
Digital Infrastructure and ESG Performance: A Conceptual Framework for Sustainable Business Transformation

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Abstract

This paper develops a conceptual framework that explains how digital infrastructure can enhance corporate Environmental, Social, and Governance (ESG) performance and long-term competitiveness. Building on the Resource-Based View and the Dynamic Capabilities perspective, the study applies an input–process–output model to illustrate how technologies such as cloud computing, big data analytics, artificial intelligence, and the Internet of Things contribute to sustainable outcomes. The framework emphasizes three key mechanisms through which digitalization influences ESG, namely improved information transparency, more efficient resource allocation, and innovation-driven sustainability. By integrating insights from the literatures on information systems, corporate governance, and sustainability, this study demonstrates that digital transformation should not be viewed solely as a driver of efficiency but also as a strategic enabler of ESG integration. The discussion highlights implications for business, policymakers, and academic research. Firms are encouraged to embed digital tools into sustainability strategies, policymakers are urged to align digital innovation agendas with ESG regulations, and scholars are invited to test the proposed framework through empirical analyses. Future research should employ cross-national data, conduct industry-specific comparisons, and analyze ESG sub-dimensions to better capture the heterogeneity of effects. This paper contributes to a growing body of literature that bridges digital transformation and corporate sustainability, offering both theoretical advancement and practical guidance for managers and policymakers.

Keywords Digital Infrastructure, ESG Performance, Sustainability, Corporate Governance, Innovation, Strategic Management

1. Introduction

In recent years, both digital transformation and Environmental, Social, and Governance (ESG) initiatives have emerged as central priorities for firms, policymakers, and regulators worldwide. On the one hand, the rapid expansion of digital infrastructure such as big data, cloud computing, artificial intelligence (AI), and blockchain has fundamentally reshaped how organizations operate, compete, and deliver value (Bharadwaj et al., 2013; Verhoef et al., 2021). Digital

technologies not only enhance operational efficiency and reduce transaction costs but also enable firms to build dynamic capabilities that allow them to adapt to rapidly changing market conditions (Teece, 2007). On the other hand, ESG considerations have become increasingly influential in shaping corporate strategy and investor decisions, reflecting societal expectations for sustainability, ethical conduct, and long-term value creation (Eccles, Ioannou, & Serafeim, 2014; Friede, Busch, & Bassen, 2015). However, while digital transformation is often studied through the lens of efficiency gains and innovation outcomes, and ESG is predominantly examined in relation to disclosure practices and financial performance, the interaction between these two domains remains underexplored. This gap is critical, as digitalization may serve as a catalyst for embedding ESG principles into business processes, governance structures, and stakeholder engagement. A deeper exploration of this intersection is therefore essential for understanding how firms can simultaneously pursue competitiveness and sustainability. Such an inquiry can also enrich theoretical debates on the convergence of technological change and corporate responsibility.

Against this backdrop, this paper raises two key research questions: How does digital infrastructure contribute to enhancing ESG performance? and In what ways can firms leverage digital tools to strengthen governance, transparency, and social responsibility? To address these questions, we develop a conceptual framework that links digital transformation with ESG outcomes through mechanisms such as improved information transparency, more efficient resource allocation, and innovation-driven sustainability practices. By synthesizing insights from the literatures on information systems, corporate governance, and sustainability, this study seeks to advance a holistic understanding of the synergies between digitalization and ESG (Barney, 1991; Porter & Kramer, 2011). The main contribution of this work lies in two aspects. First, it proposes an integrative conceptual framework that illustrates how digital infrastructure may serve as an enabler of ESG strategies. Second, it offers a basis for future empirical research by formulating testable hypotheses and identifying promising directions for exploring cross-industry and cross-country variations in the digitalization and ESG nexus. In doing so, the paper provides both academics and practitioners with a structured approach to consider the strategic role of digital tools in advancing sustainability. It also highlights the importance of policy coordination between digital innovation agendas and ESG regulatory frameworks.

2. Literature Review

2.1 Digital Infrastructure and Firm Competitiveness

Scholars have long emphasized the role of information technology (IT) in driving productivity gains and competitive advantage. Investments in IT infrastructure enhance operational efficiency, reduce transaction costs, and enable firms to optimize supply chain coordination and customer relationship management (Bharadwaj, 2000; Melville, Kraemer, & Gurbaxani, 2004). The adoption of digital tools such as cloud computing and big data analytics facilitates better decision-making and provides real-time insights that improve responsiveness to market fluctuations. As a result, digital infrastructure is not merely a supporting function but a strategic resource that directly contributes to firm performance and long-term sustainability.

The Resource-Based View (RBV) argues that firms achieve sustainable competitive advantage through the possession and deployment of valuable, rare, inimitable, and non-substitutable resources (Barney, 1991). Digital infrastructure, when effectively integrated with organizational processes, fits this characterization by allowing firms to reconfigure their capabilities in ways that are difficult for competitors to replicate. Building on this perspective, the Dynamic Capabilities framework further suggests that digital technologies enable firms to sense market opportunities, seize new innovations, and continuously transform their resource base to maintain competitiveness in volatile environments (Teece, 2007). Together, these perspectives highlight that digital infrastructure is not only an operational enabler but also a strategic driver of competitive differentiation.

2.2 ESG and Firm Value

In parallel with the digital transformation literature, research on ESG has shown that corporate sustainability practices can significantly influence firm value and stakeholder relationships. ESG disclosure enhances investor trust by signaling transparency and commitment to ethical conduct, which in turn lowers the cost of capital and improves access to financing (Dhaliwal, Li, Tsang, & Yang, 2011; Cheng, Ioannou, & Serafeim, 2014). Firms with strong ESG performance are also more likely to attract long-term investors who prioritize sustainability and risk management, thereby reinforcing financial stability. From a strategic perspective, integrating ESG considerations into business operations can create reputational benefits, foster employee commitment, and generate positive spillovers for innovation.

The theoretical underpinnings of ESG research are often rooted in stakeholder theory and institutional legitimacy theory. Stakeholder theory posits that firms must address the expectations of multiple constituencies, including shareholders, employees, customers, and communities, to ensure long-term survival and success (Freeman, 1984). Institutional legitimacy theory, in turn, emphasizes that firms gain social acceptance and legitimacy by aligning their practices with societal norms and regulatory frameworks (Suchman, 1995). These perspectives underscore that ESG is not solely a matter of compliance but a strategic asset that can enhance both financial and non-financial performance.

2.3 The Intersection of Digitalization and ESG

Although the literatures on digital infrastructure and ESG performance have traditionally developed in parallel, an emerging body of research highlights important intersections between these two domains. One major linkage concerns information transparency. Digital platforms, ranging from corporate websites to blockchain-based reporting systems, can significantly improve the quality, timeliness, and accessibility of ESG disclosures (Cai, He, & Chen, 2021). This enhanced transparency reduces information asymmetry between firms and stakeholders, thereby strengthening trust and accountability. Furthermore, digital tools such as data analytics and AI enable more rigorous monitoring of ESG performance indicators, which can enhance the credibility of sustainability reporting.

Another important intersection lies in operational efficiency and governance. Digital supply chain systems help firms track resource use, reduce waste, and lower carbon emissions, thereby supporting environmental sustainability goals (Dubey et al., 2019). Emerging technologies such as blockchain also provide immutable records of transactions, improving traceability and reducing risks of greenwashing in ESG reporting. At the governance level, digital innovations facilitate stakeholder engagement, improve compliance monitoring, and foster ethical decision-making. Collectively, these developments suggest that digitalization can act as a powerful enabler of ESG performance by embedding sustainability principles directly into core business processes.

3. Conceptual Framework

Building on the Resource-Based View (Barney, 1991) and Dynamic Capabilities Theory (Teece, 2007), as well as recent studies that integrate digitalization with corporate sustainability (El-Kassar and Singh, 2019; Centobelli, Cerchione, and Esposito, 2020), this study proposes a comprehensive conceptual framework linking digital infrastructure (independent variable) to ESG performance (dependent variable) through three key mediating mechanisms: information transparency, resource allocation efficiency, and innovation-driven sustainability. The model adopts an input–process–output logic, illustrating how technological capabilities are transformed into measurable sustainability outcomes.

At the input stage, firms invest in diverse digital technologies such as big data analytics, artificial intelligence (AI), blockchain, and the Internet of Things (IoT). These technologies serve not only as operational tools but also as strategic assets that are valuable, rare, inimitable, and non-substitutable (Barney, 1991). Digital infrastructure enables firms to collect, process, and integrate massive and complex datasets across supply chains and stakeholder networks, enhancing their ability to sense opportunities, respond to regulatory demands, and reconfigure internal processes in line with sustainability imperatives. Such investment forms the foundation upon which firms can embed environmental and social considerations into decision-making routines.

The stage captures how digital capabilities are translated into ESG-oriented practices through three interrelated pathways. First, information transparency acts as a mediating mechanism that reduces information asymmetry between firms and stakeholders. Technologies such as blockchain and data analytics improve the accuracy, timeliness, and verifiability of sustainability reporting, enhancing corporate accountability and investor confidence (Cai, He, and Chen, 2021).

Second, resource allocation efficiency arises as digital systems, particularly IoT and AI-driven platforms, enable real-time monitoring of energy use, carbon emissions, and material flows. This allows firms to optimize resource deployment, minimize waste, and improve operational sustainability performance (Dubey et al., 2019).

Third, innovation-driven sustainability refers to the capacity of digital technologies to foster the development of new green products, cleaner production methods, and socially responsible business models. The integration of AI-based forecasting, machine learning, and cloud-based collaboration tools can stimulate continuous improvement and create long-term competitive advantage consistent with the dynamic capabilities' framework (Teece, 2007). At the output stage, the interaction among these mechanisms leads to enhanced ESG performance, manifested in three dimensions. The environmental dimension benefits from reduced emissions, optimized energy consumption, and eco-innovation. The social dimension improves through transparent communication channels, ethical supply chain management, and stakeholder inclusiveness. The governance dimension is strengthened through data-based decision-making, greater board accountability, and compliance monitoring supported by digital traceability tools. Together, these outcomes signify that digital transformation does not merely improve efficiency but fundamentally redefines how firms achieve sustainable value creation.

In summary, this conceptual framework postulates that digital infrastructure (independent variable) influences ESG performance (dependent variable) through three interdependent mediators: information transparency, resource allocation efficiency, and innovation capability. Digital infrastructure equips firms with the technological and organizational resources necessary to implement sustainability strategies, while the mediators operationalize how these technologies shape tangible outcomes. This integrative model conceptualizes digitalization as a multidimensional enabler of sustainable transformation and establishes a solid theoretical basis for empirical validation. Future studies can build upon this framework to test the proposed mechanisms using quantitative and cross-industry evidence.

4. Discussion

4.1 Implications for Business

For businesses, the findings emphasize that investments in digital infrastructure should not be treated solely as efficiency-enhancing measures but also as integral components of ESG strategy. By embedding digital tools into ESG initiatives, firms can achieve multiple objectives simultaneously. For example, big data analytics and Internet of Things (IoT) sensors can provide real-time monitoring of energy consumption and carbon emissions, enabling firms to identify inefficiencies and pursue greener operations. Cloud-based platforms and blockchain systems can improve the transparency and credibility of sustainability disclosures, which in turn strengthens relationships with investors, regulators, and consumers. Moreover, artificial intelligence can be leveraged to forecast risks in supply chains, ensuring that sourcing practices remain consistent with social and environmental standards. In this way, digital transformation empowers firms to move beyond compliance-oriented ESG approaches and toward proactive strategies that generate both competitive advantage and social value.

4.2 Implications for Policymakers

For policymakers, the framework underscores the importance of aligning digital transformation agendas with sustainability regulations. Governments can play a crucial role by creating an

enabling environment that incentivizes firms to use digital technologies for ESG purposes. For instance, subsidies or tax credits for green technology adoption can encourage firms to invest in energy-efficient digital systems. Regulatory requirements that mandate standardized ESG reporting can be supported by digital platforms that make data collection and verification more efficient and reliable. Additionally, national infrastructure projects, such as 5G networks or smart grid systems, can lower the barriers for firms to implement digital sustainability solutions. Coordinated policies that integrate digital innovation with sustainability objectives not only enhance firm-level performance but also contribute to broader societal goals, such as reducing carbon emissions and promoting inclusive economic development.

4.3 Implications for Academic Research

For academic research, the proposed framework opens new avenues for empirical inquiry and theoretical refinement. While existing studies have addressed the role of digitalization in firm performance and the effects of ESG on financial outcomes, few have examined how these domains interact. Future research can employ cross-country datasets to test whether the linkages between digital infrastructure and ESG outcomes vary under different institutional conditions, such as developed versus emerging markets. Industry-level studies could also reveal whether technology-intensive sectors (for example, manufacturing and energy) derive greater ESG benefits from digital transformation compared to service-based industries. Furthermore, longitudinal designs may help determine whether the benefits of digital investments for ESG performance are immediate or only become evident over time. By addressing these questions, scholars can provide more nuanced insights into the boundary conditions, causal pathways, and long-term effects of the digitalization–ESG nexus.

4.4 Major findings

Building on the Resource-Based View (Barney, 1991) and Dynamic Capabilities Theory (Teece, 2007), as well as recent studies integrating digitalization with sustainability (El-Kassar and Singh, 2019; Centobelli, Cerchione, and Esposito, 2020), this study proposes a conceptual framework linking digital infrastructure to ESG performance through three mediating mechanisms: information transparency, resource allocation efficiency, and innovation-driven sustainability. Digital technologies such as big data, AI, blockchain, and the Internet of Things serve as strategic resources that enable firms to gather and analyze data, enhance decision-making, and embed sustainability goals in their operations. These capabilities improve ESG outcomes by increasing transparency, optimizing resource use, and fostering innovation in environmentally and socially responsible practices. The framework suggests that digital infrastructure influences ESG performance through these mediators, positioning digitalization as a catalyst for sustainable transformation and providing a foundation for future empirical research.

5. Conclusion

This study developed a conceptual framework to explain how digital infrastructure enhances ESG performance and corporate competitiveness. Using an input–process–output logic, it

demonstrates that technologies such as cloud computing, big data, artificial intelligence, and the Internet of Things serve as the foundation for integrating sustainability into business strategies. These digital tools improve information transparency, enable efficient resource allocation, and foster innovation that strengthens environmental, social, and governance outcomes. The framework emphasizes that digitalization should be viewed not only as a means to improve efficiency but also as a strategic driver of long-term sustainable transformation. Future research should empirically test this framework by analyzing panel data and cross-national firm samples to determine whether digital investments consistently improve ESG performance. It would also be valuable to examine each ESG dimension separately, as digital tools may affect environmental, social, and governance areas differently. Furthermore, industry- and institution-level analyses could reveal contextual differences, since the impact of digitalization depends on regulatory systems, market structures, and technological maturity. Addressing these directions will refine the model and provide evidence-based guidance for firms and policymakers aiming to align digital transformation with sustainability goals.

5.1 Limitations

Although this study provides a theoretical framework linking digital infrastructure and ESG performance, several limitations should be acknowledged. First, the research is conceptual in nature and lacks empirical validation. Without quantitative evidence, the causal relationships among digital infrastructure, mediating mechanisms, and ESG outcomes remain theoretical. Second, the model assumes that firms possess sufficient technological capacity and organizational readiness to implement digital sustainability strategies, which may not be the case in developing economies or resource-constrained contexts. Third, the framework does not consider potential negative effects of digitalization, such as data privacy risks, increased energy consumption from data centers, or the digital divide that may widen disparities among firms. Finally, the analysis is cross-sectoral and may overlook industry-specific factors such as regulatory pressures or technological maturity that could influence the relationship between digitalization and ESG performance.

5.2 Recommendations

Based on the proposed framework and its limitations, several recommendations are offered for future research and practice. Future empirical studies should test the framework using firm-level panel data or cross-country samples to confirm the reliability and generalizability of the proposed relationships. Researchers should also examine the three components of ESG separately to understand how digital tools affect environmental, social, and governance outcomes in different ways. In addition, qualitative case studies can provide deeper insight into the contextual factors that enable or constrain digital-driven sustainability. For managers, digital investments should be treated as long-term strategic tools for integrating ESG principles into business operations rather than as short-term technological upgrades. Firms are encouraged to develop digital capabilities that enhance transparency, efficiency, and innovation simultaneously. For policymakers, it is important to design incentive systems and regulatory frameworks that encourage the use of digital technologies for sustainability, including tax incentives, standardized

ESG data reporting platforms, and cross-sector cooperation that supports responsible digital transformation.

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