

Research on the Status Quo and Pathways of Enterprise Green Innovation under the Background of the Digital Intelligence Economy

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Abstract: With the booming digital intelligence economy, the innovation mode of enterprises has been affected, making green innovation and sustainable development a prevailing trend. This paper discusses the status quo and pathways of enterprise green innovation in the context of the digital intelligence economy. It also discusses how digital intelligence technology can be used to promote sustainable development, providing theoretical and practical guidance for Chinese enterprises.

Keywords: Digital Intelligence Economy; Green Innovation; Sustainable Development

1. Introduction

As global climate change and environmental issues intensify, green development has become a common focus of international attention. Since the 18th National Congress of the Communist Party of China, China has actively responded to the call for global green development by integrating ecological development into its overall national development strategy. By actively promoting the greening and decarbonisation of economic and social development, China strives for Chinese modernisation characterised by the harmony between humanity and nature. Green innovation, as the core driver of green development, is not only related to the sustainable development of enterprises but also an important way to achieve coordinated development among the economy, society, and environment. With the ever-advancing science and technology, especially the rapid development of digital intelligence technology, enterprise green innovation has received strong technical support. The era of digital intelligence marks the deep integration of information technology and big data, which is changing the

operational mode and business logic of various industries at an unprecedented speed. This integration has significantly improved data processing and analysis capabilities, providing enterprises with more accurate market insights and decision-making support. In the field of enterprise innovation, digital intelligence has promoted comprehensive innovation from product development, production process to marketing, achieving a more efficient and smarter innovation mode, which also provides strong technical support for enterprise green innovation. In today's society, the deep integration of digital intelligence and greening has become an important driving force for green transformation and upgrading. Digital intelligence technology, in particular, significantly accelerates the greening process, while the continuous promotion of greening, in turn, creates broad opportunities and demand for the development of digital intelligence. This mutually-promoting relationship not only injects new kinetic energy into China's green transformation and economic upgrading but also serves as a key force that promotes high-quality economic development. Based on this, this paper intends to explore the status quo and pathways of enterprise green innovation in the context of the digital intelligence economy. This research aims to provide theoretical references and practical guidance for enterprises in green innovation in the context of digital intelligence, thus making a positive contribution to China's green development.

2. Literature Review

Enterprise green innovation is a fusion of environmental protection concepts and technological innovation, which aims to enhance resource utilisation efficiency and reduce pollution emissions to promote comprehensive sustainable development of

economy, society and environment [1]. In the process of economic restructuring and upgrading, digitalisation and intelligence are considered to be effective strategies for green development. The digital and intelligent economy is a new economic form with digitalisation, networking and intelligence as its core, promoting economic development through technical means such as big data, cloud computing and artificial intelligence [2]. Currently, there is a wide range of research related to the influence of enterprise digitalisation and intelligent development on enterprise green innovation. Early studies focused on the impact of green innovation on enterprise performance and long-term development. Most scholars believe that green innovation has a positive impact on the growth of enterprise value, but some hold the opposite view, such as Tang M. F. et al. (2018), observing that the rise in environmental expenditures adversely affects profits among a subgroup of manufacturing enterprises that conduct green innovation.

Given that digital and intelligent technology is becoming a social hotspot, scholars at home and abroad have begun to explore their impact on enterprises and analyse heterogeneity. Guo Feng et al. (2023) proposed that enterprise digital transformation has become an important driving force for green technological innovation, particularly in state-owned enterprises. Hu and Dai (2024) confirmed that firms' competitive position moderates the influence of digital transformation on green innovation promotion in enterprises, which is more significant in enterprises in the eastern and western regions of China, as well as in listed companies in the manufacturing industry. An empirical study by Lv Zhimei (2024) based on data from Shanghai and Shenzhen A-share markets from 2011-2021 showed that digital transformation significantly improves the efficiency of corporate green innovation, especially for high-tech firms, low-marketisation firms and manufacturing firms. In addition, some scholars have also explored the impact mechanism. The study of Jin Yu et al. (2022) showed that digital transformation not only reduces the agency conflict within the enterprise to maximise their interests but also stimulates their development potential, which alleviates the financing pressure and ensures robust cash flows, ultimately promoting sustained development in green innovation. Qi

and Liu (2023) found that digital technology improves the quantity and quality of corporate green innovation in several aspects, including information accuracy, reductions in corporate financing pressures, and enhancements in the capacity for technological integration. Xu et al. (2024) confirmed through empirical tests that digitalisation in environmental governance helps to bring into play the synergies between environmental and economic values, which in turn promotes corporate green innovation and transformation.

Overall, current research mainly focuses on the impact of green innovation on enterprise development and the impact of digital intelligence technology on enterprise green innovation. However, there are relatively few investigations into the pathways of green innovation in the context of the digital intelligence economy. Therefore, this paper aims to fill this gap by focusing on the development of the digital intelligence economy, exploring the status quo of enterprise green innovation in this context and putting forward suggestions for future development.

3. Analysis of the Current Situation

With the further development of social economy and technology, more enterprises choose to improve the efficiency of green innovation through digital intelligence. At present, the role of digital intelligence technology in green innovation is mainly reflected in the following three perspectives.

From the resource perspective, digital intelligence technologies facilitate better management of supply chains and inventories for enterprises. Digital intelligence technologies optimise the allocation and utilisation of resources by increasing the transparency and accessibility of information, which, in turn, reduces waste and improves resource efficiency, thereby enabling green innovation. On the other hand, digital intelligence technology reduces the demand for energy and raw materials, thereby promoting the development and use of renewable energy. Currently, digital intelligence solutions such as smart grids, smart homes and energy management systems can help companies monitor and control energy consumption in real time for efficient energy use. IoT and cloud technologies enable remote monitoring and management of renewable energy sources, ensuring stable and optimised

project operation.

From the market perspective, digital intelligence technology, compared with the traditional industrial development mode, facilitates precise docking between producers and consumers, which allows market players to quickly and accurately match market supply with demand, thereby reducing transaction costs, as well as resource input and consumption through precise docking. Secondly, under the wave of digital transformation, enterprises have significantly enhanced their level of informatisation, a move that not only improves information flow and transparency inside and outside the enterprise but also makes the enterprise development process more transparent and subject to extensive supervision from all sectors of society. This monitoring mechanism effectively motivates enterprises to actively invest in green innovation and environmental protection, which in turn enhances their public image [3]. These positive changes not only enhance the market competitiveness of enterprises but also further promote the sustainable development of green innovation.

From the financing perspective, the information transparency of enterprise operations and management processes has been significantly enhanced by the digital intelligence economy. Through the in-depth application of big data platforms, enterprises can monitor fund flow and R&D progress in real-time, which not only effectively reduces risks of moral hazards and adverse selections but also effectively alleviates financing constraints and provides strong support for green innovation activities. In addition, as enterprises actively embrace digital intelligence, they accelerate their green innovation and green development, which marks an important strategic initiative to promote high-quality development. This shift not only shows external stakeholders the determination of the enterprise to meet challenges and pursue sustainable development. It also enhances investor confidence, thus improving their willingness to invest. Furthermore, such initiatives make it more likely for the enterprise to receive support from national preferential policies to broaden their access to financing channels and inject new impetus into their development [4].

On the other hand, against the backdrop of the booming digital and smart economy, corporate

green innovation is also confronted with multiple challenges. On the technical level, although digital and intelligent technologies provide powerful tools for green innovation, effective integration of these advanced technologies into green product development, production process optimisation and waste management remains an urgent issue for enterprises. From a talent perspective, green innovation needs interdisciplinary, cross-field composite talents. However, such talent is relatively scarce in the current market, making it necessary for enterprises to increase efforts in training and recruitment. At the financial level, green innovation often involves large initial investments and a long payback period, which exposes many enterprises to considerable financing pressure.

4. Innovation Pathways and Strategies

In recent years, enterprises and academics are constantly exploring the pathways for green development. Based on the above analysis regarding the status quo of enterprise green innovation in the context of the digital intelligence economy, this paper puts forward the following suggestions for the pathways and strategies of green innovation.

4.1 Technological Innovation

In the context of digital intelligence, the primary pathway to green innovation for enterprises lies in technological innovation. With the rapid development of artificial intelligence, big data, cloud computing and other technologies, enterprises should actively integrate these advanced technologies to optimise production processes and reduce energy consumption and waste emissions. Data analysis and intelligent technologies can assist in the accurate assessment of the impact of their environmental production and operation and then contribute to the efficient resource utilisation and the implementation of environmental protection measures, aiming to achieve a harmonious symbiosis between economic growth and environmental protection. Data-driven decision-making mechanisms and intelligent management systems enable enterprises to capture market dynamics more acutely, optimise resource allocation, improve production efficiency and product quality, and strengthen internal supervision and risk control capabilities, thereby enhancing overall

corporate governance. To this end, enterprises should increase investment in research and development and establish close partnerships with universities and research institutes to jointly develop green and efficient production technologies and processes. At the same time, enterprises should also pay attention to the commercialisation of technology to ensure that technological innovation can be truly transformed into real productivity that promotes sustainable green innovation.

4.2 Organisational Innovation

Organisational innovation is an important guarantee for enterprise green innovation. In the era of digital intelligence, enterprises should break the traditional organisational structure and operation mode to build a flexible, efficient and green organisational system. First of all, enterprises should establish a green innovation-centred corporate culture. It is essential to raise green awareness among internal stakeholders and encourage them to explore forward-looking strategies for green innovation and further drive momentum towards green innovation and transformation through reasonable incentive mechanisms. At the same time, enterprises should optimise internal organisational structures by reducing management levels and strengthening cross-departmental and cross-field collaboration, which contributes to a synergy of green innovation. In addition, enterprises should build an open and inclusive innovation ecosystem. Close cooperation with suppliers, customers and partners allows for joint efforts to promote green innovation.

4.3 Market Innovation

Market innovation is an important avenue for enterprise green innovation. In the context of digital intelligence, enterprises should actively explore new markets for green products and services to meet consumer demand for environmentally friendly products. On the one hand, enterprises should intensify the promotion of green products and services by establishing a green marketing system and enhancing the market competitiveness of green products and services through green certification and green labelling. Through active participation in international green trade cooperation, enterprises can expand the international market and promote the globalisation of green products and services. In

addition, by actively participating in social responsibility activities, such as environmental protection activities and public welfare undertakings, enterprises shape a positive social image. This, in turn, enhances recognition and support from consumers and society, thus promoting enterprise green development by addressing external concerns.

4.4 Policy Innovation

Policy innovation lends an important support to green innovation by enterprises. The government should formulate and improve the policy system for green innovation, including policies on finance, taxation, finance and environmental protection. Targeted policy support should be provided to enterprises with different characteristics: non-state-owned enterprises with slower technological development and heavily polluting enterprises under greater environmental governance pressure. To reduce the costs and risks related to green innovation for enterprises, the government should establish a special fund for green innovation and provide tax incentives and loan support. At the same time, the government should actively guide and expand the adoption of digital and intellectual integration so that more enterprises can enjoy the efficiency, convenience, and competitive advantages brought about by digital and intellectual technologies. By doing so, enterprises can enhance their comprehensive competitiveness and long-term development capacity. These initiatives will inject strong momentum into the green and sustainable development of enterprises and society.

5. Conclusions

At present, green innovation among Chinese enterprises is presented with unprecedented development opportunities, and the advent of the digital and intellectual economy era is profoundly changing the operation and business modes across all industries. Under the background of the Digital Intelligence Economy, enterprise green innovation is forging new development trends and paths. Through advanced technologies such as big data, cloud computing, artificial intelligence, etc., enterprises can not only improve resource utilisation efficiency, reduce environmental pollution, and realise sustainable development but also accurately capture market demands to

expedite the innovation process and enhance market competitiveness. In the future, with the in-depth development of digital intelligence technology and the expansion of the global green economy, enterprise green innovation will become a key driver for sustainable and healthy socio-economic development.

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