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Digital Transformation, Green Innovation and Enterprise Performance

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Abstract. Against the backdrop of global sustainable development and enterprise digitalization, digital transformation and green innovation have emerged as pivotal pathways to enhance enterprise performance. Digital transformation not only optimizes asset efficiency, boosts revenue, and reduces costs, but also enables precise carbon management, fosters a circular economy, and efficient use of resources. In terms of innovation, it facilitates business model transformation, integrates business processes, and improves R&D efficiency-while strengthening enterprises' overall competitiveness of enterprises through data-driven decision-making and digital talent development. Green innovation improves financial performance by reducing costs, increasing revenue, and mitigating risks. It also secures financing support through green financial instruments such as green credit, bonds and industrial funds, so as to enhance the sustainability of enterprises from the economic, capital and strategic levels. The synergy between the two further optimizes operational efficiency, accelerates technology R&D, innovates business models, and indirectly improves carbon performance through green technologies, effectively reducing energy consumption, increasing product premiums, shortening R&D cycles. This synergy builds a sustainable competitive edge characterized by "digital control + green creation," comprehensively propelling high-quality enterprise development.

Keywords: digital transformation, green innovation, corporate performance

1. Introduction

In the context of the digital technology revolution and global sustainable development, enterprises are confronted with strategic choices regarding transformative development. Digital transformation refers to the strategic transformation of enterprises to systematically reconstruct business processes and value networks through the application of digital technologies such as artificial intelligence and big data, and its core features include data-driven decision-making, deep integration of technologies, and organizational capacity re-engineering. Digital transformation provides technical support and data-driven capabilities for green innovation, and the two synergistically help enterprises achieve high-quality growth, green innovation is the integration of environment-friendly concepts into the whole process of innovation, through the development of environmental protection technology, the construction of circular economy and other ways to achieve the coordinated development of economic and environmental benefits, its essence is a sustainable innovation model. Digital

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transformation provides technical support and data-driven capabilities for green innovation, and the two work synergistically to facilitate high-quality growth of enterprises. As a key indicator to measure the effectiveness of transformation, corporate performance has expanded from traditional financial performance (e.g., ROE and profit margin) to a multi-dimensional evaluation system that includes environmental performance, social performance and innovation performance.

Existing literature generally acknowledges a significant synergistic relationship between digital transformation and green innovation. Digital technologies can enable green innovation, such as block-chain technology to improve supply chain transparency, and the Industrial Internet of Things to optimize energy management efficiency. However, green innovation also provides new application scenarios for digital transformation. However, there are three main limitations in the current research: first, most studies analyze digital transformation or green innovation in isolation, and lack a systematic discussion of the synergistic mechanism between the two; Secondly, the performance evaluation system is still dominated by financial indicators, which is difficult to fully reflect the comprehensive effect of transformation. Third, the critical role of organizational capabilities, especially talent teams, in the transformation process is neglected.

The innovative contributions of this paper lies in the construction of a comprehensive performance evaluation framework that integrates financial and non-financial indicators; The synergistic path of digital transformation and green innovation conducting an in-depth analysis. Particular emphasis was placed on the central role of the talent team in the dual transformation. Future research should further explore the industry-specific differentiated pathways of dual transformation in different industry contexts, develop more scientific performance measurement tools, and strengthen empirical research on small and medium-sized enterprises, thereby provide more actionable theoretical guidance for the sustainable development of enterprises [1].

2. Digital transformation and enterprise performance

2.1. Financial performance

The impact of digital transformation on enterprise performance in financial aspects is mainly reflected in three dimensions:

2.1.1. Asset efficiency

The improvement of asset efficiency reflects the digitalization of data and supply chain (e.g., intelligent inventory management) to accelerate capital turnover and optimize the efficiency of capital allocation, which is reflected in the improvement of core financial indicators such as ROIC and ROA, and enhances investor confidence.

2.1.2. Revenue growth

The revenue growth driver reflects the digitally empowered new product development (e.g., IoT services), precision marketing (via big data analytics) and channel expansion (online platform), creating incremental revenue sources and driving sustainable growth in revenue scale and market share [2].

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2.1.3. Cost optimization

Through automation and intelligent technologies (e.g., AI forecasting), digital transformation significantly reduces operating costs, minimizes waste of human resources and materials, directly increase gross profit margin and net profit margin, and improve the revenue and profit structure of enterprises [3].

2.2. Environmental performance

Digital Transformation and Enterprise Performance From the environmental aspect, there are three main points:

2.2.1. Carbon neutrality control

The precise management and control of carbon neutrality of enterprises reflects the real-time tracking of carbon footprints (e.g., using blockchain technology) based on big data network platforms, combined with digital twin technology to simulate emission reduction paths.This helps enterprises achieve carbon neutrality goals, avoid carbon tax risks and obtain green environmental policy dividends.

2.2.2. Circular economy

Circular economy empowerment embodies digital technologies (e.g., product life cycle management systems) to promote the recycling and reuse of waste materials, build an industrial ecological closed loop, not only reduce the cost of environmental compliance, but also create ESG premium value through the green supply chain.

2.2.3. Resource efficiency

The improvement of resource utilization efficiency accelerates the digital transformation to reduce the consumption of energy/raw materials in the production process, reduce the waste of resources, directly reduce environmental costs, and improve the profitability of the green economy through IoT monitoring and AI-driven intelligent optimization (energy intelligent management system).

2.3. Innovation performance

Digital transformation impacts enterprise performance through innovation in two key dimensions.

2.3.1. Business model

Business model disruption reflects new business formats such as digital technology platformization and servitization (e.g., IoT-based subscription services), breaking industry norms, carrying out business integration, promoting enterprises to shift from product suppliers to solution providers, unlocking high-value-added profit streams, and reshaping valuation logic [4].

2.3.2. Innovation efficiency

The qualitative change of innovation efficiency reflects the digital transformation of the R&D process through big data analytics, AI-driven intelligent simulation and other technologies,

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significantly shortening the innovation cycle and reducing the cost of trial and error (e.g., virtual experiments instead of physical tests), so that enterprises can achieve more frequent technological breakthroughs at a lower cost, and directly boost revenue from new products and patent-related income [4].

2.4. Team capability enhancement

Digital transformation impacts enterprise performance through team-related improvements in two key aspects.

2.4.1. Talent upgrading

The optimization and upgrading of talent structure reflects that digital tools (RPA or low-code platforms) lower the technical threshold [5], promote the transformation of employees to "digital + business" interdisciplinary talents, increase the ROI of enterprise human capital by 50%, and attract talents with high digital quality to join [6].

2.4.2. Data decision-making

Data-driven decision-making transformation reflects the transformation from empirical decision-making to data-driven decision-making by building a digital management dashboard (Power BI or Tableau), where management can monitor KPI fluctuations in real time, and front-line employees can obtain accurate implementation guidance to reduce the decision-making error rate [7].

3. Green innovation and corporate performance

3.1. Finance performance

Green innovation significantly improves corporate performance through three key financial mechanisms.

3.1.1. Cost optimization and resource efficiency

By optimizing resource utilization, reducing energy consumption and waste disposal costs, directly reducing operating expenses. For instance, cleaner production technologies can minimize raw material waste and enhance long-term economic benefits [8].

3.1.2. Revenue growth and market competitiveness

Green products meet environmental demands, enabling enterprises to tap into new markets and increase brand premiums, while government subsidies and green credit further strengthened financial performance [9].

3.1.3. Risk mitigation and long-term value

Green innovation reduces the risk of environmental fines and litigation, improves ESG ratings to reduce the cost of capital, and attracts long-term investment to enhance corporate valuation [10].

In summary, green innovation drives the improvement of financial performance from three aspects: cost reduction, income increase, and risk control.

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3.2. Value creation

Green innovation enhances corporate performance through multi-dimensional value creation, which can be categorized into three levels to significantly improve corporate performance through multi-dimensional value creation.

3.2.1. Economic perspective

From the economic perspective, green innovation can optimize processes, reduce energy consumption and reduce operating costs, while green products meet the demands of emerging markets and directly increase revenue and profits [9].

3.2.2. Capital perspective

At the capital level, it is understood that the improvement of ESG ratings reduces financing costs, attracts green credit and sustainable investment, and obtains higher market valuations to create greater value for shareholders [10].

3.2.3. Strategic perspective

At the strategic level, green innovation can help enterprises deploy low-carbon transformation, avoid policy risks, seize market opportunities, and form long-term competitive advantages through building green supply chains and technical barriers.

Together, these three dimensions form a complete path for green innovation to drive corporate value creation, achieving synergies between short-term financial improvement and long-term strategic development.

3.3. Financing support

Green innovation provides enterprises with significant financing advantages through three channels:

3.3.1. Credit support

Green credit provides low-interest and long-term financing solutions, and policy banks provide special loan support for projects that meet the green industry catalogue, which significantly reduces the capital costs for enterprises.

3.3.2. Bond financing support

Green bond financing channels attract professional investors for enterprises, which not only reduces the cost of issuance, but also enhances the image and value of the capital market.

3.3.3. Industry fund support

The green industry fund provides financial support for innovative enterprises through equity investment, and at the same time introduces value-added services such as technical resources and market channels.

These three financing dimensions jointly form a capital guarantee system for green innovative enterprises, which not only alleviates the pressure on R&D investment, but also optimizes the

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capital structure, and provides strong financial support for the green transformation and sustainable development of enterprises.

4. Synergy effect between digital transformation and green innovation on enterprise performance

The mechanism through which digital transformation and green innovation drive the improvement of enterprise performance is mainly reflected in four key dimensions.

4.1. Operational efficiency

In terms of operational efficiency, digital technology provides precise support for green production: it collects real-time equipment energy consumption data through the Industrial Internet of Things and optimizes process parameters using artificial intelligence algorithms, reducing energy consumption per unit of product by 15-20% while increasing production efficiency by more than 10%, thus creating significant operational synergies.

4.2. Financial performance

In terms of financial performance, the combination of digital marketing tools and green product characteristics can increase the product premium capacity by 8-12 percentage points; the intelligent supply chain system directly contributes to a 2-3 percentage point improvement in profit margins through the acceleration of inventory turnover brought about by enhanced demand forecasting accuracy.

4.3. Technological innovation

In terms of technological innovation, the virtual experiment platform based on digital twins shortens the R&D cycle of green materials by 40% and reduces trial-and-error costs by 60%, significantly accelerating the commercialization process of environmental protection technologies.

4.4. Strategic value

From the perspective of strategic value analysis, the deep integration of the two has given rise to new business models such as industrial Internet platforms; for example, a manufacturing enterprise, by building a circular economy cloud platform, not only achieved a 25% increase in its own resource utilization but also created new profit growth points through platform services.

This synergistic effect is not a simple superposition of technologies but forms a virtuous cycle of "digital precision control + green value creation" through organizational restructuring and business process reengineering, enabling enterprises to build sustainable competitive advantages while achieving immediate financial returns. Additionally, regarding the mediating role of green technology innovation, digital transformation indirectly improves enterprises' carbon performance by promoting green technology innovation: digital technologies accelerate the flow of information and innovation, reduce R&D costs for green technologies, and increase the number of green patent applications, thereby reducing energy consumption in the production process[10].

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5. Conclusion

In terms of finance, digital transformation drives asset efficiency (optimizing ROIC/ROA), driving revenue growth, and optimizing cost structure (automated cost reduction), while green innovation reduces costs (resource optimization), increases revenue, and avoids risks. Together, they enhance our financial performance. In terms of environment, digital technology enables precise carbon neutrality management (blockchain tracking), circular economy and resource efficiency improvement, which complements green and innovative clean production technologies and green supply chain management. At the innovation level, R&D efficiency improvement (e.g.,virtual experiments) and digitalization promote business model transformation (e.g., platform-based services), while green innovation accelerates the commercialization of environmental protection technologies. In terms of team building, digitalization cultivates interdisciplinary talents and data decision-making capabilities, and provides organizational guarantee for green innovation. The synergistic effect of the two is more reflected in the improvement of operational efficiency, financial synergy, accelerated technological progress and business model innovation, and development sustainable competitive advantages of enterprises through the virtuous cycle of "digital management and control + green creation".

Future research should focus on: (1) Exploring differentiated collaborative paths in different industry contexts; (2) Develop a more refined synergistic effect measurement index system; (3) case studies on enhancing the synergy between digital transformation and green innovation of small and medium-sized enterprises; (4) Deepen the analysis of the intermediary mechanism of digital technology to empower green technology innovation. With the in-depth implementation of the "dual carbon" strategy and the continuous advancement of digital technologies, enterprises should adopt an integrated development strategy of "digital precision governance + green value creation", and cultivate sustainable competitive advantages for the future while improving short-term financial performance.

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