

A Study of The Impact of Digital Transformation on ESG Development

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Abstract. In the face of global climate challenges, enterprises need to integrate digitalization and ESG strategies to promote green transformation and help achieve dual-carbon goals and sustainable development. This investigation examines the intricate relationship between ESG development and digital transformation, elucidating mechanisms about how digital changes affect ESG achievement, the heterogeneous, dynamic roles it plays in enterprises' ESG performance. It is found that transformation of digit has a significant impact on the level of corporate ESG accomplishment, but its effect is moderated by the external environment and corporate characteristics, showing heterogeneity. Furthermore, digital transformation has different effects on ESG performance. The study also points out that enhancing firms' dynamic capabilities serves as a distinct route and mechanism by which digital transformation exerts a leverage on the ESG performance, which indicates the level of environmental, social, and governance. The paper concludes by presenting the limitations of investigation in existence and the outlook of forthcoming research. It suggests that enterprises customize their strategies and that governments provide support to promote sustainable development jointly.

Keywords: Digital transformation; esg performance; moderating effects; mediating effects; heterogeneity.

1. Introduction

Under the severe challenges of global climate issues, the dual-carbon strategic objective and sustainable development have become major issues of common concern to the international community. When it comes to sustainable development and strategic objectives for reducing carbon emissions, enterprises, as major participants in economic activities and essential sources of carbon emissions, urgently need to take action. Enterprises need to integrate digital transformation deeply with ESG strategies to meet the real needs of their development. Furthermore, businesses must promote the green transformation of the economy and society to achieve sustainable development. Through these efforts, enterprises will contribute to the realization of global climate governance goals and the development of a human destiny community.

According to a survey of related literature [1], enterprise digital transformation dramatically enhances an organization's ESG performance. Enterprise ESG performance significantly increases enterprise value, and digital transformation positively moderates ESG performance, thereby increasing enterprise value [2]. Although scholarly investigations into digital transformation and ESG have yielded promising outcomes, most of the literature concentrates on certain domains or industry-specific aspects and does not employ a systematic analysis.

This paper fills in that research gap by reviewing the existing work and starting with a look at how the process of digital change impacts ESG performance. It then analyzes the various ways that digital transformation influences an enterprise's ESG performance and its effects on the three dimensions of E-governance, S-society, and E-environment. Finally, it provides an analytical framework that opens new research avenues for scholars. Additionally, it provides the practice community with strategic recommendations on what the best practices for businesses to achieve their ESG goals through digital transformation are.

2. Digital Transformation Mechanisms of Impact on ESG Performance

Extant scholarly research has extensively probed the intricate interrelationship comparing digital transformation initiatives with performance indicators for environmental, social, and governance (ESG). Using a variety of moderating and mediating effect perspectives, researchers have thoroughly examined the underlying mechanisms of what the consequences of digital transformation on ESG are. In statistics and social science research, the terms "mediating effect" and "moderating effect" refer to two distinct ideas that are crucial for understanding how variables relate to one another. The focus of moderating effects is the effects of a third variable on the tendency or stage of the relationship between variables that are independent and dependent. The process via that the variable in terms of independent affects the dependent variable is known as a mediating effect. ESG performance is the dependent variable in this research topic, and digital transformation is the independent variable. These investigations not only underscore the pivotal importance of digitization in propelling firms' performance on ESG but also further point out its driving effect exhibits heterogeneity across organizations.

2.1. Moderating Effects Perspective

From the point of view of moderating effects research, researchers looked at how two factors—the external environment and business characteristics—affected the relationship between ESG performance and digitized progress. Externally, the fluctuating environmental landscape mitigates the advantageous effects of digitization process on advancing ESG performing level, and this instability negatively affects the results of digital progress. In highly uncertain environments, the enterprises' enhancement on ESG performance, which was affected by digital transformation is gradually waning [3]. Therefore, the development of relevant environmental legislation has broad practical implications. In Junjun Li et al.'s study, the interrelationship between dual environmental regulatory regimes (informal environmental regulation (IFRG) and formal environmental regulation (FRG)) in regulating digitization and firms' performing level on ESG is explored through empirical research [4]. According to the studies mentioned above, informal ecological regulatory have a more important influence on reducing the adverse effects of progress of digitization on ESG performance level [4]. Simultaneously, the literature demonstrates the dearth of concrete data in relation to the moderating effect of dual eco-friendly rules in the relation between ESG and a firm's digital transformation [4]. However, it aligns with Porter's robust theory [4]. According to Porter's hypothesis, companies that are subject to strict environmental regulations have a greater chance of innovating in technology, which benefits the economy and the environment [5,6]. When it comes to actual data, Porter's theory is still debatable [7]. Mingyue Fang et al. claim that while digitization improved organizations' overall ESG performance, it had no appreciable effect on environmental emissions or energy efficiency [8]. In this field of study, there is a similar belief that there is no significant improvement in environmental performance due to digital transformation. Therefore, further research is crucial to uncover how dual regulatory systems bolster the link and the advancement of ESG performance. In the meantime, the level of regional digitization between digital transformation n modifies the digital transformation in a way that improves the ESG performance of businesses [9]. The ESG performance increase from digital transformation is more significant in regions with highly established digital infrastructure, abundant talent resources, and open digital ecosystems than in lesser levels of digitization [9]. Starting from the internal characteristics of firms, alleviating financial constraints emerges as a crucial factor in moderating the influence of digitized transformation on firms' performing level of ESG, emphasizing its pivotal task in facilitating this transformation. Digital transformation boosts ESG more when financial constraints are relaxed. Digital transformation is a motivator for these corporations to strengthen their performing level of under casual financial situations [10]. According to similar research studies conducted by Chong et al., digitalization can alleviate company financial crises by increasing equity funding as an external factor [11]. There is a two-way interaction between corporate digital transformation and funding restrictions. In the meantime, Lan Lan et al. investigate how digitization and ESG initiatives collaborate with each other

to spur innovation by considering substitution or complementary impacts [12]. They conducted further analysis of two contextual factors on the moderating effects: business size and financial resources [12]. The link between digitalization practices and ESG practices changes from complementing to substitutive as budgetary restrictions increase [12]. The link between digitalization techniques and ESG practices changes from complementing to substitutive as business size lowers [12].

2.2. Mediating Effects Perspective

Conversely, research on mediating effects reveals the precise pathways and mechanisms by which the performing level of ESG is impacted by digitized progress. Xin Su et al. found that dynamic capabilities play a role in the connection between digitization and improved ESG performance [13]. The innovation of digitization can improve company's performing level of ESG through dynamic capacities, such as social responsibility, green innovation, and operation management [13]. Empirical evaluations affirm the beneficial effects of digital transformation on firms' ESG outcomes [13]. According to Yan Peng et al., digital transformation can increase a company's performing level on environmental, social, and governance (ESG) by supporting green innovation, streamlining operations and management, and optimizing the human capital structure [14]. Dynamic capacities were further subdivided by Lan Zhang et al. into three components: learning and absorption (LA), coordination and integration (CI), and invention variability (IT) [15]. They discovered that by using empirical testing, transformation of digitization can enhance dynamic capabilities of a company, which in turn promotes firms' ESG performance [15]. Furthermore, they concluded that the key ways in which digital transformation affects ESG performance level of a company are by putting more pressure on external legitimacy and decreasing information asymmetry [15]. According to Chen Hong et al., digital transformation can improve a business's ability to innovate green technologies and reduce financing limitations, which in turn can favorably regulate the impact of ESG performance on enterprise value enhancement [2]. Digitized process helps to improve the grade of green innovation, which finally enhances performance on ESG [3]. The digitization of businesses and platforms fosters eco-friendly advancements, encompassing both green process and product innovations, thereby enhancing companies' ESG performance [16]. One of the primary ways that businesses' digital transformation influences their ESG performance is through innovative capabilities in dynamic capacities [17]. Digitized progress also influences the ESG performance of companies by changing their absorptive capacity in dynamic capacities [18]. An effective approach to enhancing the ESG performance of enterprises is through digital transformation to strengthen their absorptive capacity [18]. There are, however, the academic investigation into the effects of digital transformation on corporate ESG performance, viewed through the lens of absorptive capacity, is relatively sparse, indicating a gap in research [19]. The current literature predominantly examines the the impact of digital alteration on the corporate performing level of ESG, examining the ways in which firms' dynamic capabilities help to mitigate information asymmetry and increase innovation capacity [17].

2.3. Literature Review

The influencing mechanisms of this relationship are studied by scholars from the viewpoints of both moderating and mediating effects. According to the moderating effect, the external environment and business characteristics are a third factor influencing the relationship between digital transformation and ESG performance. When examined in various contexts, these studies demonstrate how businesses should modify their digital strategy to enhance ESG performance. However, studies on mediating effects identify the precise pathways and mechanisms by which digital transformation influences environmental, social, and governance (ESG) performance. Studies have revealed dynamic capabilities as a crucial intermediary variable, bridging the gap between digital transformation initiatives and elevated environmental, social, and governance (ESG) outcomes. By bolstering dynamic capabilities, notably green innovation strategies, enterprises can amplify their ESG performance. The examination of existing literature also demonstrates the simultaneous

existence of moderating and mediating effects. Financial limitations, for instance, financing constraints, can be a moderating factor affecting how the digital revolution affects ESG. Financial constraints, meanwhile, also have a mediating effect. Digital transformation improves ESG performance by removing financing constraints. In summary, these studies offer a theoretical framework for comprehending the impact of digital transformation on environmental, social, and governance (ESG) performance. Moreover, they furnish practitioners with tactics for executing digital transformation to augment ESG performance. These studies do, however, still have certain limitations, such as a lack of investigation into additional potential mediators in dynamic capabilities. Additional research in these areas is required in the future to comprehend the intricate relationship between digital transformation and ESG performance completely.

3. Heterogeneity in the Role of Digital Transformation in Driving Firms' ESG Performance

The impact of digital transformation on firms' ESG performance displays diversity, with varying degrees of influence across different entities, emphasizing the heterogeneity in its driving effect. Digital transformation is more beneficial for bigger businesses in terms of their performing level of ESG [3]. Among listed companies, firms, which are without political connections and in the area of high-quality institutions experience more significant positive effects of digitization on ESG performance [8]. According to an empirical study by Quan-Jing Wang et al., the concern of digitization on ESG is particularly noticeable among enterprises in western or central China, polluting and competitive industries, and non-state-owned firms [20]. The digital revolution in highly monopolized industries affects ESG performance [21]. Monopoly lowers an organization's ESG performance and distorts the "digital goodness" effect [21].

Wenjun Li et al. conducted an empirical study in which they further analyzed the impact of digital transformation on the performance of enterprises of environmental, social, and governance (ESG) [18]. The study uncovered a heightened sensitivity of ESG performance to digital transformation among state-owned enterprises and high-ended equipment manufacturing firms, with differences observed like enterprise property rights and industry [18]. This perspective conflicts with Quan-Jing Wang et al.'s findings. (In non-state-owned businesses, the effect of digitized progress on ESG is more significant). Digital transformation significantly inhibits corporate ESG greenwashing [22]. Digital transformation positively moderates ESG performance through this mechanism of action [22]. Digital transformation significantly inhibits the ESG greenwashing of businesses in the central and western areas [22]. Yan Peng et al. demonstrated through heterogeneity analysis that businesses with a higher capitalization rate, higher technology, and lower carbon emissions saw more significant gains in ESG performance because of digital transformation [14].

In summary, researchers have engaged in rigorous deliberations regarding the heterogeneity of digital transformation's propulsive impact on corporate ESG performance and found that this driving effect varies significantly across different scales, regions, industries, and the nature of enterprise ownership. Given the disparities in research methodologies and sample populations, certain studies yield conflicting outcomes, precisely stemming from these variations and inconsistencies. This underscores the intricate nature of digital transformation's influence on ESG performance across diverse enterprise types and industries. Therefore, future research should focus on the complexity of the impact mechanism under different scenarios.

4. Three-dimensional Impact Study of Esg Performance Driven by Digital Transformation

Although consensus exists among researchers regarding the beneficial impact of digital transformation on ESG performance, they cannot agree on how it affects the three ESG characteristics. Mingyue Fang et al. identified two pathways regarding how digitization influences ESG performance

[8]. Firstly, through digitization, companies can save agency costs and raise their governance (G) scores [8]. Secondly, digitization makes it easier for businesses to boost goodwill and raise their social (S) ratings even higher [8]. Businesses can reduce their pollution emissions with the aid of digitization. Digital technology application is an excellent technique to deal with changing environmental challenges such as wastewater treatment, climate change, carbon emissions, and air pollution [23]. Nevertheless, the study's findings did not indicate that digitized progress raised businesses scores environmentally (E) [8]. Yang and Han concentrated on how financial limitations moderate the effects of digital transformation on environmental, social, and governance [10]. According to their findings, digital alteration remarkably improves corporate social (S) and environmental (E) ratings but not its governance (G) scores [10]. The research conducted by Sun Qiang et al. further indicates that digital transformation does not significantly positively impact corporate governance (G) scores [24]. Yan Peng et al. delved into the advantageous impacts of digital transformation on various dimensions of ESG through econometric experiments [14]. Digital transformation will not significantly impact corporate governance (G), with most of its beneficial effects on corporate ESG performance going towards the environmental (E) and social (S) components [14]. However, Xin Su et al. conducted an investigation into the intermediary role of dynamic capabilities in shaping the connection between performance on ESG and digitization, and empirical tests showed that digital technological innovations can enhance governance scores and ESG performance through green innovations [13]. Similar conclusions were drawn by Yang Yang et al. from their empirical data, which showed that businesses' ESG performance in terms of environmental and social responsibility was greatly improved by their digital transformation [10]. In conclusion, the effects of digital transformation on ESG performance are not uniform; instead, it is a multifaceted and multilevel process. Overall, scholarly debates about how digital transformation affects ESG present a range of viewpoints and have not yet come to a consensus. This implies that existing research faces limitations: lack of universality, diverse methodologies, unclear mechanisms behind digital transformation's ESG impact, and insufficient research samples. Therefore, future research should thoroughly investigate the precise pathways of how digital transformation impacts ESG performance and explore the disparities in their effects. Businesses receive comprehensive guidance on leveraging digitization to boost their three-dimensional ESG ratings and achieve sustainable development.

5. Conclusion

5.1. Conclusions of the Study

As a critical force driving sustainable business development, digital transformation's deep integration with ESG strategies has become a strategic choice for global enterprises. The purpose of this paper is to analyze the influence of digitization on ESG development by thoroughly reviewing related papers. The transformation of enterprises towards digitalization offers a notable means to elevate and refine their ESG performance. Enterprise characteristics and the external environment can moderate the ESG-digitalized nexus. The process of digitization bolsters ESG performance by strengthening organizations' dynamic capabilities. The influence of digital transformation on corporate performing level on ESG exhibits a notable degree of heterogeneity, suggesting that various factors contribute to its varying influence across different contexts and organizations. After reviewing pertinent research, this paper concludes that there are considerable differences in this driving effect between firms with varying sizes, geographies, industries, and property rights.

In the interim, this report discusses the belongings of digitization on three ESG dimensions in more detail. Researchers have not come to a consensus on this one yet. In summary, corporate performance level on environmental, social, and governance (ESG) is complex, multifaceted phenomenon due to the impact of digital transformation. Furthermore, digital transformation has different effects on the performing level on ESG.

5.2. Limitations of Existing Study and Future Perspectives

The current literature, which primarily focuses on individual industries or single dimensions, lacks cross-industry and multidimensional comprehensive analysis. In the future, researchers can conduct cross-industry comparison research. The study samples primarily focus on businesses of specific sizes or locations, which hinders their ability to accurately represent the diversity of businesses globally and limits the results' generalizability. Future research should analyze the circumstances faced by businesses in other nations to enhance and broaden the results. Because different research uses different procedures and has different data conflicts, the conclusions are limited in generalizability. Future studies can use alternative research approaches for validation, such as comparative study design and quantitative and qualitative analysis. Most studies have not sufficiently examined the long-term influence of digitization, which may be due to sample period limitations and other factors. Future studies should conduct long-term research tracking, concentrating on the investigation and analysis of the ESG implications of digitized transformation of enterprises in the long term. The current research landscape lacks sufficient examination into the intricate interplay between the progress of digitization and performing level of ESG, necessitating further scholarly endeavors to comprehensively comprehend their mutual influence. Future research can investigate this further from the standpoint of the spotlight impact, synergy effect, etc., to see how digital transformation may influence ESG performance.

5.3. Strategic Recommendations for Businesses

Firms should develop digital transformation plans that adhere to ESG guidelines based on their sector's unique attributes and characteristics. Actively participate in the digitized progress and ESG processes. Take note of any changes in the external environment and flexibly adjust the digital transformation plan to manage uncertainty and improve the ESG performance. The positive outcome of ESG performance can be heightened through digital transformation's enhancement of dynamic capabilities. Companies should assess the long-term effects of digital transformation, investigate the full range of ways in which it could enhance the ESG performing level, and maintain a steady improvement in ESG performance

5.4. Strategic Recommendations to the Government

The government should create regulations aimed at encouraging both the digital evolution and the adoption of ESG principles by businesses, and it should offer targeted financial and regulatory support. Government agencies ought to fortify the local digital infrastructure and foster an atmosphere that is conducive to businesses adopting digital transformation.

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