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Research on the Synergistic Innovation Logic and Mechanism Construction of Digital Transformation and Circular Economy

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Abstract: Currently, digital transformation and circular economy development face numerous challenges: insufficient in-depth integration between digital technology application and circular economy models, and imperfect data sharing and collaborative mechanisms, which restrict the improvement of resource utilization efficiency; in the digital transformation of traditional industries, the penetration of circular economy concepts is insufficient, and the momentum of green development has not been fully stimulated. Based on this, this paper deeply explores the internal logic, operation mechanism, and implementation paths of the synergistic innovation between digital transformation and circular economy. It aims to achieve the dual development of high-quality economic growth and ecological environmental protection through various strategies.

Keywords: Digital transformation; Circular economy; Synergistic innovation logic; Mechanism construction

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1. Introduction

The Implementation Guide for the Coordinated Transformation and Development of Digitalization and Greenization clearly points out that we should adhere to innovation as the primary driving force for development, break through traditional thinking and methods, actively explore new concepts, technologies, formats, and models in the coordination of digitalization and greenization, promote the all-round integration of digitalization and greenization, and accelerate the development of new quality productive forces; adhere to innovation as the primary driving force for development, break through traditional thinking and methods, actively explore new concepts, technologies, formats, and models in the coordination of digitalization and greenization, promote the all-round integration of digitalization and greenization, and accelerate the development of new quality productive forces; promote experience exchange and resource sharing through multilateral and bilateral open cooperation,

create an open and inclusive cooperative environment for digitalization and greenization, continuously strengthen international cooperation and mutual recognition in policies, standards, technologies, and talents for the coordination of digitalization and greenization, and expand new space for international exchanges and cooperation [1]. Higher vocational colleges should follow the path in line with national development in accordance with national policy documents to better cultivate talents.

2. Internal Logic of Synergistic Innovation Between Digital Transformation and Circular Economy

2.1. Compatibility of Value Pursuits

2.1.1. Synergistic Improvement of Economic Value

Digitalization mainly provides enterprises with more value and profits by using information technology to improve production efficiency and save operating costs; the circular economy achieves cost savings by maximizing resource utilization and recycling. The two complement each other, boosting high-quality economic development and maximizing economic value [2].

2.1.2. Joint Enhancement of Social Value

Social value refers to improving public services for people's livelihood through digital transformation, such as smart medical care and smart education, to promote social equity and progress; ensuring the sustainable supply of resources, reducing pollution, and improving people's quality of life through the circular economy. Digital transformation and the circular economy form a joint force, creating a good social environment and increasing more welfare for society [3].

2.1.3. In-Depth Integration of Environmental Value

Digitalization provides an information foundation for precise environmental monitoring and governance, and uses big data to predict environmental development trends to support environmental decision-making; the circular economy reduces the generation of pollutants and waste at the source, reducing pressure on the environment. The two can promote the continuous optimization of the ecological environment and green development [4].

2.2. Driving Nature of Technological Innovation

2.2.1. Digital Technology Empowering Circular Processes

Informatization and intelligence empower precise environmental monitoring and governance, providing big data analysis and prediction basis for environmental forecasting and decision-making; "low-carbon and circular" production saves resources and reduces waste emissions at the source of production, reducing ecological and environmental pressure. The coupling of informatization, intelligence, and circular economy promotes the continuous improvement of the ecological environment and creates green development.

2.2.2. Innovative Models Expanding Development Boundaries

The Internet empowers new economic forms such as the sharing economy and platform economy, providing directions for exploring innovative development of the circular economy [5]. Shared manufacturing can realize the sharing of production capacity and capabilities, reducing redundant construction and idle waste of resources; platform economy can coordinate and integrate resources upstream and downstream of the industrial chain,

promoting the coordination of the circular industrial chain.

2.2.3. Technology Integration Promoting Industrial Upgrading

The integration of digital technology and circular economy-related technologies has become a new technological system and innovative technology application. For example, the application of digital twin technology in the circular economy can simulate and optimize the circular economy process, improving the intelligence level and resource utilization efficiency in the circular economy process [6].

2.3. Guidance of Market Demand

2.3.1. Driven by Upgraded Consumer Demand

More and more consumers are changing their consumption concepts to protect the environment, and the demand for green and sustainable products is increasing. To meet the market demand for green products and achieve sustainable development, enterprises implement digital transformation and the circular economy to provide green products and services and enhance their own capabilities [7].

2.3.2. Market Competition Pressure Promoting Innovation

Facing increasingly fierce market competition, enterprises aim to reduce their own production costs, obtain more profits, and increase the differentiated competitive advantage of their products. They seek synergistic innovation of digital and circular economy models to find the optimal business model and production method and achieve their own sustainable development [8].

2.3.3. Industry Development Trends Leading the Direction

Digital transformation and the circular economy have become major trends in global industrial development [9]. Various industries have formulated relevant development strategies to promote the transformation of industries towards digitalization and greenization. Enterprises conform to industry development trends and carry out synergistic innovation, which helps them occupy a favorable position in future market competition [10].

3. Operation Mechanism of Synergistic Innovation Between Digital Transformation and Circular Economy

3.1. Resource Integration Mechanism

3.1.1. Integration and Sharing of Data Resources

Build information systems to collect internal and external enterprise-related data, such as enterprise production and operation data, market data, and environmental data, break the information barriers between various databases, realize data exchange and sharing between different databases, provide complete and accurate data support for circular economy decision-making, and optimize resource allocation [11].

3.1.2. Integration and Coordination of Technical Resources

Integrate digital technology and circular economy-related technologies, such as energy-saving technology, environmental protection technology, and resource recycling technology. Form technical integration advantages, carry out joint research and technical innovation, promote the upgrading and upgrading of circular economy technology, and improve the technical level of resource recycling.

3.1.3. Integration and Optimization of Industrial Resources

Promote the connection between the digital transformation and circular economy development of different industries, and promote resource sharing between industries. For example, the integration of manufacturing and service industries uses digital services to further enhance the value of manufacturing and the level of circular economy; the integration of agriculture and industry realizes the recycling of agricultural waste [12].

3.2. Interest Coordination Mechanism

3.2.1. Fair and Reasonable Interest Distribution

Establish a fair and reasonable interest distribution mechanism to clarify the rights and responsibilities of each participating subject in synergistic innovation. According to the investment, contribution, and risk-taking of all parties, reasonably distribute the interests brought by innovative achievements, and stimulate the innovation enthusiasm and initiative of all parties [13].

3.2.2. Improvement of Risk Sharing Mechanism

Construct a risk sharing mechanism to reasonably share technical risks, market risks, environmental risks, etc. that may be faced in the process of synergistic innovation. Reduce the innovation risks of all parties and enhance the confidence and determination of innovation by signing cooperation agreements and establishing risk funds [14].

3.2.3. Flexible and Diverse Incentive Mechanisms

Improve the incentive mechanism and give material and spiritual rewards to subjects that have made outstanding contributions to synergistic innovation. Set up innovation awards, provide promotion opportunities, and give equity incentives to stimulate innovation vitality and promote the continuous and in-depth development of synergistic innovation.

3.3. Innovation-Driven Mechanism

3.3.1. Technological Innovation Leading Development

Focus on the innovation of digital technology and circular economy-related technologies to promote the development of synergistic innovation. Increase investment in the research and development of key technologies, encourage enterprises to carry out independent innovation and integrated innovation, break through technical bottlenecks, and improve the technical level and core competitiveness of synergistic innovation [15].

3.3.2. Model Innovation Expanding Space

Actively explore new models and formats combining digital transformation and the circular economy. For example, carry out the construction of digital circular economy parks, promote green supply chain management models, and develop new formats integrating the sharing economy and the circular economy, expanding the development space and market areas of synergistic innovation.

3.3.3. Management Innovation Improving Efficiency

Introduce advanced management concepts and methods to optimize the management processes and organizational structure of synergistic innovation. Establish a flat and flexible organizational model to improve decision-making efficiency and response speed; adopt tools such as project management and knowledge management to improve the management level and efficiency of synergistic innovation.

3.4. Market-Oriented Mechanism

3.4.1. Market Demand Driving Innovation Direction

Taking market demand as the orientation, determine the key directions and fields of synergistic innovation between digital transformation and the circular economy. Deeply understand the characteristics and trends of consumers' demand for green and sustainable products, develop products and services that meet market demand, and increase market share.

3.4.2. Market Competition Promoting Innovation Upgrading

In the fierce market competition, enterprises continuously increase investment in digital transformation and the circular economy to promote innovation upgrading to improve their competitiveness. Improve product and service quality, reduce costs, and enhance market competitiveness through technological innovation, model innovation, and management innovation.

3.4.3. Market Feedback Optimizing Innovation Achievements

Establish a market feedback mechanism to timely collect feedback information from the market on synergistic innovation achievements. According to market feedback, optimize and improve products and services, improve the market adaptability and satisfaction of innovation achievements, and realize the continuous iteration and upgrading of innovation achievements.

4. Implementation Paths of Synergistic Innovation Between Digital Transformation and Circular Economy

4.1. Enterprise-Level Implementation Paths

4.1.1. Formulate Strategic Plans

Enterprises should incorporate the synergistic innovation of digital transformation and the circular economy into their long-term development strategic plans, clarify innovation goals, key tasks, and implementation steps. Combine their own actual situation to formulate personalized synergistic innovation plans to ensure the scientificity and feasibility of strategic plans.

4.1.2. Increase Technical Investment

Increase investment in the research and development of digital technology and circular economy-related technologies, establish R&D institutions or carry out joint R&D in cooperation with universities and scientific research institutions. Introduce advanced technologies and equipment to enhance enterprises' independent innovation capabilities and technical levels, and provide technical support for synergistic innovation.

4.1.3. Optimize Business Processes

Comprehensively optimize and upgrade enterprises' production, management, marketing and other business processes using digital technology. Realize the intelligence of the production process, the refinement of management, and the precision of marketing, improve enterprises' operational efficiency and resource utilization efficiency, and promote the development of the circular economy.

4.2. Industry-Level Implementation Paths

4.2.1. Build Industrial Ecology

Supported by digital technology, build an industrial ecosystem for the coordinated development of digital transformation and the circular economy. Integrate resources such as upstream and downstream enterprises, scientific research institutions, and service institutions in the industrial chain to form an industrial coordinated development pattern, and promote resource sharing and recycling between industries.

4.2.2. Create Industrial Platforms

Build a public service platform for the digital transformation and circular economy industry to provide enterprises with one-stop services such as technology R&D, achievement transformation, talent training, and market docking. Through platform construction, reduce enterprises' innovation costs and transaction costs, and improve the synergistic innovation efficiency of the industry.

4.2.3. Promote Industrial Agglomeration

Guide enterprises related to digital transformation and the circular economy to gather in industrial parks to form industrial cluster effects. Through industrial agglomeration, realize resource sharing, co-construction of infrastructure, centralized pollution control, etc., reduce enterprises' operational costs and environmental costs, and improve the overall competitiveness of the industry.

4.3. Regional-Level Implementation Paths

4.3.1. Formulate Regional Plans

Local governments should formulate regional plans for the coordinated development of digital transformation and the circular economy in combination with regional actual conditions. Clarify regional development goals, key industries, and spatial layout, guide resources to gather in key areas and fields, and promote the coordinated development of the regional economy.

4.3.2. Construct Infrastructure

Increase investment in the construction of digital infrastructure and circular economy infrastructure, such as 5G networks, data centers, sewage treatment facilities, and garbage classification and treatment facilities. Complete infrastructure provides hardware support for the development of digital transformation and the circular economy, and promotes the development of regional synergistic innovation.

4.4. National-Level Implementation Paths

4.4.1. Formulate National Strategies

Elevate the synergistic innovation of digital transformation and the circular economy to a national strategy, and clarify national development goals and key tasks. Formulate relevant policies, regulations, and development plans to guide the synergistic innovation of digital transformation and the circular economy nationwide, and promote the high-quality development of the national economy.

4.4.2. Strengthen Top-Level Design

Strengthen top-level design at the national level to coordinate the synergistic innovation work between various departments and regions. Establish a cross-departmental and cross-regional coordination mechanism, break

administrative barriers and interest barriers, and form a national synergistic innovation pattern.

5. Conclusion

The synergistic innovation of digital transformation and the circular economy is a key initiative to comply with the trend of the times and achieve a sustainable future. By deeply exploring the synergistic logic between the two and constructing a scientific and effective innovation mechanism, we provide new ideas for addressing resource and environmental constraints and cultivating new quality productive forces. In the future, it is necessary to continuously strengthen technology integration, policy guidance, and multi-party cooperation, let digitalization empower the circular economy, and let the circular economy expand application scenarios for digitalization, jointly moving towards a new journey of green prosperity.

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