

A Study on the Impact of Digital Economy on the Green Transformation of Enterprises

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Abstract: Green and sustainable development has become an inevitable choice for the global economy to enter a new stage. At the same time, China's digital economy is accelerating its expansion from the consumption sector to the production sector, and digital transformation is gradually becoming an emerging dividend that leads enterprises to create green value. This paper takes Chinese enterprises as the research object, and based on the development of green economy, studies the main problems faced by Chinese enterprises in achieving green transformation and upgrading. At the same time, it studies the impact of the digital economy on the green transformation of enterprises. In this study, it is found that Chinese enterprises face the following problems in the process of achieving green transformation: insufficient resource utilization, low efficiency in product research and development, low productivity, and low recycling rate. This paper also points out how the development of the digital economy can drive enterprises to achieve green transformation. It presents an analysis from five aspects: resource utilization, product research and development, production and processing, industrial structure, and circular utilization, explaining the impact of digital technology on enterprise transformation, and emphasizes the importance of technological innovation. Meanwhile, the research in this paper provides ideas for the development of domestic enterprises, helping them adapt to the current requirements of economic development and achieve green transformation.

Keywords: Digital Economy, Green Transformation, Technology Innovation, Utilization.

1. Introduction

The “14th Five Year Plan for National Economic and Social Development” pointed out that during the “14th Five Year Plan period”, new progress should be made in the construction of national ecological civilization. At the same time, against the backdrop of global informatization entering a comprehensive penetration, accelerating innovation, and leading a new stage of development, the digital economy is becoming a powerful driving force for innovative economic growth. The “White Paper on Global Digital Economy (2022)” released by the China Academy of Information and Communications Technology (CAICT) in 2022 pointed out that the digital economy provides important support for global economic recovery. Industrial digitalization was still the main engine of the development of digital economy, accounting for 85% of the digital economy, among which, the digitalization of the tertiary industry led the transformation and development of the industry, and the digital economy of the primary, secondary and tertiary industries accounted for 8.6%, 24.3% and 45.3% of the added value of the industry respectively. Meanwhile, China has also vigorously promoted the development of digital economy. Since the “18th National Congress of the Communist Party of China”, China has implemented the network power strategy and the national big data strategy. China has also issued the digital economy development strategy and the “14th Five-Year Plan” digital economy development plan. The relevant departments conscientiously implement the deployment, accelerate the promotion of digital industrialization and industrial digitization, and promote the vigorous development of the digital economy.

Currently, the Chinese economy is undergoing a green transformation from high-speed growth to high-quality development. Faced with the continuous deterioration of the ecological environment and the increasing pressure of

environmental resource constraints, enterprises urgently need to enhance green creativity, achieve a transformation of development models, obtain sustainable competitive advantages and achieve long-term development.

The development of the digital economy has driven enterprises to improve their production and business models, adjust their industrial structure, and achieve green transformation. The application of digital information technology has made the connections between various links such as production, distribution, and consumption closer, improving the operational efficiency of economic activities. At the same time, the enterprise has achieved resource and energy conservation. And digital technology can also help enterprises understand the implementation status of various links, choose the optimal decision, improve business efficiency and energy utilization efficiency, and reduce environmental pollution.

2. Literature Review

2.1. Research Related to The Digital Economy

The concept of the digital economy was first proposed by an American scholar Don Tapscott in a book named *The Digital Economy: Promise and Peril in the Age of Networked Intelligence* in 1996, which described the Age of Networked Intelligence as an all encompassing and revolutionizing phenomenon [1]. In 1998, the US Department of Commerce released the report “Emerging Digital Economy”, which officially shaped the concept of the digital economy. Yang & Li (2021) believed that the digital economy can be redefined as the synthesis of various economic activities with intelligent technology clusters as the core driving force, network connectivity as the foundation, data as the production factor, and the connotation of technological economic paradigm transformation [2]. Shi (2022) gave a comprehensive academic definition of the digital economy that the digital

economy is an emerging economic form based on three major elements: big data, intelligent algorithms, and computing power platforms [3]. It is based on computing power platforms and uses intelligent algorithms to store, process, analyze, and discover knowledge of big data, thereby serving the optimization and upgrading of resources in various industries and promoting high-quality economic development. In 2016, in the G20 Digital Economy Development and Cooperation Initiative, the Organization for Economic Cooperation and Development (OECD) proposed that digital economy refers to data information as the main production factor. A series of economic activities with modern information networks as an important carrier and the effective use of information and communication technologies as an important driving force for improving efficiency and optimizing economic structure.

2.2. Research Related to The Impact of Digital Economy on Green Development of Enterprises

Most studies on the impact of the digital economy on green transformation of enterprises believe that the digital economy has a promoting effect. Liu et al. (2023) selected panel data from 30 provinces in China from 2012 to 2020 for empirical analysis, indicating that the digital economy has a positive impact on the green development of traditional manufacturing through digital innovation, industrial upgrading and human capital [4]. Zhang et al. (2022) presented that the main impacts of the digital economy on industries include environmental governance, technological innovation and industrial structure upgrading [5]. The main research findings of Ran et al. (2023) indicated that natural resource utilization and digital economy can significantly promote industrial green transformation [6]. The digital economy promotes green transformation of industries by improving the utilization of natural resources. Chen & Li (2022) believed that the digital economy is an important driving force for the green development of the manufacturing enterprises [7]. Enterprises need to drive changes in production methods through digital transformation, adopt new generation information technology to improve energy, resource, and environmental management levels, and empower green manufacturing. Kou et al. (2023) proposed through empirical analysis that the improvement of enterprise digitalization level promotes research and development innovation investment and enhances the enthusiasm of enterprises to actively control pollution [8]. Su et al. (2021) indicated that the digital economy helps to build a clean and intelligent industrial chain, solve the fundamental reason for the lack of new driving force in China's industrial upgrading, and help to form a new development pattern of domestic and international dual circulation, thereby achieving high-quality and sustainable development of the Chinese economy [9]. However, there are still some problems in the process of promoting enterprise transformation and upgrading in the digital economy. Guo & Zhao (2023) proposed that in the process of integrating the digital economy with the real economy, there are still constraints such as insufficient core technology reserves, imbalanced industry integration, insufficient innovation in transformation, lagging governance systems and a lack of linkage mechanisms [10]. Zhou, Han & Xiao (2022) believed that the government should pay more attention to the role of the digital economy in green innovation and industrial structure upgrading, encourage

enterprises to eliminate outdated production capacity, and achieve win-win results in industrial upgrading and reducing environmental pollution [11].

3. Methodology

This chapter mainly introduces the research background, research questions, and research methods of the paper.

With the rapid development of the world economy, issues related to resource utilization and environmental pollution are becoming increasingly prominent, such as climate warming, ozone layer destruction, and reduced biodiversity. These issues directly affect the survival and development of humanity and have attracted widespread attention from both domestic and international communities. How to effectively carry out production and achieve green economic development has become an important issue. At the same time, digital technology continues to develop, providing technical support for enterprises' green transformation.

The main research questions of this paper include: the main problems faced by enterprises in achieving green transformation, and the impact mechanism of the digital economy on the green development of enterprises. The research methods include literature analysis and data analysis. Based on the background of green economic development, this paper analyzes the development problems faced by enterprises, including four aspects: resource utilization, product research and development design, production and processing, and recycling. Based on the background of digital technology development, this paper provides a detailed introduction to the impact of digital technology on the green development of enterprises, including optimizing resource allocation, improving production technology, building information sharing platforms, optimizing the industrial structure and innovating environmental protection models.

4. Results and Discussion

4.1. Constraints On the Green Transformation of Enterprises

4.1.1. Resource utilization process

With the rapid development of the world economy and the intensification of competition in the international market, the problems of insufficient resources and low utilization rate of resources have become increasingly prominent. Enterprises are facing increasing pressure of resource cost. At the same time, how to make green

use of resources and improve the effectiveness of resource utilization has become an important issue faced by enterprises in green transformation.

First of all, enterprises need to rely on the support of advanced technology in order to utilize the resources in a green way, and most enterprises do not have such technical means and are unable to effectively use resources and transform them into green products. This is not only detrimental to improving the utilization of resources by enterprises, but also may cause pollution and damage to the environment. Secondly, talent and capital investment are an important prerequisite for the utilization of resources. However, small and medium-sized enterprises are unable to invest a large amount of funds in related professionals and equipment, which lead to low efficiency and poor effect in the process of resource utilization. This is not only to the

disadvantage of the green transformation of the enterprises in the use of resources, but also may exacerbate the waste of resources.

4.1.2. Product design process

In the process of product research and development, the main problems faced by enterprises in their green transformation are as follows.

Firstly, in the product design process, the selection of materials is crucial and has a significant impact on the usability and environmental friendliness of the product. How enterprises choose green, environmentally friendly, and recyclable materials correctly is an important issue that researchers need to consider. In the process of material selection, some companies are unable to fully evaluate and test various materials, and cannot obtain accurate experimental data on the usability and environmental impact of relevant materials. This may lead to incorrect material selection, resulting in cost loss, resource waste, environmental damage, and other issues, which is not conducive to research green products and promote the development for enterprises. Secondly, packaging is an important component of products and an essential aspect of green design. Enterprises need to choose environmentally friendly and recyclable packaging materials. However, the selection of packaging materials is also influenced by factors such as product attributes and resource costs, resulting in conflicts between green packaging and product availability. At the same time, product design also needs to consider the consumption of materials, and evaluate the product's service life and replacement frequency. In addition, product design also needs to comply with relevant laws and regulations to meet the requirements of environmental protection. This requires enterprises to continue to pay attention to domestic and international environmental trends, keep up with the times, and adjust product design plans in a timely manner.

4.1.3. Production and manufacturing process

Production equipment is an important tool for enterprises to produce products, but some enterprises are facing problems such as low efficiency and high pollution of production equipment. This may be due to the prolonged use of production equipment in some enterprises, leading to equipment aging and a decrease in production efficiency. Backward equipment technology is also an important reason for low productivity and environmental pollution in enterprises. Outdated equipment cannot adapt to new production needs, resulting in high resource consumption and serious environmental pollution during the production process. In addition, insufficient skills or improper operation by operators may also lead to equipment malfunctions and other issues.

In addition, there may be information asymmetry issues in the production process of enterprises. The enterprise has not established a comprehensive information sharing platform, and during the production process, relevant operators are unable to communicate efficiently. This may lead to the production of products that do not meet the requirements, resulting in large-scale resource waste, which is not conducive to the enterprise's green transformation and development.

4.1.4. Recycling process

With the increasing awareness of environmental protection, enterprises have begun to attach importance to the recycling and utilization of obsolescent products. However, enterprises

still face many problems in the process of recycling and utilization. Although some enterprises have begun to realize the importance of recycling, there are still some enterprises that do not realize the need to carry out environmental protection through the recycling and utilization of products and resources, in order to improve their market competitiveness, and promote green transformation.

At the same time, many enterprises are currently facing the problem of insufficient recycling channels. They do not have relevant technology to comprehensively collect and analyze information on recycling channels, and then determine appropriate recycling plans to effectively recycle resources. In addition, companies have not established a comprehensive information exchange and communication platform with consumers, so they cannot know the information of products that need to be recycled, and consumers are also unable to pass on the products to the company.

4.2. The Impact of Digital Economy on the Green Development of Enterprises

The technological means brought by the digital economy run through a series of links in enterprise development. The impact of digital economy on the green development of enterprises includes five main aspects: improving the effective utilization of resources, improving the efficiency and effectiveness of product design, reducing resource waste and environmental pollution, promoting effective recycling of products and optimizing the product structure of enterprises.

4.2.1. Improving the effective utilization of resources

The development of the digital economy is conducive to optimizing resource allocation, including natural and non natural resources.

Firstly, from the perspective of natural resources, the technological innovation and development brought about by the digital economy help enterprises fully understand the existence, distribution, and flow of natural resources in the world, so as to better develop and utilize natural resources based on their own development needs and environmental standards. Secondly, the deepening of digital technology application can also optimize the allocation of market resources. The development of digital platforms contributes to the flow of market factors, promotes the integration of online and offline resources, and greatly promotes the efficiency of resource allocation in factor markets. For example, the application of digital technology can reduce market information, communication and operational costs, promote cross regional flow of labor resources, effectively improve the utilization rate of labor resources, and also improve the matching rate of the labor market. Therefore, whether it is natural or non natural resources, the development of digitalization has significantly improved the utilization rate of resources by society and enterprises, reducing resource waste.

4.2.2. Improving the efficiency and effectiveness of product design

The development of digital technology is conducive to improving the efficiency and effectiveness of enterprises in product research and development. Firstly, digital technology and means are conducive to the product development team of enterprises clarifying their design goals better, including product positioning, goals, customers' requirements, etc. This is beneficial for the design team to better grasp relevant information, improve the accuracy and purpose of product

design. Secondly, the product development team can adopt more appropriate design methods. The team can conduct detailed integration, analysis, classification, and summary of the relevant information collected by digital technology which can help enterprises choose more suitable methods for product research and development.

At the same time, in the process of product research and development, there is inevitably resource waste and environmental pollution. The development of the digital economy has brought about 3D printing technology, big data, artificial intelligence, etc., which effectively help enterprises solve these problems. Product packaging is a part of product research and development. However, it is inevitable that some packaging materials may cause damage to the environment and do not align with the product positioning. Big data can help teams better match resource information with product information, and obtain the optimal choice through precise calculations. Artificial intelligence can help enterprises simulate the effects of designed products. The collected data can help teams adjust and optimize product designs, improve the competitiveness of products after entering the market. And 3D printing technology helps enterprises reduce the trial and error costs in product development. 3D printing can enable enterprises to achieve single product production. Compared to traditional processing technologies, the use of 3D printing also allows enterprises to avoid the production of a series of related parts, effectively reducing production costs. Meanwhile, 3D printing also shortens production time, which is beneficial for enterprises to shorten product development cycles.

4.2.3. Reducing resource waste and environmental pollution in production

Firstly, digital technology can help enterprises optimize their production processes. Digital technology can automate complex production processes, reduce manual intervention in the production process, and effectively reduce error rates. At the same time, digital technology can better analyze and calculate market data, help enterprises understand market demand and consumer preferences more accurately, and thus optimize product production. The traditional production process cannot respond to market demand in a timely manner and the production line is single. If adjustments are made, it will greatly affect the operation of the entire production line, inevitably leading to an increase in production costs and potential resource waste.

Secondly, digital technology can help enterprises optimize resource management. Through the construction of energy and resource management systems, enterprises can achieve real-time monitoring and make timely optimization plans for resources and energy consumption in the production process, thereby reducing the consumption rate of enterprises in the production process and reducing environmental pollution.

Thirdly, digital technology is also beneficial for enterprises to establish and improve information sharing platforms. This platform can effectively collect relevant data and information during the production process, avoiding the problems of overproduction or insufficient production caused by information asymmetry in various stages of production, thereby effectively improving production efficiency, reducing resource waste and environmental pollution.

Moreover, digital technology can also help enterprises achieve green procurement. Enterprises can have a more comprehensive understanding of whether the production processes of suppliers and manufacturers comply with

environmental standards, achieving a reduction in energy consumption and environmental pollution during the production process.

4.2.4. Promoting effective recycling of products

Firstly, the technology and related means brought by the development of the digital economy can help enterprises establish recycling information collection systems and product recycling systems. The recycling information collection system can help enterprises collect, integrate, and analyze products related data, understand which products can be recycled and reused, and which products need to be eliminated. The product recycling system can enable enterprises to retrieve and process products through multiple channels. At the same time, digital technology can also promote the development and utilization of online platforms by enterprises. For example, enterprises can publish information on product recycling and reuse, and consumers can understand the requirements, methods, channels, and other contents of product recycling through this channel. They can participate in the process of product recycling and effectively improve the product recycling rate.

Secondly, the development of the digital economy can also enable enterprises to innovate and upgrade recycling related technologies, effectively developing corresponding treatment methods based on different products, rather than simply destroying products.

4.2.5. Optimizing the product structure of enterprises

Currently, primary products still occupy a considerable share in China's product structure. However, it is often these primary products that are more prone to causing pollution and damage to the environment. Due to the serious environmental pollution and high energy consumption of these products, they have lost market share in the international market and are not competitive, which is not conducive to the development of enterprises towards green transformation and upgrading.

The impact of the digital economy on enterprises' product structure adjustment is mainly reflected in two aspects. Firstly, from the policy perspective, enterprises can use big data technology to collect information and adjust product types, quality, and quantity based on the green environmental standards of countries and regions around the world. Secondly, from the market perspective, the development of the digital economy can help enterprises expand their market scope. While consolidating the existing traditional market, enterprises can actively explore emerging markets, making the market scope of products more diversified. A diversified market can not only reduce a company's dependence on a specific market, reduce market risks, but also facilitate the development of more green products. Due to the differences in product demand between emerging markets and traditional markets, consumers have higher requirements for environmental protection. Therefore, enterprises will continue to move towards green development to meet market demand and consumer preferences.

5. Conclusion

The rapid development of the world economy inevitably causes pollution and damage to the environment. Under the influence of the concept of sustainable development, green development has become the main line of economic development in today's era. The green transformation and upgrading of enterprises is an important development path for sustainable development and maintaining market

competitiveness. With the development of the digital economy, the technological innovation and emerging means provide strong support for enterprises to achieve green development. This paper first analyzes the problems faced by Chinese enterprises in achieving green transformation. Meanwhile, this paper points out how the digital economy can drive enterprises to achieve green development. It is believed that digital technology drives enterprises to achieve green transformation and upgrading from the following five aspects: improving resource utilization efficiency, improving the efficiency and effectiveness of product research and development, reducing resource waste and environmental pollution in the production process, improving product recycling efficiency, and optimizing the product structure of enterprises. In short, digitalization runs through all aspects of enterprise development, helping enterprises effectively respond to environmental standards and effectively promote green development.

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