

# Exploration of Financial Support Mechanisms for Green Innovation in Enterprises under the Background of Digital Transformation

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## ABSTRACT

Against the backdrop of actively addressing climate change and promoting sustainable development globally, green innovation in enterprises has become a key driving force for achieving coordinated economic and environmental development. The wave of digital transformation has brought new opportunities and new means for green innovation in enterprises, and financial support is an important support to ensure the smooth implementation of green innovation activities in enterprises. This article deeply analyzes the financial support mechanism for green innovation in enterprises under the background of digital transformation, aiming to reveal how finance can assist green innovation in enterprises through various channels and methods. At the same time, it explores the problems existing in the current mechanism and proposes optimization suggestions, providing theoretical reference and practical guidance for promoting green innovation in enterprises and promoting green economic development.

## KEYWORDS

Digital transformation; Enterprise green innovation; Financial support mechanism

## 1. INTRODUCTION

With increasingly severe environmental issues such as global climate change and resource scarcity, green development has become a consensus for economic development in countries around the world. As the main body of economic activities, the green innovation capability of enterprises is directly related to the achievement of green development goals. Green innovation requires enterprises to integrate environmental protection concepts into product research and development, production processes, management models, etc., reduce negative impacts on the environment through innovative activities, and improve resource utilization efficiency. At the same time, digital transformation is profoundly changing the operational models and innovative approaches of enterprises. Digital technologies such as big data, artificial intelligence, and blockchain provide precise data analysis, efficient production process optimization, and reliable information tracing support for green innovation in enterprises [1].

However, corporate green innovation activities often face characteristics such as high investment, long cycles, and high risks, which make financial support an indispensable factor for corporate green innovation. A reasonable and effective financial support mechanism can provide sufficient funds for green innovation in enterprises, reduce innovation risks, and guide the allocation of resources to the field of green innovation. Therefore, it is of great practical significance to conduct in-depth research on the financial support mechanism for green innovation in enterprises under the background of digital transformation.

## **2. THE CORRELATION BETWEEN DIGITAL TRANSFORMATION AND GREEN INNOVATION IN ENTERPRISES**

### **2.1. Digital Transformation Provides Technological Support for Green Innovation in Enterprises**

Digital technology plays a crucial role in the product design process. Through computer-aided design (CAD) and simulation technology, enterprises can conduct precise simulation analysis of product performance, energy consumption, environmental impact, etc. in the early stages of product development. By utilizing digital simulation technology, automobile manufacturing enterprises can optimize the aerodynamic performance of vehicles during the design phase and reduce energy consumption during driving; At the same time, simulating and evaluating the recyclability of automotive materials can improve the resource recovery and utilization rate after product scrapping, thereby achieving green design of products [2].

In the production process, digital technology has promoted the deep integration of intelligent production and energy conservation and emission reduction. Intelligent sensors and IoT technology enable enterprises to monitor the real-time operation status and energy consumption of production equipment, and achieve precise control and optimized scheduling through data analysis. The factory utilizes intelligent control systems to adjust the operating parameters of equipment in real-time according to production needs, avoiding energy waste; Adopting automated production lines to improve production efficiency while reducing energy loss and pollution emissions caused by manual operations.

In terms of enterprise management, digital transformation has optimized resource allocation and supply chain management. The Enterprise Resource Planning (ERP) system integrates internal resource information such as human, material, and financial resources, and achieves rational allocation of resources through data analysis, reducing idle and waste. In supply chain management, big data and blockchain technology have built a transparent and traceable supply chain system. Enterprises can grasp real-time information on various links such as raw material procurement, product production, transportation and sales, ensuring that all nodes of the supply chain comply with green standards and jointly promote green innovation. A certain electronic product manufacturing enterprise utilizes blockchain technology to record and trace information such as the source of raw materials and environmental indicators during the production process, ensuring the green attributes of products and enhancing the company's green image.

### **2.2. Green Innovation Demand Drives The Digital Transformation Process of Enterprises**

The pursuit of green innovation by enterprises has prompted them to actively introduce digital technology to cope with environmental regulations and market competition pressure. The increasingly strict environmental regulations have put forward higher requirements for the production standards and pollutant emissions of enterprises. In order to meet regulatory requirements and reduce the risk of violations, enterprises have to rely on digital technology to optimize production processes and improve environmental monitoring capabilities. For example, chemical companies can install digital environmental monitoring equipment to monitor real-time emissions of waste gas and wastewater, and use data analysis technology to promptly detect and solve problems of excessive emissions, ensuring that their production complies with environmental regulations [3].

In market competition, the increasing awareness of environmental protection among consumers has made green products more popular. To gain a competitive advantage, enterprises need to create green products and brand image through green innovation. Digital technology helps enterprises gain a deeper understanding of consumers' green needs, and carry out precise marketing and product

innovation. By analyzing consumer purchasing behavior, environmental preferences, and other information through big data, enterprises can develop targeted green products and use digital marketing channels to convey the green value of products to consumers, thereby increasing product market share.

### **3. THE EXISTING MECHANISM OF FINANCIAL SUPPORT FOR GREEN INNOVATION IN ENTERPRISES**

#### **3.1. Green Credit Mechanism**

Green credit is an important way for financial institutions to provide financial support for green innovation projects of enterprises. Financial institutions evaluate project risks and benefits based on the green attributes of enterprise projects, such as whether they adopt environmental protection technologies and whether they contribute to energy conservation and emission reduction, and provide preferential loan interest rates and quotas for eligible projects. Large state-owned banks provide long-term, low interest loans for clean energy projects such as wind and solar power, supporting enterprises in building new energy generation facilities. In the approval process, financial institutions open up green channels for green projects, simplify procedures, improve approval efficiency, and ensure that enterprises can obtain timely financial support.

#### **3.2. Green Bond Mechanism**

Enterprises raise funds in the capital market for green innovation activities by issuing green bonds. The issuing entities of green bonds include various enterprises, and the funds raised from the bonds are specifically used for green project construction, technology research and development, etc. Bond rating agencies conduct special ratings on green bonds, evaluating the environmental benefits, feasibility, and other factors of the projects supported by the bonds, and providing decision-making references for investors. A certain environmental protection enterprise issued green bonds to raise funds for the research and development of new sewage treatment technologies to improve the quality of urban water environment. The investors of green bonds include institutional investors and individual investors, who support the green innovation of enterprises while obtaining investment returns [4].

#### **3.3. Venture Capital and Private Equity Investment Mechanisms**

Venture capital (VC) and private equity (PE) play a crucial role in the early stages of corporate green innovation. These investment institutions focus on innovative green technologies and business models, investing in start-up or growth stage enterprises. Investment institutions not only provide funding for enterprises, but also offer value-added services such as strategic planning and market expansion based on their industry experience and resource networks. Venture capital firms invest in a start-up company that develops new energy storage technologies, helping the company improve its technology research and development route, connect with potential customers, and promote rapid growth. In terms of investment returns, venture capital and private equity investment institutions expect to achieve capital appreciation through methods such as corporate listings and mergers and acquisitions.

## **4. HOW DIGITAL TRANSFORMATION AFFECTS FINANCIAL SUPPORT FOR GREEN INNOVATION MECHANISMS IN ENTERPRISES**

### **4.1. Digitalization Enhances The Evaluation Capability of Financial Institutions for Green Innovation Projects of Enterprises**

Financial institutions use big data technology to collect multidimensional information about enterprises, including production and operation data, environmental information disclosure, social responsibility performance, etc., to construct a comprehensive corporate portrait. By analyzing massive amounts of data, we can more accurately evaluate the technical feasibility, market prospects, environmental benefits, and risk levels of green innovation projects for enterprises. Using machine learning algorithms to analyze energy consumption data and environmental investment data of enterprises, predict the future energy-saving and emission reduction effects of green innovation projects, and provide scientific basis for credit approval and bond rating. The application of blockchain technology has improved the transparency and credibility of enterprise information. The information of green innovation projects and fund flows of enterprises are recorded on the blockchain and cannot be tampered with. Financial institutions can obtain real and accurate project information in real time, reduce the risks caused by information asymmetry, enhance trust in green innovation projects of enterprises, and provide financial support more actively [5].

### **4.2. Digital Expansion of Financial Support for Enterprises' Green Innovation Channels and Methods**

Internet financial platform provides new financing channels for green innovation of enterprises. Through online platforms, companies can directly showcase green innovation projects to investors and attract social capital to participate. Some Internet financial platforms have launched green crowdfunding projects, and individual investors can participate in supporting enterprises' green innovative product research and development or project construction with small funds. The innovation of digital financial products has enriched the ways of financial support. For example, developing supply chain finance products based on enterprise green production data, core enterprises use their own credit to provide green financing services for upstream and downstream small and medium-sized enterprises. Based on the order data and delivery records of small and medium-sized enterprises in the green supply chain, financial institutions provide them with financial services such as accounts receivable financing and inventory pledge financing to promote the coordinated development of the green supply chain.

### **4.3. Digitalization Enhances the Risk Management Capability of Financial Support for Green Innovation in Enterprises**

Using artificial intelligence and big data analysis technology, financial institutions construct risk warning models to monitor the real-time operation of green innovation projects in enterprises. Track and analyze key indicators such as the progress of technical research and development, changes in market demand, and efficiency of fund utilization for the project, promptly identify potential risks, and issue warning signals. When the R&D cycle of green innovation projects in enterprises is extended, cost overruns occur, or market demand fluctuates, financial institutions can take measures in advance, such as adjusting credit limits, requiring enterprises to supplement guarantees, etc., to reduce risk losses. Digital technology also helps financial institutions optimize their risk diversification strategies. Through financial technology platforms, financial institutions can share and cooperate with other financial institutions and investment institutions to jointly participate in corporate green innovation project investments and diversify risks. Multiple banks provide financial support for large-scale green infrastructure construction projects through joint loans, reducing the risk exposure of a single bank.

## **5. THE PROBLEMS EXISTING IN THE CURRENT FINANCIAL SUPPORT MECHANISM**

### **5.1. Uneven Allocation of Financial Resources**

In the field of green credit, large enterprises and high-quality projects are more likely to be favored by financial institutions, with sufficient funds and favorable interest rates. However, small and medium-sized enterprises face high barriers when applying for green loans due to their small scale, light assets, and weak risk resistance, making it difficult for them to obtain sufficient financial support. Some small and medium-sized enterprises engaged in green technology research and development, although having innovative potential, are rejected by financial institutions due to lack of collateral and incomplete financial data. In the green bond market, it is relatively easy for large state-owned enterprises and listed companies to issue green bonds, while small and medium-sized enterprises have a smaller scale and greater difficulty in issuing green bonds. This has led to restrictions on green innovation activities of small and medium-sized enterprises due to funding shortages, which is not conducive to the overall construction of a green innovation ecosystem.

### **5.2. Insufficient Innovation in Financial Products and Services**

There is a gap between existing financial products and services in meeting the diverse needs of enterprises for green innovation. Green credit products are mostly concentrated in traditional green fields such as energy and transportation, and there are relatively few targeted financial products for emerging green technology innovation fields such as research and development of biodegradable materials and application of green artificial intelligence. The types of green insurance products are limited, currently mainly concentrated in a few types of insurance such as environmental pollution liability insurance. There is a lack of effective insurance products to protect against technology research and development risks, market risks, etc. in the process of enterprise green innovation. In addition, financial institutions often lack personalized customization when providing green and innovative financial services to enterprises, and cannot provide precise services based on the specific needs and innovative characteristics of enterprises.

### **5.3. Insufficient Depth and Breadth of Digital Technology Application**

Some financial institutions have only focused on basic data collection and analysis in using digital technology to support green innovation in enterprises, and have not fully tapped into the potential of technologies such as big data, artificial intelligence, and blockchain. In the risk assessment process, although some financial institutions use data analysis techniques, their models are not comprehensive enough, and the risk assessment of green innovation projects for enterprises is not accurate enough. In terms of blockchain technology application, only a few large financial institutions have conducted pilot explorations, and mature application models and industry standards have not yet been formed, resulting in obstacles in information sharing, project traceability, and other aspects. In addition, the lack of effective integration between digital systems of different financial institutions and the serious phenomenon of information silos have affected the synergistic effect of financial support for green innovation in enterprises.

## **6. SUGGESTIONS FOR OPTIMIZING FINANCIAL SUPPORT MECHANISMS**

### **6.1. Improve Policy Guidance to Promote Balanced Allocation of Financial Resources**

The government should formulate differentiated financial policies and guide financial institutions to increase their support for green innovation in small and medium-sized enterprises. Provide tax incentives, government subsidies, and other policy incentives to financial institutions that provide green credit to small and medium-sized enterprises, in order to reduce their risk costs. Establish a special fund for green innovation in small and medium-sized enterprises, providing financial support for green innovation projects through direct investment, loan interest subsidies, risk compensation, and other means. Improve the green bond market system, simplify the issuance process of green bonds for small and medium-sized enterprises, lower the issuance threshold, and encourage small and medium-sized enterprises to raise funds through green bonds. At the same time, we will strengthen the credit rating of green bonds for small and medium-sized enterprises, and enhance the market recognition and attractiveness of the bonds.

### **6.2. Encourage Financial Innovation and Enrich the Supply of Financial Products and Services**

Financial institutions should strengthen cooperation with enterprises and research institutions, deeply understand the green innovation needs of enterprises, and develop diversified financial products. Design specialized credit products for emerging green technology innovation fields, such as intellectual property pledge loans, technology transfer loans, etc., to provide financial support for enterprise technology research and development. Enrich the green insurance product system, launch insurance products targeting the risks of enterprise green innovation technology research and development and market promotion, such as technology research and development failure insurance, green product market development insurance, etc., to help enterprises diversify innovation risks. Provide personalized financial service solutions based on the different needs and innovative characteristics of enterprises. Develop different financing strategies and service packages for enterprises at different stages of development to meet their green innovation finance needs throughout their entire lifecycle.

### **6.3. Deepen Digital Transformation and Enhance the Efficiency of Financial Services**

Financial institutions should increase their investment in digital technology and enhance their digital application capabilities. Improve the big data analysis model, comprehensively consider multi-dimensional factors such as environmental performance, technological innovation capability, and market competitiveness of enterprises, and enhance the accuracy of risk assessment for green innovation projects of enterprises. Accelerate the application and promotion of blockchain technology in financial support for green innovation in enterprises, establish a unified blockchain platform, achieve information sharing among financial institutions, enterprises, regulatory departments, and other parties, and improve project information transparency and fund utilization efficiency. Strengthen the integration and coordination of digital systems among financial institutions, establish financial service alliances, integrate resources from all parties, and jointly provide comprehensive and integrated financial services for enterprise green innovation. By establishing a financial service information sharing platform, different financial institutions can share customer information, project information, risk information, etc., and improve the synergy and efficiency of financial services.

## 7. CONCLUSION

In the context of digital transformation, green innovation in enterprises has ushered in new development opportunities, and the improvement of financial support mechanisms is crucial for promoting green innovation in enterprises. Digital technology has brought positive impacts such as improved evaluation capabilities, expanded channels, and optimized risk management to financial support for green innovation in enterprises. However, the current financial support mechanism still faces problems such as uneven resource allocation, insufficient product and service innovation, and insufficient digital application. By improving policy guidance, encouraging financial innovation, deepening digital transformation and other measures, optimizing financial support mechanisms, we can better meet the financial needs of enterprises for green innovation, promote the widespread development of green innovation activities, and provide strong support for achieving sustainable economic and social development. In the future, with the continuous development of digital technology and the continuous promotion of financial innovation, the mechanism of financial support for green innovation of enterprises will be continuously improved, injecting new vitality into the development of green economy.

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