meanwhile, a quantitative approach can be carried out through surveys that collect data from related companies or organizations, to analyze the level of technology adoption, its effectiveness, as well as the challenges faced. This method allows researchers to get a comprehensive picture of the role of technology in supporting sustainable reporting.

4. Discussion

4.1 Big Data and analytics in monitoring and measuring sustainability performance

The use of big data analytics is essential for sustainability reporting because it allows companies to collect and analyze large amounts of data in real-time, so that they can track various environmental, social, and governance (ESG) parameters more accurately and efficiently (Anggoro, 2023). With big data analytics, companies can identify trends and patterns that are invisible to traditional methods, aiding in better and strategic decision-making[2]. In addition, the technology improves transparency and accountability in sustainability reporting, which is important for building trust with stakeholders[3].

Big Data and analytics play a crucial role in monitoring and measuring a company's sustainability performance. With the ability to collect and analyze large amounts of data in real-time, companies can track their various environmental, social, and governance (ESG) parameters continuously. This technology allows companies to identify trends and patterns that may not be visible with traditional methods, thus aiding in better and strategic decision-making (Anggoro, 2023).

Additionally, Big Data analytics allow companies to more accurately evaluate the impact of their sustainability policies and initiatives. For example, companies can use data from IoT sensors to monitor energy consumption and carbon emissions in their facilities. With proper analysis, companies can identify areas that need improvement and optimize the use of resources to reduce their environmental impact.

It also helps to improve transparency and accountability in sustainability reporting. By using Big Data analytics, companies can produce reports that are more comprehensive and easy for stakeholders to understand. This is important to build trust with investors, customers, and regulators who are increasingly demanding transparency in corporate sustainability practices (PuskoMedia, 2024).

Many large companies in the world have used big data analytics to improve operational efficiency and provide better services to their customers. Here are some examples (Rohman, 2023):

a) Google: Google uses big data through products like Google Cloud and Google BigQuery to help companies manage and analyze data at scale at a relatively low cost.

b) Amazon: Amazon uses big data to analyze customer behavior and provide more personalized product recommendations. They also use big data to optimize supply chains and reduce shipping costs.
c) Netflix: Netflix leverages big data to analyze user preferences and provide recommendations for movies and TV shows accordingly. This analysis includes data such as watch time, devices used, and whether or not the user watched the movie to the end.
d) IBM: IBM provides big data solutions through products such as IBM Watson and IBM InfoSphere, which help companies manage, analyze and integrate data from multiple sources.
e) Microsoft: Microsoft uses big data through services like Azure and SQL Products to help companies manage their businesses more efficiently.
f) Telkomsel: In Indonesia, Telkomsel uses big data to provide more personalized services and appropriate recommendations for its customers.
g) Gojek: Gojek uses big data to develop features such as GoPay and update the driver app to show the location of passengers and destinations more accurately.

The use of big data by these companies shows how this technology can provide a significant competitive advantage in various industries.

4.2 Artificial Intelligence (AI) to predict and optimize sustainability reports.

Artificial Intelligence (AI) plays a crucial role in predicting and optimizing sustainability reports with its ability to analyze large amounts of data quickly and accurately. AI can identify patterns and trends that traditional methods do not see, allowing companies to make better and strategic decisions regarding their sustainability initiatives. For example, AI can be used to predict carbon emissions based on historical operational data and provide recommendations to reduce environmental impacts (Susilo & Athallah, 2023).

Additionally, AI assists in automating the sustainability reporting process, ensuring that reports are compiled efficiently and in accordance with international standards. By using AI, companies can reduce human error and improve the accuracy of reported data. This is important to build trust with stakeholders, including investors, customers, and regulators, who are increasingly demanding transparency and accountability in sustainability practices (Setiawan, 2024).

Research shows that the use of AI in sustainability reporting can improve transparency and accountability. A study reveals that AI can help companies manage and analyze ESG (Environmental, Social, and Governance) data more effectively, allowing companies to set more realistic and measurable sustainability targets (Riantono, 2023). As such, AI not only helps companies meet their reporting obligations but also encourages more sustainable and responsible business practices.

Some of the world's major companies have adopted Artificial Intelligence (AI) to improve efficiency and accuracy in their sustainability reporting. Google, for example, is using AI to manage their sustainability data through Google Cloud, which allows for real-time data collection and analysis. This helps Google in monitoring carbon emissions and energy use, as well as identifying areas that need improvement (Setiawan, 2024).

IBM has also implemented AI in sustainability reporting through the Envizi platform. Envizi helps companies collect data from multiple sources, calculate emissions, and track progress toward sustainability goals. By using AI, IBM can ensure that the reported data is accurate and compliant with international standards, which is essential for building trust with stakeholders[2].

In Indonesia, PT IDX Solusi Teknologi Informasi (IDXSTI) has launched Reporthink.AI, an AI-based platform designed to assist issuers in compiling sustainability reports. Reporthink.AI allows companies to automate the reporting process, reduce human error, and ensure that reports are prepared efficiently and in accordance with local and international standards (Miftahudin, 2024). This initiative demonstrates how AI can be used to improve transparency and accountability in sustainability reporting across various industry sectors. Currently in Indonesia itself, several companies have utilized AI technology to improve their operational efficiency. For example, Asian Pulp and Paper, which uses AI to monitor forests, in addition to monitoring potential fires and preventing them, can also scan even if a single tree is cut down. Of course, this technology is very useful for preserving forests. Another example is Adaro using AI to improve job security. The AI system used is in the form of an Advance Driving Monitoring System (ADAS) and Driver Monitoring System (DMS) cameras that analyze in real time deviations from the operation of moving vehicles, such as deviations from a safe distance, maximum speed limits, and driver eligibility (fatigue, using a mobile phone, not wearing a seat belt, etc.) (Idayanti, 2024).

The Internet of Things (IoT) plays a crucial role in the collection of real-time sustainability data, which is particularly beneficial for sustainability accounting and reporting. By using sensors and connected devices, IoT enables accurate and timely data collection regarding resource use, emissions, and waste (Mahalakshmi et al., 2024). This data can be used to monitor environmental performance in real-time, allowing companies to immediately identify and address sustainability issues. For example, IoT sensors can be used to monitor energy and water consumption in production facilities, helping to reduce waste and improve resource efficiency (Malik, 2024).

In addition, IoT also supports sustainability accounting by providing more detailed and integrated data. Data collected through IoT can be processed and analyzed to produce more accurate and transparent sustainability reports[3]. This helps companies meet regulatory requirements and increases stakeholder trust. For example, in the manufacturing sector, IoT

sensors can track the carbon footprint of production processes, providing the data necessary for reporting greenhouse gas emissions (Mahalakshmi et al., 2024). Thus, IoT not only improves operational efficiency but also supports more environmentally responsible business practices.

Research shows that the application of IoT in sustainability data collection can improve data-driven decision-making and encourage innovation in sustainability practices (Malik, 2024). With real-time data, companies can conduct predictive analytics to identify trends and patterns that can aid in long-term strategic planning. For example, data from IoT sensors can be used to predict equipment maintenance needs, reduce downtime, and increase productivity (Wu et al., 2022). Thus, IoT not only aids in the collection of sustainability data but also provides valuable insights to improve overall business performance.

Here are some examples of companies that have used the Internet of Things (IoT) for real-time sustainability data collection along with related research (Leo, 2024):

a) IBM: IBM uses IoT to collect sustainability data across various sectors, including agriculture and energy. One of their research shows how IoT can be used to monitor soil and plant conditions in real-time, which helps farmers optimize water and fertilizer use.
b) Bosch: Bosch uses IoT to manage energy and resources in their factories. Their research shows that the use of IoT sensors can reduce energy consumption and improve operational efficiency.
c) GE Digital: GE Digital uses IoT to monitor and optimize the performance of industrial machinery. Their research shows that by using real-time data from IoT sensors, companies can perform predictive maintenance that reduces downtime and improves efficiency.
d) Samsara: Samsara provides IoT solutions that help companies manage their vehicle fleets more efficiently. Research shows that the use of IoT sensors can reduce fuel consumption and carbon emissions by monitoring driver behavior and vehicle conditions in real-time.

The use of IoT in sustainability data collection allows companies to make better and faster decisions, as well as reduce their environmental impact. Is there a specific company or sector that you would like to know more about?

4.3 Blockchain as a tool for transparency and data security.

Blockchain has an important role in improving transparency and data security in the world of accounting. This technology allows for the recording of transactions that cannot be altered and verified by all parties involved, thereby reducing the risk of data manipulation (Elshqirat, 2023). With each transaction recorded in a sequentially connected block, the blockchain creates a clear and reliable audit trail. This is especially important in accounting, where data accuracy and integrity are key to correct financial reporting (Elshqirat, 2023).

Additionally, blockchain improves data security by using advanced cryptographic techniques. Every transaction recorded in the blockchain is encrypted and can only be accessed by the party who has the appropriate cryptographic key (Singh et al., 2023). This can reduce the risk of unauthorized access and data leakage, which is a major problem in traditional accounting systems. Research shows that the use of blockchain can reduce the incidence of fraud and errors in the recording of financial transactions (Daidai, 2023). Thus, blockchain not only increases transparency but also provides an additional layer of security that is much needed in accounting.

Further research shows that blockchain can automate many accounting processes through the use of smart contracts (Liu et al., 2019). Smart contracts are programs that run on the blockchain and automatically execute agreements based on predefined conditions. This not only reduces the need for human intervention but also ensures that all transactions are carried out in accordance with the established rules. Thus, blockchain not only improves operational efficiency but also ensures compliance with accounting standards and regulations.

Several large companies have adopted blockchain technology in their accounting practices to improve data transparency and security. Here are some examples:

a) PwC (PricewaterhouseCoopers): PwC has integrated blockchain in their audit and accounting services to improve the efficiency and reliability of the audit process. They use blockchain to record transactions transparently and ensure data integrity (Elshqirat, 2023).
b) EY (Ernst & Young): EY uses blockchain for a variety of applications, including financial reporting and auditing. They have developed a blockchain-based platform that assists their clients in better managing and tracking financial transactions (Garanina et al., 2022).
c) Deloitte: Deloitte has implemented blockchain in their accounting systems to improve security and transparency. They also provide consulting services to help other companies adopt blockchain technology in their operations (Hsieh & Li, 2024).

Research shows that the adoption of blockchain by these companies has brought about significant changes in the way they manage and report financial data, as well as increasing stakeholder trust in their financial reports.

4.4 Cloud Computing for the management and storage of sustainability data.

Cloud computing has an important role in the management and storage of sustainability data in accounting. By using the cloud, companies can collect, store, and manage sustainability data from various sources centrally and efficiently (Petcu et al., 2024). This allows for real-time access to data, which is essential for accurate and timely sustainability reporting. For example, data on carbon emissions, energy use, and waste can be collected and analyzed

automatically, assisting companies in monitoring their environmental performance on an ongoing basis (Kovacova et al., 2023).

In addition, cloud computing increases transparency and accountability in sustainability reporting. With data stored in the cloud, companies can easily share information with stakeholders, including investors, regulators, and the general public (PwC, 2021). This helps build trust and demonstrates the company's commitment to sustainable business practices. Research shows that the use of cloud computing in sustainability reporting can improve data quality and reliability, as well as facilitate the audit and verification process (Tian et al., 2024).

Cloud computing also supports more sophisticated data analysis and better decision-making. With powerful computing capabilities and analytics tools available in the cloud, companies can conduct predictive analytics and identify relevant trends and patterns for their sustainability strategies. For example, companies can use data from the cloud to predict equipment maintenance needs or identify opportunities to reduce carbon emissions. Thus, cloud computing not only helps in the management of sustainability data but also provides valuable insights to improve overall business performance.

Many companies around the world have adopted cloud computing for sustainable data management and storage. Here are some examples:

a) Microsoft: Microsoft uses the Microsoft Cloud for Sustainability to help organizations manage their sustainability data. These solutions include environmental, social, and governance (ESG) data analysis, as well as AI capabilities to accelerate decision-making and reporting (Thomas, 2024).
b) Amazon: Amazon Web Services (AWS) providing a variety of cloud services that support sustainability. AWS helps companies reduce their carbon footprint by providing more efficient and environmentally friendly infrastructure.
c) Google: Google Cloud Platform (GCP) is also used by many companies to manage sustainability data. Google itself is committed to using renewable energy and reducing carbon emissions in its operations.
d) Södra: Sweden's largest association of forest owners uses Microsoft Sustainability Manager to improve their sustainability practices. With the help of AI, they can collect and analyze data more efficiently.
e) Stadium Allegiant: The company uses Microsoft Sustainability Manager to support state-of-the-art and energy-efficient facilities. They have obtained LEED Gold certification and use renewable energy from local solar power plants.

Cloud computing allows companies to manage sustainability data more efficiently, reduce costs, and increase operational flexibility.

5. Conclusion

Developing technology and sustainability reporting must be synergized for companies in communicating performance related to sustainability issues, which include three main dimensions, namely environmental, social, and economic. This sustainability report provides comprehensive information about an entity that operates sustainably in managing the impact of its operational activities on the environment and society as well as efforts to achieve long-term sustainability goals. Sustainability reports often include measurable data, policies, strategies, and relevant achievements that aim to provide transparent information to stakeholders such as investors, customers, employees, governments, and the wider community.

Sustainability reporting that takes advantage of technological developments can be described as an important step in increasing transparency, efficiency, and accountability in achieving sustainability goals. Technological developments, such as big data, artificial intelligence (AI), Internet of Things (IoT), and blockchain, provide various conveniences in collecting more accurate data, more in-depth analysis, and more real-time monitoring of a company's social, economic, and environmental impacts.

The benefits of sustainability reporting are extensive, both internally and externally for companies. By compiling clear reports, companies can increase credibility, attract more complex stakeholders and identify opportunities to improve efficiency and innovation in company operations. In addition, sustainability reports also help companies to contribute to larger global goals, such as environmental protection, reduction of social inequality, and inclusive and sustainable economic growth.

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