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Sustainable Digital Accounting: Integrating ESG Reporting and Data Analytics in the Era of Industry 5.0

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Abstract. *This study explores the conceptual integration of Environmental, Social, and Governance (ESG) reporting and data analytics within the framework of sustainable digital accounting, with Industry 5.0 acting as a moderating paradigm. As organizations increasingly face demands for transparency, ethical governance, and sustainable operations, the limitations of traditional accounting systems have become evident. ESG reporting plays a crucial role in communicating non-financial performance and guiding strategic decisions aligned with stakeholder interests and regulatory expectations. However, the effectiveness of ESG disclosures is often hindered by fragmented data structures, inconsistent standards, and insufficient technological support. Data analytics, when integrated into ESG processes, enhances the precision, timeliness, and reliability of sustainability disclosures through predictive modeling, anomaly detection, and real time performance monitoring. Yet, despite its potential, the adoption of data analytics in accounting remains limited and under-theorized. Industry 5.0 introduces a human centric approach to technological transformation, emphasizing ethical innovation, inclusivity, and resilience. By positioning Industry 5.0 as a contextual and moderating framework, this study offers a novel perspective on how ESG and data analytics can synergize to create ethically aligned, future-ready accounting systems. Employing a systematic literature review, the research develops a conceptual model linking ESG, data analytics, and Industry 5.0, providing insights for academics, practitioners, and policymakers aiming to embed sustainability into digital accounting systems. The findings underscore the importance of aligning digital tools with ethical and societal values to advance accountable and sustainable business practices..*

Keywords: *ESG Reporting, Data Analytics, Sustainable Digital Accounting, Industry 5.0, Ethical Innovation*

Abstrak. Penelitian ini bertujuan untuk mengeksplorasi integrasi konseptual antara pelaporan Environmental, Social, and Governance (ESG) dan analitik data dalam kerangka akuntansi digital berkelanjutan, dengan Industry 5.0 sebagai variabel pemoderasi. Di tengah tuntutan yang semakin tinggi terhadap transparansi, tata kelola etis, dan keberlanjutan, praktik akuntansi tradisional dinilai tidak lagi memadai. Pelaporan ESG memiliki peran penting dalam menyampaikan kinerja non keuangan dan membangun kepercayaan pemangku kepentingan. Namun, efektivitas pelaporan ESG masih terhambat oleh ketidakseragaman standar, kerangka kerja yang terbatas, serta kurangnya dukungan teknologi. Di sisi lain, penggunaan analitik data memungkinkan peningkatan ketepatan, kecepatan, dan ketajaman informasi ESG melalui pemantauan real time, deteksi anomali, dan prediksi risiko. Meskipun potensinya besar, penerapan analitik data dalam pelaporan keberlanjutan masih bersifat parsial dan belum menyeluruh. Kehadiran Industry 5.0 memberikan konteks baru yang bersifat human-centric dan etis, menekankan kolaborasi antara manusia dan teknologi untuk menciptakan inovasi yang inklusif dan tangguh. Melalui pendekatan systematic literature review, studi ini mengembangkan model konseptual yang mengintegrasikan pelaporan ESG, analitik data, dan prinsip Industry 5.0. Temuan ini memberikan kontribusi teoretis dan praktis dalam mengarahkan transformasi digital sistem akuntansi ke arah yang lebih berkelanjutan, etis, dan bertanggung jawab. Implikasi dari penelitian ini penting bagi akademisi, praktisi, dan pembuat kebijakan yang ingin membangun sistem pelaporan yang selaras dengan nilai-nilai keberlanjutan dan inovasi masa depan.

Kata kunci: Pelaporan ESG, Analitik Data, Akuntansi Digital Berkelanjutan, Industri 5.0, Inovasi Etis

1. INTRODUCTION

Sustainable digital accounting has emerged as a transformative paradigm in the field of accounting, reflecting the convergence of digital innovation and sustainability principles. It

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represents the integration of advanced digital technologies with environmentally and socially responsible accounting practices, aiming to improve transparency, accountability, and realtime decision making processes (Appelbaum et al., 2021; Asatiani et al., 2021). This evolution is driven by the increasing demand for comprehensive reporting mechanisms that not only capture financial data but also address broader environmental, social, and governance (ESG) concerns. The concept of sustainable digital accounting extends beyond digitization to incorporate ethical standards, stakeholder inclusivity, and a commitment to long term value creation (Moll & Yigitbasioglu, 2022). As organizations face growing pressure from investors, regulators, and society at large, the shift towards sustainable digital accounting becomes a critical strategic imperative. Understanding the factors that influence its implementation is essential in aligning organizational objectives with sustainability goals.

The growing prominence of ESG reporting and digital transformation signals an urgent need to reframe accounting practices within the framework of sustainability and technology. ESG disclosures have evolved from voluntary practices into strategic tools for managing corporate reputation, regulatory compliance, and investor relations (Ioannou et al., 2023). Meanwhile, digital technologies, including artificial intelligence and cloud computing, have accelerated the capacity of organizations to collect, process, and report data more efficiently (Bauer & King, 2022). However, the integration of ESG and digital tools remains fragmented in many firms, highlighting the need for a cohesive accounting model that supports sustainable outcomes. This research is timely, considering global policy shifts, increased environmental regulations, and the digital disruption reshaping corporate reporting practices. As such, examining the relationship between ESG reporting, data analytics, and sustainable digital accounting within the context of Industry 5.0 provides valuable insights into the evolving role of accounting in achieving sustainability.

Environmental, Social, and Governance (ESG) reporting has become a key driver of transparency and long term value in corporate strategy. It enables firms to communicate their non financial performance and demonstrate their commitment to sustainability principles, which has been shown to influence investor behavior and stakeholder trust (Eccles et al., 2020; García-Sánchez et al., 2022). Recent regulatory developments, such as the European Union's Corporate Sustainability Reporting Directive (CSRD), further emphasize the institutionalization of ESG practices (Sierra-García et al., 2021). In the accounting context, ESG reporting plays a pivotal role in extending traditional financial disclosures to encompass climate risk, social responsibility, and governance integrity (Kotsantonis & Serafeim, 2022). However, the effective implementation of ESG reporting requires robust frameworks, standardized metrics, and technological support elements that are often lacking in conventional accounting systems. Therefore, integrating ESG considerations into digital accounting practices is essential to enable comprehensive and sustainable decision making processes.

In parallel, data analytics has transformed the field of accounting by enhancing the capacity for predictive insights, anomaly detection, and performance evaluation. The use of data analytics allows for the real time monitoring of financial and non financial indicators, thereby improving the accuracy and relevance of corporate reports (Richins et al., 2021). Accounting professionals are increasingly leveraging big data tools to optimize risk management, compliance, and forecasting (Appelbaum et al., 2021). Despite its potential, the adoption of data analytics in sustainable accounting practices remains underexplored, particularly regarding how these technologies can support ESG-related disclosures and decision making (Moll & Yigitbasioglu, 2022). Consequently, it is necessary to investigate the role of data analytics as an enabler of sustainable digital accounting systems, particularly in enhancing transparency and aligning reporting practices with sustainability goals.

The rise of Industry 5.0 introduces a new paradigm in which human centric innovation, resilience, and sustainability are central to technological advancement. Unlike Industry 4.0,

which prioritized automation and efficiency, Industry 5.0 emphasizes collaboration between humans and intelligent systems, fostering ethical and sustainable innovation (Breque et al., 2021). This human centered approach has significant implications for accounting practices, as it demands greater adaptability, ethical alignment, and integration of human values into technological solutions (Margherita & Braccini, 2022). As a moderating variable, Industry 5.0 can influence the effectiveness of ESG reporting and data analytics in shaping sustainable digital accounting. The ethos of Industry 5.0 aligns with the goals of sustainable development, promoting the use of technology not merely for profit but for societal benefit. Therefore, considering Industry 5.0 as a contextual framework enhances our understanding of how digital tools and ESG mechanisms can jointly contribute to more accountable and sustainable accounting practices.

Given these developments, this study aims to examine the effect of ESG reporting and data analytics on sustainable digital accounting, with Industry 5.0 as a moderating factor. The theoretical contribution of this research lies in advancing the literature on sustainability accounting by integrating contemporary technological and regulatory dimensions. Empirically, the study provides actionable insights for organizations seeking to align their digital transformation strategies with ESG commitments and the evolving demands of Industry 5.0. Ultimately, the findings are expected to inform accounting professionals, regulators, and policymakers about the pathways for embedding sustainability into digital accounting systems in a human centric and future oriented manner.

Although the literature on digital accounting and sustainability has grown significantly in recent years, the integration of ESG (Environmental, Social, and Governance) reporting and data analytics within the framework of sustainable digital accounting remains conceptually and practically limited. Most previous studies highlight the benefits of digital technologies in improving reporting efficiency (Appelbaum et al., 2021; Asatiani et al., 2021) and emphasize the importance of ESG in creating long term value (Eccles et al., 2020; García Sánchez et al., 2022). However, very few studies explore the direct relationship between ESG reporting and data analytics in shaping an accounting system that is not only efficient but also sustainability oriented. Moreover, existing literature tends to address these elements separately, offering limited insight into how their integration can collectively enhance accountability, transparency, and data driven strategic decision making in modern organizations (Moll & Yigitbasioglu, 2022). This reveals a conceptual gap in understanding how ESG indicators, supported by real time data analytics, can be operationalized in digital accounting systems to support sustainable outcomes.

Furthermore, the emerging paradigm of Industry 5.0 has yet to be sufficiently addressed in accounting literature. Most research remains focused on Industry 4.0, which emphasizes automation and efficiency, while the human-centric, sustainability driven, and value oriented perspective of Industry 5.0 has not been fully integrated into accounting discourse (Breque et al., 2021; Margherita & Braccini, 2022). This is a missed opportunity, especially given that ESG reporting requires stakeholder engagement, ethical alignment, and a broader value perspective elements strongly aligned with the principles of Industry 5.0. The lack of empirical studies examining how ESG reporting and data analytics interact within the context of Industry 5.0 indicates a critical research gap. Very few models or frameworks exist that position Industry 5.0 as a contextual or moderating factor in understanding the digital transformation of sustainable accounting practices. Therefore, there is a strong need for research that explicitly examines the influence of ESG reporting and data analytics on sustainable digital accounting, while accounting for the moderating role of Industry 5.0 in fostering ethically-aligned and socially responsible reporting practices.

This study offers a novel theoretical and practical contribution by integrating three key components ESG reporting, data analytics, and Industry 5.0 into a unified framework for

understanding the development of sustainable digital accounting. The uniqueness of this research lies in its interdisciplinary and forward looking approach, positioning Industry 5.0 as a moderating variable an aspect that has rarely been explored in accounting research. By doing so, this study not only deepens insights into how ESG and data analytics can work together to promote sustainable accounting but also expands theoretical boundaries by incorporating the human centric and ethical dimensions of Industry 5.0 into accounting innovation.

2. THEORETICAL STUDY

In an era defined by digital transformation and increasing global emphasis on sustainability, accounting practices are undergoing a fundamental shift. The emergence of sustainable digital accounting reflects a new paradigm where technological innovation, ethical responsibility, and environmental consciousness converge. This convergence is particularly evident in the growing relevance of Environmental, Social, and Governance (ESG) reporting and the integration of advanced data analytics into accounting systems. At the same time, the advent of Industry 5.0 introduces a human centric approach to digitalization, emphasizing ethical, inclusive, and sustainable innovation. To understand how these dimensions interact and contribute to the evolution of accounting, this study draws upon multiple theoretical perspectives. This section provides a structured review of the foundational theories and key concepts underpinning ESG reporting, digital data analytics, and the moderating role of Industry 5.0, culminating in a conceptual synthesis that informs the development of a sustainable digital accounting framework.

2.1 ESG Reporting in Accounting

Environmental, Social, and Governance (ESG) reporting has become a cornerstone of modern corporate accountability, extending beyond traditional financial disclosures to include information on a firm's environmental impact, social responsibility, and governance practices. ESG reporting enables organizations to demonstrate their sustainability commitments, fulfill stakeholder expectations, and manage long term risks (Eccles et al., 2020; García Sánchez et al., 2022). From a theoretical standpoint, ESG frameworks reflect stakeholder theory, which posits that companies must be accountable not only to shareholders but also to a broader array of stakeholders including employees, customers, regulators, and society at large (Freeman, 1984). In accounting, ESG reporting represents a shift towards integrated thinking, where financial and non financial metrics are combined to offer a more comprehensive view of organizational performance (Kotsantonis & Serafeim, 2022). However, effective ESG implementation requires standardized metrics, consistent methodologies, and robust data infrastructure components often lacking in conventional accounting systems.

2.2 Data Analytics in Digital Accounting

Data analytics has revolutionized the accounting profession by transforming how information is collected, processed, and analyzed. Leveraging big data, artificial intelligence (AI), and machine learning, accounting systems can now generate real time insights, automate complex processes, and enhance decision making accuracy (Appelbaum et al., 2021; Richins et al., 2021). Theoretically, the integration of data analytics in accounting aligns with the resource-based view (RBV) of the firm, which emphasizes the strategic use of internal capabilities such as data infrastructure and analytical competencies to achieve competitive advantage. In the context of sustainability, data analytics enables the continuous monitoring of ESG indicators, identification of risks and opportunities, and improved reporting quality. Yet, despite its potential, the role of data analytics in enabling ESG aligned sustainable digital accounting remains under theorized and fragmented in existing literature (Moll &

Yigitbasioglu, 2022). This creates an opportunity to explore how data analytics can support sustainability oriented accounting practices beyond efficiency and compliance.

2.3 Industry 5.0 as a Moderating Framework

Industry 5.0 introduces a human-centric paradigm that complements technological advancement with ethical, inclusive, and sustainable values. Unlike Industry 4.0 which focused on automation, productivity, and cost reduction Industry 5.0 emphasizes collaboration between humans and intelligent systems to generate societal value (Breque et al., 2021). Theoretically rooted in socio technical systems theory, Industry 5.0 frames technological innovation as part of a broader ecosystem that includes human agency, ethics, and resilience. In accounting, this perspective demands systems that are not only digitally advanced but also socially responsive and ethically aligned (Margherita & Braccini, 2022). As a moderating framework, Industry 5.0 has the potential to influence the effectiveness of ESG reporting and data analytics in driving sustainable digital accounting. By embedding human values into digital accounting processes, Industry 5.0 reinforces the relevance of sustainability and inclusivity, thus shaping accounting practices that reflect the ethical and environmental responsibilities of modern organizations.

2.4 Conceptual Synthesis

Integrating ESG reporting and data analytics within the framework of Industry 5.0 offers a comprehensive theoretical model for understanding sustainable digital accounting. ESG reporting provides the content, data analytics delivers the capability, and Industry 5.0 contributes the context anchored in human centric values and ethical innovation. Together, these elements form the theoretical foundation of this study and justify the investigation of their interconnected roles in shaping future-ready, sustainable accounting systems.

3. RESEARCH METHODS

This study employs a qualitative research approach using a systematic literature review (SLR) to explore the conceptual integration of ESG (Environmental, Social, and Governance) reporting and data analytics in the context of sustainable digital accounting, moderated by the principles of Industry 5.0. The qualitative approach is deemed appropriate for capturing theoretical insights and synthesizing fragmented literature across accounting, sustainability, and digital transformation domains (Sivarajah et al., 2021). The research draws from peer reviewed articles published between 2020 and 2025, retrieved from scholarly databases such as Scopus, Web of Science, and ScienceDirect. Keywords used in the search include “ESG reporting,” “data analytics in accounting,” “sustainable accounting,” and “Industry 5.0.” The inclusion criteria were based on relevance, theoretical contribution, and methodological rigor. Literature mapping was then performed to categorize studies thematically and conceptually.

This review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol to ensure transparency and reproducibility (Page et al., 2021). Analytical coding and thematic synthesis were conducted to uncover emerging patterns and construct a unified conceptual framework that links ESG disclosures, data analytics, and Industry 5.0 within the scope of sustainable digital accounting. The use of this methodology is justified by the novelty and interdisciplinary nature of the research topic, which intersects accounting innovation, corporate sustainability, and technological ethics. By synthesizing literature from multiple theoretical perspectives including stakeholder theory, socio technical systems theory, and the resource based view this study offers a robust foundation for developing a future oriented accounting model aligned with Industry 5.0 principles (Margherita & Braccini, 2022; García-Sánchez et al., 2022).

4. RESULTS AND DISCUSSION

The results of the systematic literature review reveal the critical integration of ESG (Environmental, Social, and Governance) reporting and data analytics as foundational pillars in the development of sustainable digital accounting. The studies analyzed indicate that ESG reporting has evolved from a voluntary practice to a strategic tool for managing corporate reputation, regulatory compliance, and investor relations (Eccles et al., 2020; García-Sánchez et al., 2022). Integrating ESG considerations into digital accounting practices requires advanced, adaptable information systems aligned with global reporting standards, supported by technology that ensures data accuracy, transparency, and accountability. In this context, data analytics plays a significant role in enhancing the quality of ESG disclosures by enabling predictive insights, detecting anomalies, and evaluating performance in real time (Appelbaum et al., 2021; Richins et al., 2021). However, the adoption of data analytics in ESG reporting remains fragmented and largely exploratory, signaling a need for further empirical research to establish best practices and standardized models.

In addition to these findings, the review emphasizes the moderating role of Industry 5.0, which introduces a human-centric, ethical, and sustainable approach to technological advancement. Unlike the efficiency driven paradigm of Industry 4.0, Industry 5.0 promotes collaboration between human intelligence and intelligent systems, aligning with the ethical dimensions of ESG reporting. The literature suggests that when ESG and data analytics are embedded within the framework of Industry 5.0, they produce a synergistic effect that strengthens the ethical foundation of sustainable digital accounting (Breque et al., 2021; Margherita & Braccini, 2022). The integration supports inclusive stakeholder engagement, long-term value creation, and resilient accounting systems. This insight extends prior research by highlighting that sustainability in digital accounting is not solely a technological challenge but also a normative one requiring organizations to align innovation with ethical principles and societal values. The implication is that future accounting models must move beyond operational efficiency to incorporate human dignity, transparency, and ecological consciousness, thus aligning digital transformation with sustainability imperatives.

A. Results

Table 1. Key Features of ESG Reporting in Sustainable Digital Accounting

ESG Dimension	Description	Role in Accounting	Challenges
Environmental	Reporting on carbon emissions, energy use, and environmental impact	Enhances environmental accountability and compliance	Lack of standardization, data complexity
Social	Covers labor practices, diversity, and community engagement	Supports social transparency and stakeholder trust	Difficulty in quantifying qualitative data
Governance	Includes board structure, ethics, and compliance	Reinforces ethical decision making and integrity	Inconsistent governance metrics

(**Source:** Eccles et al. (2020); García-Sánchez et al. (2022); Kotsantonis & Serafeim (2022)

Table 2. Application of Data Analytics in ESG Oriented Accounting Systems

Analytical Tool	Functionality	ESG Application	Benefit
Predictive Analytics	Forecast trends and risks	Climate risk forecasting, stakeholder sentiment	Informed decision making
Real Time	Monitor ongoing	Real time ESG metric tracking	Improved responsiveness and

Dashboards	performance		accuracy
Machine Learning	Pattern recognition and anomaly detection	Fraud detection in ESG disclosures	Enhanced data reliability
Big Data Processing	Manage large, complex datasets	Integration of structured/unstructured ESG data	Increased reporting efficiency

(**Source:** Appelbaum et al. (2021); Richins et al. (2021); Moll & Yigitbasioglu (2022)

Table 3. The Role of Industry 5.0 as a Moderating Framework in Sustainable Digital Accounting

Aspect of Industry 5.0	**Implication for Accounting**	**Synergy with ESG and Analytics**
Human-Centric Innovation	Prioritizes ethics, inclusion, and resilience	Aligns accounting with stakeholder values
Ethical Technology Use	Promotes responsible AI and data governance	Enhances transparency in ESG reporting
Societal Value Creation	Focuses on long-term, holistic outcomes	Supports sustainable decision making
Collaborative Intelligence	Merges human and machine capabilities	Strengthens the effectiveness of data analytics

(**Source:** Breque et al. (2021); Margherita & Braccini (2022); Binns et al. (2020)

B. Discussion

The findings of this study underscore the critical interconnection between ESG reporting, data analytics, and the evolving paradigm of Industry 5.0 in shaping the future of sustainable digital accounting. As businesses increasingly encounter demands for transparency, ethical governance, and environmental responsibility, traditional accounting frameworks are no longer sufficient. ESG reporting emerges not only as a mechanism of non financial disclosure but as a strategic instrument for risk management, stakeholder engagement, and long-term value creation. However, the implementation of ESG principles in accounting practice is often hindered by fragmented standards, inconsistent data formats, and the lack of integrated reporting models. This study reveals that without technological reinforcement, the transformative potential of ESG disclosures remains largely unrealized, limiting their effectiveness in driving sustainable outcomes.

To bridge this gap, the incorporation of advanced data analytics offers new possibilities in capturing, analyzing, and reporting ESG related information with greater speed, accuracy, and depth. Beyond its operational efficiency, data analytics enables real time insights, enhances risk prediction, and strengthens decision making processes, all of which are crucial in managing sustainability imperatives. Yet, as the literature suggests, these tools must be contextualized within a broader ethical and human-centered framework to achieve their full potential. This is where Industry 5.0 becomes essential not merely as a technological shift but as a normative lens through which sustainability, innovation, and human values converge. By moderating the relationship between ESG and analytics, Industry 5.0 offers a roadmap for designing accounting systems that are not only digitally robust but also socially and ethically responsive. The following subsections provide a detailed explanation of how each element ESG reporting, data analytics, and Industry 5.0 contributes to sustainable digital accounting, supported by empirical synthesis and structured tabular analysis.

1. ESG Reporting in Sustainable Digital Accounting

Table 1 presents the key dimensions of ESG reporting and their functional roles in sustainable digital accounting, revealing the multifaceted nature of modern corporate accountability. Each dimension Environmental, Social, and Governance contributes distinct value to sustainability oriented reporting frameworks. The environmental aspect includes disclosures related to emissions, energy efficiency, and ecological impact, aligning with global demands for climate transparency and environmental stewardship. These disclosures play a crucial role in guiding corporate environmental strategy and in supporting regulatory compliance, especially under frameworks such as the EU CSRD (Sierra-García et al., 2021). However, challenges such as inconsistent metrics, complex data types, and lack of standardization hinder the effective incorporation of environmental data into accounting systems. This reflects the findings of Kotsantonis & Serafeim (2022), who argue that environmental disclosures often lack comparability due to divergent regulatory requirements and voluntary reporting practices.

The social and governance dimensions, while equally important, present their own complexities. Social indicators such as labor practices, community relations, and workplace diversity are increasingly scrutinized by investors and regulators alike. These indicators are essential for understanding a company's broader social impact, yet they are often difficult to quantify and standardize, as noted by García Sánchez et al. (2022). Meanwhile, governance reporting, which encompasses board composition, audit integrity, and ethical practices, strengthens stakeholder trust and institutional accountability. Governance-related disclosures are seen as fundamental in minimizing agency risk and ensuring compliance with corporate governance codes. Nevertheless, the governance component too faces challenges such as variations in internal control systems and disparities in ethical expectations across jurisdictions. The synthesis provided in Table 1 demonstrates that while ESG reporting significantly enriches the scope of accounting disclosures, its practical implementation necessitates technological integration and methodological rigor to overcome current limitations and ensure sustainability alignment.

2. The Role of Data Analytics in ESG-Oriented Accounting Systems

Table 2 illustrates the application of data analytics in enhancing ESG oriented accounting systems, emphasizing the transformative potential of technology in sustainable reporting. The use of predictive analytics, real time dashboards, machine learning, and big data processing not only improves reporting efficiency but also significantly elevates the strategic value of ESG disclosures. Predictive analytics, for instance, enables organizations to anticipate sustainability risks such as regulatory non compliance or environmental liabilities, allowing for more proactive risk management. This is consistent with the findings of Richins et al. (2021), who highlight the importance of predictive models in supporting long term sustainability strategies. Moreover, real time dashboards allow decision makers to track key ESG indicators dynamically, thus improving responsiveness to stakeholder concerns and environmental or social events as they unfold.

Machine learning and big data processing further deepen the analytical capabilities of accounting systems. Machine learning techniques are increasingly used for anomaly detection in financial and ESG datasets, thereby improving the credibility and integrity of sustainability disclosures (Appelbaum et al., 2021). These tools also assist in identifying fraudulent practices or irregularities in governance-related reporting, enhancing accountability across corporate structures. Meanwhile, big data technologies allow for the integration of vast and heterogeneous ESG datasets ranging from structured corporate data to unstructured sources such as social media sentiment or satellite imagery into comprehensive reporting systems.

However, despite these advancements, many organizations still lack the technical infrastructure or expertise needed to fully operationalize these tools. As noted by Moll & Yigitbasioglu (2022), the integration of data analytics into ESG practices remains underdeveloped, particularly in contexts where digital maturity is low. Therefore, while Table 2 highlights the significant potential of data analytics in advancing sustainable digital accounting, it also points to the critical need for organizational investment in digital capacity building and analytical governance frameworks.

3. Industry 5.0 as a Moderating Framework in Sustainable Digital Accounting

Table 3 elucidates the role of Industry 5.0 as a moderating framework that enriches the integration of ESG reporting and data analytics within accounting systems. Unlike Industry 4.0, which prioritized automation and operational efficiency, Industry 5.0 centers on ethical, human centric, and socially inclusive innovation (Breque et al., 2021). This paradigm shift carries profound implications for accounting, as it repositions digital technologies not merely as tools for data processing, but as instruments for fostering societal well being, stakeholder inclusivity, and long term sustainability. The human centric innovation dimension, for instance, highlights the need to embed ethical and inclusive values into the design of accounting technologies, thus ensuring that reporting systems are responsive to the diverse needs of stakeholders and aligned with broader social and environmental objectives (Margherita & Braccini, 2022).

The principles of ethical technology use and collaborative intelligence underscore the importance of balancing automation with human oversight and ethical governance. In sustainable digital accounting systems, this means employing artificial intelligence and big data tools in ways that uphold transparency, protect stakeholder rights, and promote responsible innovation (Binns et al., 2020). Furthermore, the focus on societal value creation redefines the objectives of accounting not simply to measure financial outcomes, but to evaluate the firm's contribution to social equity, environmental protection, and ethical conduct. These principles create a synergistic relationship with ESG reporting and data analytics by grounding technical capabilities in normative frameworks. As a result, Industry 5.0 moderates the integration process by providing both a philosophical and operational foundation for sustainability. The insights from Table 3 suggest that future accounting models must go beyond technological sophistication to embody resilience, human dignity, and ethical responsibility in every layer of digital reporting infrastructure.

5. CONCLUSION AND SUGGESTIONS

A. Conclusion

This study concludes that the integration of ESG (Environmental, Social, and Governance) reporting and data analytics constitutes a foundational strategy for the advancement of sustainable digital accounting in the Industry 5.0 era. The findings reveal that ESG reporting provides critical insights into non financial performance, fostering transparency, ethical governance, and stakeholder trust. However, its effectiveness is contingent upon the availability of standardized frameworks and technological infrastructure. Data analytics enhances this potential by enabling real time monitoring, predictive insights, and anomaly detection, thus supporting more responsive and strategic decision making processes. Nevertheless, the integration of these two domains remains uneven and underdeveloped across various institutional and organizational contexts.

The introduction of Industry 5.0 as a moderating framework adds a new ethical and human centric dimension to digital transformation in accounting. Unlike the mechanistic focus of Industry 4.0, Industry 5.0 promotes inclusive, resilient, and value-driven innovation. This

perspective not only aligns with the goals of ESG but also guides the ethical application of data technologies. The study's conceptual framework demonstrates that the convergence of ESG, data analytics, and Industry 5.0 provides a robust path toward designing future ready accounting systems that are not only efficient but also ethically and socially responsible. As such, sustainable digital accounting must be reimagined not just as a technological innovation but as a moral and strategic imperative aligned with the broader objectives of sustainable development.

B. Suggestions

To maximize the potential of sustainable digital accounting, this study proposes several recommendations for stakeholders, practitioners, and future researchers. First, organizations should invest in digital infrastructures that enable the integration of ESG data with analytical tools. This includes adopting standardized ESG metrics, implementing real time dashboards, and training accounting professionals in data literacy and ethical AI use. Second, regulatory bodies should develop cohesive reporting standards that facilitate consistent and comparable ESG disclosures across sectors and jurisdictions, thereby strengthening accountability and investor confidence.

For academic and policy research, future studies should empirically test the proposed framework through case studies or quantitative modeling, particularly in diverse geographic and industrial contexts. Investigating how different firms operationalize ESG analytics within Industry 5.0 environments can reveal best practices and implementation challenges. Moreover, interdisciplinary collaboration between accountants, data scientists, and sustainability experts is vital to foster innovation that is technically sound and socially attuned. Overall, advancing sustainable digital accounting requires not only technological adoption but also a deep commitment to ethical principles and systemic change in accounting education and practice.

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