

Research on the Development Path of Digital Transformation of Cangzhou's Rural Manufacturing Industry under the Background of Rural Revitalization

Zhen Zhang

Department of Mechanical Engineering, Hebei University of Water Resources and Electric Engineering, Cangzhou, 061000, China

Abstract

The in-depth integration of manufacturing digitalization and rural revitalization is crucial for coordinated regional development and common prosperity. Taking Cangzhou as the research object, this study focuses on manufacturing digitalization empowering rural revitalization, points out the lack of targeted integrated research, and analyzes its dilemmas: unbalanced digital infrastructure, insufficient industrial integration, shortage of digital talents, and imperfect data governance. It proposes practical pathways in four aspects: infrastructure, industrial integration, talent training and data governance. The study shows that manufacturing digitalization can foster a new industrial ecosystem to support rural revitalization, providing theoretical and practical references for Cangzhou and similar regions.

Keywords

Digital Transformation; Rural Manufacturing Industry; Rural Revitalization.

1. Introduction

The in-depth integration of the digital transformation of the manufacturing industry and the rural revitalization strategy has increasingly become a new trend in promoting coordinated regional development. Digital transformation can not only enhance the competitiveness of the manufacturing industry and the quality of economic development, but also drive the comprehensive progress of rural economy, society, ecology and culture, injecting new vitality into rural revitalization. Therefore, exploring how manufacturing digitalization empowers rural revitalization is of great significance for promoting regional industrial upgrading, advancing urban-rural integration, and realizing common prosperity. Based on this, this study will focus on the following three core issues: first, comprehensively analyze the current situation and dilemmas of the digital transformation of Cangzhou's manufacturing industry empowering rural revitalization; second, explore the practical paths of the digital transformation of Cangzhou's manufacturing industry empowering rural revitalization, so as to provide theoretical basis and practical guidance for relevant practices in Cangzhou and even the whole country.

2. Literature Review

2.1. Research on the Economic Consequences of Digital Transformation

Digital transformation is the core driving force for promoting the high-quality development of the manufacturing industry. Its core logic lies in integrating digital technologies and data resources to reduce system uncertainty, optimize resource allocation, and improve operational efficiency, thereby building new competitive advantages for enterprises [1]. From a micro perspective, digital transformation not only significantly enhances enterprises' ability to

respond to external risks, but also greatly improves production efficiency [2]. Studies have shown that digital transformation can strengthen enterprises' organizational resilience and market adaptability, which is specifically reflected in enterprises' rapid response to market fluctuations and dynamic adjustment of business models. In addition, integrating supply chains and production processes through digital means can effectively reduce enterprises' operational costs [3] and form more sustainable competitive barriers. From a macro perspective, the digital transformation of the manufacturing industry is not only conducive to restructuring the production paradigm of enterprises, but also provides key technical support and innovation momentum for the high-quality development of regional and national economies through the collaborative optimization of industrial chains [4], thereby promoting the upgrading of industrial structure and the transformation of economic development mode.

2.2. Research on the Rural Revitalization

As an important component of the national strategy, Rural Revitalization requires coordinated advancement across multiple dimensions including industrial, talent, cultural, ecological and organizational revitalization [5]. Among them, industrial revitalization is regarded as the core driving force and fundamental support for Rural Revitalization [6]. Its key lies in breaking through the single model of traditional agricultural production, promoting the in-depth integration of the primary, secondary and tertiary industries, thereby enhancing the value of the agricultural industrial chain and facilitating the diversified development of the rural economic structure [7]. In recent years, the implementation path of Rural Revitalization has shown significant transformation characteristics: it has gradually shifted from the traditional model of "leaving rural areas for factory jobs" to a new paradigm of "industry entering rural areas" and "digital empowerment" [8]. This transformation is largely driven by the widespread adoption of digital technologies, which has effectively diminished the reliance of industrial layout on geographical locations and laid a solid foundation for the settlement of modern industries in rural regions [9]. Meanwhile, the academic perspectives on rural revitalization have been continuously broadened, with emphases placed on the supportive roles of talent revitalization, cultural revitalization, ecological revitalization and organizational revitalization in the sustainable development of rural areas. Empirical studies demonstrate that rural revitalization entails establishing a multi-stakeholder collaborative participation mechanism, improving the policy support system, and strengthening supporting measures such as financial policies. Collectively, these factors form the theoretical basis and practical pathways for the all-round revitalization of rural areas [10].

In summary, although existing research has yielded fruitful achievements in the fields of digital transformation of the manufacturing industry and rural revitalization strategy, targeted studies that organically integrate the two and are grounded in the regional reality of Cangzhou remain scarce. In particular, there is a lack of systematic theoretical and empirical research on leveraging the advantages of manufacturing digital transformation to improve rural infrastructure, boost rural industrial upgrading, facilitate in-depth industrial integration, expand employment channels, and lead rural green development. In view of this, based on existing findings, this study focuses on the practical development of rural manufacturing in Cangzhou, and deeply analyzes the empowerment mechanism and realization paths of its digital transformation for rural revitalization, so as to provide new theoretical references and practical ideas for promoting coordinated regional development, deepening urban-rural integration, and steadily advancing common prosperity.

3. Current Situation & Dilemmas

3.1. Regional Imbalance in Digital Infrastructure

At present, there is still a significant gap between urban and rural areas in Cangzhou in terms of digital infrastructure and public service facilities. This is specifically manifested in problems such as unbalanced network coverage in rural areas, low penetration rate of Internet of Things (IoT) devices, and inadequate maintenance capacity of infrastructure. Such regional imbalance in digital infrastructure makes it difficult for rural areas to fully access the digital economic system, restricts the development process of agricultural industrialization, and prevents the characteristic agricultural economy from forming scale effects and agglomeration advantages, which has become the primary obstacle to the extension of digital manufacturing technologies to rural areas.

3.2. Insufficient Coordinated Development of Industrial Integration

The organic integration and development of the primary, secondary and tertiary industries in Cangzhou's rural areas has not yet been realized, and the cross-integration between the manufacturing industry and characteristic industries such as agricultural product processing and rural tourism is at a low level. The agricultural industrial chain is relatively short and shallow: most agricultural products still enter the market in their primary form, lacking deep processing and value enhancement links, resulting in low added value of agricultural products and limited room for farmers' income growth. Meanwhile, Cangzhou has an insufficient number of well-known agricultural product brands with national influence, and its brand premium capacity is in urgent need of improvement. To a certain extent, this restricts the effectiveness of rural industry empowerment through the digital transformation of the manufacturing industry.

3.3. Insufficient Supply of Digital Interdisciplinary Talents

Talent factor is the key support for enabling Rural Revitalization through the digital transformation of the manufacturing industry, yet Cangzhou is currently facing a structural dilemma in this regard. On the one hand, the limited comprehensive attractiveness of rural areas has led to the continuous migration of a large number of young and middle-aged rural laborers and highly competent personnel to urban areas. It is difficult for rural areas to form an effective talent attraction and retention mechanism, which continuously widens the talent gap for Rural Revitalization. On the other hand, the existing rural labor force generally has weak digital skills and is highly dependent on external professional and technical talents, while the coverage and depth of talent going to the countryside programs such as the "Digital Commissioner" initiative are still insufficient. The root cause is that traditional farmers have cognitive deviations towards digital transformation, prefer to rely on traditional experience for agricultural production, and have low acceptance and participation in digital transformation, making it difficult for digital knowledge and skills to be effectively diffused and applied.

3.4. Imperfect Data Sharing and Security Governance Mechanisms

High-quality digital resources have not yet fully sunk to the frontline of rural areas, which mainly stems from the following factors. First, agricultural production has significant complexity and diversity, and manufacturing enterprises often lack customized solutions for the agricultural sector, making it difficult to directly migrate some digital technologies originating from the industrial field to agricultural scenarios. Second, the data of various departments is still trapped in silos, with low efficiency of cross-departmental collaboration. Third, agricultural data lacks a unified standard system and security management mechanism. The Industrial Internet Platform and the Agricultural IoT System adopt different technical standards, which increases the technical difficulty of realizing data interconnection and

interoperability. Finally, in the process of extending to the agricultural field, manufacturing enterprises face risks such as data privacy protection and compliance management, which affect the sharing efficiency and application depth of data resources.

4. Development Paths

4.1. Improving Rural Digital Infrastructure and Building a Support System for Industrial Upgrading

Improving rural digital infrastructure is the prerequisite and foundation for enabling Rural Revitalization through the digital transformation of the manufacturing industry. First, it is necessary to accelerate the full coverage of new infrastructure such as 5G networks, Industrial Internet and IoT in farmland, agricultural product processing enterprises and agricultural parks. Meanwhile, we should strengthen the coordinated construction with traditional infrastructure such as transportation, logistics, energy and power, and establish a sound long-term operation and maintenance mechanism, so as to provide stable support for the digital transformation of rural industries. Second, the digital technology experience accumulated in the manufacturing industry can be effectively migrated to the agricultural production field. Through IoT sensor networks and data analysis technologies, we can realize precision irrigation, scientific fertilization and intelligent pest and disease control, and accelerate the popularization and application of intelligent agricultural machinery and equipment, so as to improve the efficiency and standardization level of agricultural production. Finally, through the large-scale application of manufacturing automation and intelligent technologies in agricultural product processing links, we can establish a whole-process digital management system from raw material procurement to product sales, and develop high value-added agricultural products based on market data analysis. This can realize the value increment and brand development of agricultural products, thereby driving the sustained increase of farmers' income and rural industrial upgrading, and providing systematic technical support for the implementation of the Rural Revitalization strategy.

4.2. Promoting the Integrated Innovation of Rural Industries and Building a Diversified Development Pattern

The digital transformation of the manufacturing industry provides strong technical support and innovation momentum for the diversified development of rural industries. Multi-dimensional industrial integration effectively activates the endogenous momentum of rural development, thereby building an industrial ecosystem with regional characteristics. With the in-depth application of digital technology in rural scenarios, the boundaries between the manufacturing industry and traditional industries such as rural cultural creativity and ecotourism are increasingly blurred, which opens up diversified development paths for Rural Revitalization. From the perspective of cultural and creative empowerment, manufacturing enterprises can make full use of digital design and intelligent manufacturing technologies to carry out innovative transformation and industrial development of traditional resources such as folk handicrafts and characteristic cultural symbols, so as to create cultural and creative products with both modern aesthetics and practical functions. This not only inherits the precious rural cultural genes, but also significantly enhances the market value and influence of rural culture. Meanwhile, from the perspective of spatial layout optimization, we can base on the industrial development strategy of Cangzhou, build digital industrial parks in rural areas with location and resource advantages, effectively attract urban manufacturing enterprises to extend their development to rural areas, and form a spatial pattern of coordinated development featuring "core driving, gradient transfer". Through the agglomeration effect and radiation function of industrial parks, we can drive the coordinated development of local agricultural product

processing, rural tourism and other related industries, and finally build a compound industrial ecosystem of "agriculture + manufacturing + service industry". This fundamentally improves the systematicness and added value of the rural economy, and provides diversified industrial support for the sustainable development of rural areas.

4.3. Building a Diversified Employment and Entrepreneurship System and Strengthening Rural Talent Training

Talent resources are the core support for enabling Rural Revitalization through the digital transformation of the manufacturing industry. The digitalization of the manufacturing industry provides a new path for rural talent development, and building a talent system matching the needs of rural development is of decisive significance for stimulating endogenous momentum. First, in terms of employment structure optimization, manufacturing enterprises can develop moderately labor-intensive manufacturing links based on rural resource endowments, create jobs matching the characteristics of the rural labor force, absorb surplus labor force and attract the return of new-generation migrant workers. In view of the structural gap between the skill requirements of digital production and the rural labor force, we should build a hierarchical and modular skill training system to promote the transformation of the rural labor force into modern industrial workers. Second, in terms of entrepreneurship ecosystem construction, it is necessary to establish a digital entrepreneurship support system, support rural residents to set up manufacturing enterprises through policy guidance and technical empowerment, provide full-cycle entrepreneurship training and market docking services, and reduce entrepreneurial risks. Finally, in terms of talent training innovation, we can build an online and offline integrated skill training platform through digital technology, cultivate interdisciplinary talents integrating "intelligent manufacturing + smart agriculture" in collaboration with universities and vocational colleges, and strengthen the cultivation of scientific and technological literacy of students in the basic education stage, so as to reserve long-term talent resources for Rural Revitalization.

4.4. Building a Data Governance System for the Integration of Agriculture and Manufacturing Industry

As a new type of production factor, data plays a fundamental and strategic role in enabling Rural Revitalization through the digital transformation of the manufacturing industry. Building a cross-domain integrated data governance system is crucial to improving the efficiency of data value release and realizing coordinated industrial development. First, we should formulate unified technical standards and data specifications for agricultural digitalization, establish a standardized data system covering the whole process of agricultural product production, processing and circulation, break the dilemma of "data silos", and lay a foundation for the migration of manufacturing digital technologies to the agricultural field. Second, we should build a platform for data interconnection and integration between the manufacturing and agricultural sectors, establish a cross-industry data aggregation and service system, promote data sharing and analytical application among enterprises, realize the orderly flow and value creation of data factors. Meanwhile, we should focus on data security and privacy protection, and explore mechanisms for data right confirmation, transaction and value evaluation. Finally, we should cultivate new formats of rural industries relying on integrated data resources, give birth to innovative models such as customized agricultural products, intelligent traceability systems and digital twin farms, and promote the transformation of rural industries from traditional factor-driven to innovation-driven development. At the same time, we should pay attention to the promotion of green manufacturing technologies, build a circular economic system through clean production, application of renewable energy and resource utilization of agricultural waste, so as to realize the coordinated improvement of economic and ecological benefits.

5. Summary

This study presents an in-depth analysis of the empowering effects of the digital transformation of Cangzhou's manufacturing industry in the context of rural revitalization. Through a systematic review of the challenges encountered in the digital transformation of Cangzhou's manufacturing sector, this research reveals the vital role of digital transformation in driving the high-quality development of the rural economy. Results show that the digital transformation of the manufacturing industry facilitates resource integration and technological innovation, cultivates a new type of integrated industrial ecosystem, and effectively supports the implementation of the rural revitalization strategy. In the future, it is suggested that efforts should be made to further optimize the construction of digital infrastructure, improve the industrial integration mechanism and the training system for interdisciplinary talents, thereby enhancing the overall efficiency of digital transformation and providing theoretical support and practical guidance for advancing the all-round revitalization of rural areas.

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