

How technology drives governance transformation: a case study of ZTE's ESG governance model innovation

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Abstract. Against the backdrop of the deep integration of global sustainable development strategies and the digital technology revolution, Environmental, Social, and Governance (ESG) has become a critical dimension of corporate competitiveness. Based on the theory of technology empowerment and the dynamic capability framework, this paper systematically analyzes the innovative mechanism of technology-driven ESG governance using ZTE as a case study. The research finds that ZTE has constructed a dynamic capability loop of "perception-capture-reconstruction" through a three-stage path: "digital reconstruction of governance structure - full-process penetration of technology empowerment - collaborative evolution of value ecosystems." This has created an ESG value creation model under the multiplier effect of technology. The study not only enriches the micro-theory of technology-enabled ESG governance but also provides a replica practical paradigm for technology-intensive enterprises.

Keywords: technology empowerment, ESG governance, corporate sustainable development

1. Introduction

The report of the 20th National Congress of the Communist Party of China points out that, in the future, China will further implement green development and sustainable development strategies, enhancing environmental protection, social responsibility, and corporate governance. At the same time, in the context of escalating global climate change, the rise of socially responsible investments, and tightening regulations, Environmental, Social, and Governance (ESG) has become a core issue for corporate sustainable development [1]. With the deepening digital technology revolution, emerging technologies such as 5G, artificial intelligence, and block-chain are reshaping business operation models and providing new pathways for ESG governance innovation [2]. However, existing research has mostly focused on corporate ESG performance, digital transformation, the role of digital technologies, and efficient resource allocation to achieve high-quality sustainable development. There is still a lack of in-depth exploration into how technology systematically drives ESG governance model innovation.

Zhongxing Telecommunication Equipment Corporation (ZTE), as a global leader in the Information and Communication Technology (ICT) industry, has a typical case of deeply integrating its technological capabilities with ESG practices. It ranks among the top three globally in 5G patent reserves, with research and development (R&D) investment accounting for 19.81%, and continues to be listed in the Carbon Disclosure Project (CDP) Climate Change A-List. ZTE was the first to propose the "Digital Green Road" strategy, positioning technology empowerment as the core engine of ESG governance.

This study, based on the theory of technology empowerment [6] and the dynamic capabilities framework [3], takes ZTE as a case study, aiming to reveal the micro-mechanisms of technology-driven ESG governance, filling the gap in traditional theories that overlook the "technology empowerment" perspective, and providing a practical paradigm for technology-intensive enterprises. How ZTE integrates ICT technology throughout the entire ESG governance process and the structural changes driven by technology, compared to traditional ESG governance models, are central to this research.

2. Theoretical foundation

ESG governance originates from Corporate Social Responsibility (CSR) and Stakeholder Theory [4], gradually developing into a systematic sustainable development assessment framework. The report of the 20th National Congress of the Communist Party of China explicitly proposes "promoting green development and fostering harmonious coexistence between humanity and nature," elevating ESG governance to a national strategic imperative. Globally, ESG governance models are undergoing a transformation

from passive compliance to active value creation. However, traditional ESG governance faces three challenges: non-financial data is dispersed across departments, making integration and analysis difficult [5]; it relies on annual reporting cycles, which cannot dynamically respond to risks; and there are supervisory blind spots in areas like supply chains. Technology empowerment theory serves as the underlying logic for reshaping ESG governance, with digital technologies enabling ESG governance through three paths: data reconstruction, process optimization, and model innovation. Big data and Artificial Intelligence (AI) technologies enable real-time collection and modeling of ESG data, replacing empirical decision-making. For example, AI predicts climate risk and its potential impact on supply chain disruptions [7]; natural language processing (NLP) automatically scans suppliers' ESG violation records. Distributed ledger technology ensures the immutability of ESG data, addressing concerns about "green", such as through smart contracts that automatically execute carbon emission trading. Digital twin technology simulates the long-term impacts of ESG strategies. The essence of technology empowerment is the process of building Dynamic Capabilities. Enterprises use technology to reorganize ESG resources, forming a "perceive-capture-reconstruct" capability loop that ultimately leads to a sustainable competitive advantage.

This paper, based on technology empowerment theory and the dynamic capabilities framework, explains how technologies like 5G, AI, and block-chain serve as enablers to overcome ESG governance bottlenecks. It analyzes how technology helps enterprises perceive ESG risks, capture governance opportunities, and reconstruct organizational resources.

3. Zte's technology-driven ESG governance model practice

3.1. Digital governance architecture reconstruction

ZTE's ESG governance innovation exemplifies the catalytic effect of technology empowerment on building dynamic capabilities. Facing core issues in traditional ESG governance such as fragmented data, delayed responses, and weak execution, ZTE established a specialized working group led directly by the chairman. This group covers eight major ESG modules, including innovation empowerment and green development. The structure is underpinned by digital capabilities and reconstructs the governance paradigm through a dynamic closed loop of "perception-capture-reconstruction". By relying on the Compliance intelligent risk control platform, which integrates risk models, it scans ESG vulnerabilities in the supply chain, such as corruption and data leakage, achieving end-to-end digital management of internal controls. In 2024, the platform preemptively blocked non-compliant documents using algorithms, significantly alleviating the data silo dilemma in traditional governance. The introduction of an AI-assisted double material analysis model dynamically adjusts the prioritization of issues by integrating financial impacts (e.g., carbon tax costs) and social impacts (e.g., privacy protection), elevating "technology ethics" from a general risk to a major one, highlighting the role of data intelligence in reshaping decision-making paradigms. Through the action plan (AP) task system, ESG indicators are embedded into executive performance evaluations. The dual carbon goals are directly linked to the chief technology officer (CTO) and supply chain key performance indicator (KPI), driving a decrease in operational carbon emissions in 2024, reflecting the agile reallocation of organizational resources through technology.

Technology empowerment breaks through the static constraints of ESG governance. ZTE has positioned the digital platform as the central hub, embedding dynamic capabilities throughout the entire process of "strategy formulation-risk monitoring-performance loop". This transition shifts governance from post-compliance to real-time value creation. Technology elements reconstruct the micro-foundation of ESG governance: data flows break down departmental barriers, algorithmic models replace experience-based decisions, and digital assessments reshape incentive structures, ultimately creating an institutional path for sustainable competitive advantage.

3.2. Technology-driven green operations

ZTE's environmental governance practices illustrate how ICT technologies reconstruct the micro-foundation of dynamic capabilities to address three traditional challenges in environmental management: fragmented data, diminishing marginal returns in emission reductions, and lack of ecological collaboration. Based on the "Digital Greenway" strategic framework, the company leverages 5G-Advanced (5G-A) and AI as core technological engines to achieve breakthrough innovations across three phases: perception, capture, and reconstruction.

At the perception level, carbon data is managed with full-chain penetration, where traditional environmental governance relied on manual reporting and periodic audits, resulting in delayed data and blind spots in scope 3 emissions measurement. ZTE has built an "LoT + Block-chain" integrated system for real-time carbon emission visualization. At the capture level, algorithm-driven value creation for emission reductions breaks the traditional paradigm of "emission reduction equals cost". ZTE uses AI algorithms to turn environmental constraints into competitive advantages. For example, remote radio unit (RRU) base stations use power-sharing algorithms to achieve dynamic load balancing, reducing energy consumption per unit; customer premise equipment (CPE) terminals optimize standby power consumption through proprietary chip architectures and deep sleep algorithms. The development of the carbon border adjustment mechanism (CBAM) carbon tariff intelligent guide system, with

its embedded European Union (EU) carbon accounting rule engine, helps metal suppliers complete compliance declarations, compressing the carbon audit cycle and lowering compliance costs. The introduction of machine learning in printed circuit board (PCB) production optimizes layout plans, improving board utilization and reducing fiberglass consumption annually, demonstrating the multiplier effect of technology-driven resource efficiency.

At the reconstruction level, 5G-A enables industrial ecological transformation. The company uses a green digital base to drive cross-industry low-carbon transformation. 5G smart energy data collection aids in energy savings and emissions reductions at electrolytic aluminum plants. By building the "5G + Digital Nebula" safety control platform and using AI visual recognition to detect high-risk work violations, accident rates have decreased, and the platform has received national certification for coal mine technology innovation achievements, showcasing the potential of technology to reshape high-carbon industries.

The carbon data flow enables cross-chain penetration (perception), the intelligent algorithm transforms emission reduction costs into revenue (capture), and the digital foundation extends the ecological niche (reconstruction), constructing a micro-foundation for enterprise environmental governance using 5G-A and AI technologies. Traditional environmental management focuses on compliance, while ZTE's model creates triple value through technology multiplier effects—"operational cost reduction, product premium, and ecological benefits". The combination of 5G-A's high bandwidth and low latency supports real-time industrial carbon data feedback, and AI algorithms optimize high-dimensional non-linear emission reduction paths, providing a replicable technological governance model for achieving the dual-carbon goals.

3.3. Digital guarantee for responsible innovation system

In the context of the accelerating iteration of global technology industries and increasingly stringent ESG governance requirements, responsible innovation has become the core challenge for companies balancing technological breakthroughs and social value. ZTE integrates responsible innovation deeply into its ESG strategy, creating a full-chain management system for "prevention-control-response" through technology-embedded governance. This practice not only responds to the core demands of dynamic capabilities theory regarding risk perception and resource reconstruction but also provides an operational paradigm reference for ethical governance in technology companies. ZTE innovatively adopts a "dual-track parallel" mechanism, establishing a technology ethics committee led by the CTO and a cross-departmental AI management working group. The committee is responsible for top-level design and major decision-making evaluations regarding technology ethics, while the working group focuses on the daily compliance review of AI applications. To ensure professionalism and independence in governance, external legal experts, ethicists, and industry representatives are included in the committee. Quarterly special review meetings are held to assess potential risks of technological misuse proactively. This governance design not only strengthens the checks and balances within the ESG framework but also enhances the dynamic adaptability of decision-making through the integration of technology and ethics.

The intelligent transformation of risk control is another core breakthrough in ZTE's responsible innovation practices. The RAIS mobile assistant (Risk Analysis & Intelligent Surveillance), developed using Internet of Things (IoT) and block-chain technologies, integrates the management of algorithm filings, data compliance, and supply chain risk monitoring. Its built-in intelligent rules engine can intercept non-compliant operations and trigger early warning mechanisms in real-time. By utilizing "digital twin" technology, potential risks are transformed into quantifiable simulation scenarios, significantly improving the precision and efficiency of risk responses. This practice validates Wamba et al.'s "proactive defense" theory, where digital tools shift traditional passive compliance to proactive risk prediction, moving security management from "post-remedy" to "mid-intervention" and even "prevention".

The construction of a transparency mechanism is ZTE's key measure to resolve technological ethical controversies and solidify stakeholder trust. Its product security laboratory has received several international certifications, including CC EAL4+ (Common Criteria for Information Security) and GSMA NESAS (Network Equipment Security Assurance Scheme).

Traditional ESG research often views ethical governance as a cost of compliance or a reputational investment. ZTE, however, converts responsible innovation into measurable market competitiveness through digital tools, directly affirming Eccles et al.'s assertion that "responsible innovation can create brand premiums". This implies that when technological ethics are transformed into the "safety gene" of products and the "trust label" of brands through digital governance, they not only reduce compliance risks but also become a key source of differentiated advantage in global competition.

3.4. Supply chain empowerment in responsible value chain

In the context of global industrial chain restructuring and deepening ESG governance requirements, the responsible transformation of the supply chain has become a core issue for sustainable development. ZTE, through technological innovation, reconstructs the ESG governance system of the supply chain and achieves the co-beneficial development of industrial ecosystems through data connectivity and capability sharing. Its practices vividly demonstrate the core concepts of

environmental adaptability and resource integration in dynamic capabilities theory, providing a systematic solution for the construction of responsible value chains by leading enterprises.

The deep application of block-chain technology provides underlying support for penetrating supervision in supply chain ESG governance. ZTE's self-developed ECSS (Enterprise Compliance Service System) constructs an ESG dynamic database covering global suppliers. By leveraging block-chain's distributed ledger and immutability features, it achieves full-chain verification of sensitive issues such as conflict mineral traceability and forced labor investigation. The system converts key data like environmental qualifications, labor standards, and safety records of suppliers into traceable digital certificates on the block-chain. Each transaction and operation generates a timestamp and is synchronized to distributed nodes, eliminating the possibility of data tampering, a common issue in traditional supply chains. This governance model breaks through the limitations of traditional "paper audits + random checks" and upgrades ESG supervision from fragmented post-verification to full-process real-time control.

The empowerment of AI technology promotes collaborative governance for carbon reduction in the supply chain. ZTE developed the SMART model (Synergistic Management of Asset Reduction & Transformation) for dual-carbon governance, which uses machine learning algorithms to analyze suppliers' production processes, energy structures, and material consumption data. It provides customized carbon audit tools and reduction plans for top suppliers. In the green design phase, the model automatically matches low-carbon alternative materials and energy-saving process parameters. For example, a base station antenna product, through model optimization, adopts low-insertion loss modules, reducing product weight and lowering the overall carbon intensity of the supply chain. This technology-driven collaborative model avoids the zero-sum game of "cost shifting" in traditional carbon governance and achieves cost reduction and efficiency improvement through resource sharing and process innovation, validating AI technology's unique value in large-scale low-carbon transformation.

The integrated application of digital tools significantly enhances the crisis response resilience of the supply chain. ZTE's BCM (Business Continuity Management) system connects multiple core suppliers across several countries through application programming interface (API) interfaces, monitoring sudden events such as political unrest, natural disasters, and logistics disruptions in high-risk areas in real time. The system's built-in intelligent decision-making engine automatically triggers response plans based on risk levels, including alternative supplier scheduling, emergency spare parts allocation, and production schedule adjustments.

4. Conclusion and insights

Technology-driven ESG governance, through the deep integration of digital tools and organizational capabilities, creates a value-creation loop of "cost reduction – efficiency improvement – value enhancement." Its core logic lies in transforming technological elements into dynamic capabilities, driving the transition of ESG governance from compliance-oriented to value-oriented.

In terms of operational cost reduction, digital tools significantly improve management efficiency. For example, the Compliance intelligent risk control platform uses algorithms to predict and block non-compliant documents, reducing the traditional costs associated with manual audits. AI-assisted analysis models calibrate the prioritization cycle of issues, shortening it from quarterly to real-time, thereby minimizing decision-making delays.

In the dimension of product premium, technology-enabled green innovations create differentiated advantages. Products certified for their carbon footprint achieve a premium in international markets, strengthening the foundation of brand trust.

Regarding ecological benefits, technological output drives the improvement of ESG standards across the industrial chain. The dual-carbon governance SMART model helps suppliers optimize processes, while block-chain traceability eliminates the risk of green in the supply chain, enhancing collaborative efficiency.

The practical insights derived from this model are widely applicable across industries. First, the adaptability of technology is the prerequisite. Companies need to select enabling technologies based on business characteristics. For instance, ZTE focuses on the application of 5G-AI integration technologies in carbon data perception, balancing technological advantages with governance pain points. Second, the digital of governance structure is essential. Organizational support is provided through institutional designs, such as the establishment of strategic committees and embedding ESG indicators in executives' KPIs. The linkage of dual-carbon goals to executive performance drives a decrease in operational carbon emissions year-on-year, proving the effectiveness of the institutional framework. Third, ecological collaboration is key to amplifying value. ZTE extends its technological capabilities to the supply chain through the "Digital Green" strategy, guiding suppliers in carbon audits and building a transformation platform to upgrade from corporate ESG to industrial ESG.

This study, using the ZTE case, reveals that the core of technology-driven ESG governance is the transformation of digital technologies into dynamic capabilities. Through organizational restructuring, process optimization, and ecological collaboration, value creation is achieved. This research enriches the theoretical understanding of technology-enabled ESG and provides a practical pathway for "technology selection – capability building – value transformation." Future research could further explore cross-industry technology adaptation models and the long-term impact mechanisms of technology empowerment on ESG performance.

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