

Digital Economy Challenges and Strategies for Transforming and Upgrading Jilin Manufacturing Enterprises

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ABSTRACT

Against the backdrop of China's accelerating digital economy and the urgent need to revitalize traditional industrial bases, promoting the digital transformation of manufacturing enterprises is essential for high-quality regional economic growth. As a traditional manufacturing hub with a robust industrial foundation but lagging digital integration, Jilin Province faces a pivotal juncture of significant challenges and strategic opportunities. This study systematically investigates the primary constraints hindering this evolution, identifying key gaps such as insufficient digital infrastructure, limited technology application, a shortage of specialized digital talent, weak innovation capabilities, and a lack of coordination between government policy and enterprise execution. Grounded in a theoretical framework that integrates digital economy, industrial upgrading, and regional development theories, the research employs a mixed-methods approach—combining policy analysis, enterprise surveys, and in-depth case studies. To navigate these hurdles, the study proposes targeted strategies focused on strengthening digital infrastructure, fostering enterprise-level digital capabilities, and cultivating a composite talent pool of industrial and digital experts. Furthermore, it emphasizes enhancing innovation ecosystems and refining policy support and governance mechanisms. Ultimately, these findings provide practical, actionable policy implications for local decision-makers in Jilin, while offering a strategic reference for other traditional industrial regions striving to achieve a successful, digital-driven manufacturing transformation in an increasingly competitive global landscape.

Keywords: Digital Economy; Manufacturing Transformation and Upgrading; Digital Transformation; Regional Industrial Development; Jilin Province

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1. INTRODUCTION

The digital economy, driven by new-generation information technologies such as big data, cloud computing, artificial intelligence, and the industrial Internet, has become a core engine of global economic growth. In China, the digital economy has been elevated to a national strategic level, playing a key role in promoting industrial transformation and high-quality development. According to official statistics, the scale of China's digital economy has expanded rapidly since 2020, with industrial digitization accounting for an increasing share of economic output (National Bureau of Statistics of China, 2023).

Jilin Province, as an important manufacturing base in Northeast China, has long relied on traditional industries such as automobile manufacturing, petrochemicals, and equipment manufacturing. However, under the combined pressures of slowing economic growth, intensified interregional competition, and technological change, the traditional development model of manufacturing enterprises in Jilin Province has become increasingly unsustainable. Promoting manufacturing transformation and upgrading through the digital economy has therefore become an urgent task for both enterprises and policymakers.

"Made in China 2025" clearly sets out nine strategic tasks and priorities, emphasizing the enhancement of the country's manufacturing innovation capabilities and the deep integration of industrialization and informatization. This provides significant guidance for the comprehensive promotion of intelligent manufacturing and is of great significance for improving the internationalization level of the manufacturing industry. Currently, the digital economy has become an inevitable trend of the times, and intelligent, networked, and data-driven production and operation methods have become new highlights of economic development. In the era of the digital economy, digital resources have become key factors in improving the efficient production of manufacturing enterprises. The application of digital resources optimizes resource allocation in traditional manufacturing in aspects such as organizational operation, product production, and technological research and development, providing new opportunities for the transformation and upgrading of traditional manufacturing enterprises. To improve manufacturing quality and efficiency, it is necessary to rely on digital technology to promote the innovative development of manufacturing, achieve intelligent manufacturing by strengthening technological research and development and infrastructure construction, and enhance product performance and brand value. Therefore, under the background of the digital economy, the digital transformation and upgrading of manufacturing enterprises have become an urgent issue to be studied.

2. LITERATURE REVIEW

2.1 Digital Economy and Manufacturing Transformation

Existing studies widely agree that the digital economy enhances manufacturing competitiveness by improving production efficiency, reducing transaction costs, and fostering new business models. Digital technologies enable real-time data collection and intelligent decision-making, thereby reshaping production processes and organizational structures (OECD, 2020). Empirical research in China also confirms that industrial digitization significantly promotes productivity growth and technological upgrading in manufacturing enterprises (Zhang & Chen, 2021).

2.2 The connotation of digital transformation

The definition of enterprise digital transformation is a dynamic process that scholars continuously adjust and refine in theoretical research and practice. As the process of enterprise digital transformation advances and is implemented, this concept will also be constantly updated and refined. Digital transformation refers to the integration of digital technologies such as big data, cloud computing, artificial intelligence, and industrial internet into the production, management, and governance processes of enterprises (Vial, G, 2021). Digital transformation was first proposed by IBM, referring to the use of various digital technologies by enterprises, through processing methods such as big data and cloud computing, to integrate the data in the enterprise's production and operation processes and form valuable digital assets. It can be regarded

as a process of endowing commercial value, emphasizing the application of digital technologies in reshaping customer value and enhancing enterprise-customer interaction (Su Yanli,2023). With the deepening understanding of digital transformation, more and more scholars recognize that digital transformation is not only the use and iteration of digital technologies by enterprises, but also includes the digitalization of business interactions, value exchanges, and other business models (Chi Rengyong,2020).

Data plays a crucial role in digital transformation. By applying technologies and methods such as data capture, digital analysis, and algorithm processing, it promotes comprehensive innovation within enterprises and cultivates a data chain for data collection, analysis, and problem-solving. Based on data accumulation and circulation, the enabling effect of digital transformation is evident, steadily enhancing enterprise development (Chen Guoqing,2020). The changes in working methods, organizational structures, and even business models brought about by digital technology aim to optimize, innovate, and reconstruct the value system of enterprises (Mancuso,2023). Although digital transformation brings numerous benefits to enterprises, this process sometimes leads to a blind pursuit of performance gains at the expense of environmental protection and social responsibility (Shi Fuan,2023). A key aspect of digital transformation is the effective application of relevant elements in enterprise operations and management, which not only includes technological application but also the fundamental reorganization of enterprise strategy, business models, operational processes, and organizational structures (Li Jiateng,2024).

Many scholars have defined digital transformation from different perspectives. This article holds that digital transformation is a crucial corporate strategy. By leveraging digital technologies and tools, enterprises reshape or optimize their entire operational processes to maintain a competitive edge and enhance their development quality within the industry. This goal is not achieved overnight but through continuous exploration and adaptation.

2.3 The background of the transformation of manufacturing enterprises in Jilin Province

2.3.1 National level

In China, digital transformation has become a core component of the national development strategy. Government initiatives such as "Digital China", "New Infrastructure Construction", and "Action Plan for the Development of Industrial Internet" emphasize the integration of digital technology with the real economy to promote high-quality growth (Wu,Y.,2024). Empirical research indicates that digital transformation significantly improves enterprise performance by optimizing production efficiency, enhancing innovation outcomes, and strengthening market competitiveness (Wang,Y.,2024).

2.3.2 At the provincial level of Jilin

Jilin Province is located in the northeastern part of China and is a representative old industrial base in the country. Historically, heavy industry, automobile manufacturing, petrochemicals, and equipment manufacturing industries have all been concentrated there (Ban,Y.,2025). According to the "Statistical Bulletin of the National Economic and Social Development of Jilin Province in 2025", the province's GDP in 2025 was 1,497.388 billion yuan, with a year-on-year growth of 5.0%, ranking 26th among all provinces and municipalities in China. In traditional industrial bases like Jilin Province, enterprises are confronted with problems such as rigid structures, talent drain, and backward management systems (Zhu,X.,2023). Therefore, understanding how digital transformation affects enterprise performance and under what conditions it can succeed is of significant theoretical and practical importance.

Figure 1

Northeast China on the Map of China



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2.4 Industrial Upgrading Theory

Industrial upgrading theory emphasizes the transition from low value-added activities to high value-added ones through process, product, functional, and value-chain upgrading. Technological innovation and institutional support are considered key driving forces in this process (UNIDO, 2022). In the context of the digital economy, data has become a new production factor, accelerating the reconfiguration of manufacturing value chains.

2.5 Regional Perspective

Recent studies highlight that regional differences significantly affect the outcomes of digital transformation. Compared with coastal regions, traditional industrial bases such as Northeast China often face constraints related to talent shortages, rigid institutional systems, and weak innovation ecosystems (Liu & Wang, 2023). However, region-specific research on Jilin Province remains relatively limited.

3.0 Current Status of Manufacturing and Digital Economy in Jilin Province

3.1 Manufacturing Industry Structure

Jilin Province's manufacturing sector is characterized by a high concentration of traditional heavy industries, particularly automobile manufacturing and petrochemicals. Large state-owned and legacy enterprises dominate the industrial landscape, while small and medium-sized enterprises (SMEs) generally exhibit low technological intensity and limited innovation capacity.

3.2 Development of the Digital Economy

In recent years, Jilin Province has made progress in digital infrastructure construction, including broadband networks and data centers. However, compared with developed regions, the penetration rate of industrial Internet platforms and intelligent manufacturing systems remains relatively low. Digital technology application is often limited to isolated production links rather than integrated across the entire value chain.

3.3 Integration Challenges

The integration between the digital economy and manufacturing in Jilin Province is still at an early stage. Many enterprises lack systematic digital transformation strategies, and digital investment returns remain uncertain, which further constrains enterprises' willingness to transform.

4.0 Challenges Faced by Industrial Enterprises in Digital Transformation in Jilin Province

Jilin Province has played a crucial role in China's industrialization process. However, with the development of high-tech industries and the improvement of productivity in light industrial products, Jilin's traditional manufacturing industry once fell into a slump (Li, Y.,2022). Jilin Province is a significant old industrial base in China, with its industrial economy centered around traditional industries such as automotive manufacturing, petrochemicals, and equipment manufacturing. During the process of digital transformation, Jilin Province is confronted with multiple structural and phased challenges. The core pain points are concentrated at the foundational support level: the construction of digital infrastructure lags behind, the number of industrial internet platforms is insufficient and their functions are incomplete, cross-platform operability is poor, the digital transformation rate of traditional production equipment is low, and a large number of outdated devices lack digital interfaces, making it difficult to achieve digital control of the production process. At the same time, the local digital service ecosystem is incomplete, lacking professional technical service providers to offer customized solutions. Enterprises often encounter technical bottlenecks in areas such as industrial software application and data security protection. The shortage of talent also restricts the digital transformation of private enterprises in Jilin Province, manifested in the lack of high-end digital talents and the difficulty in retaining local technical workers.

In addition to insufficient basic support, the digital transformation of industrial enterprises in Jilin Province also faces deep-seated obstacles, especially in industrial collaboration and the external environment. In terms of the industrial ecosystem, the digitalization levels of enterprises in the upstream and downstream of the industrial chain are unbalanced, and there is a digital divide between core enterprises and small and medium-sized supporting enterprises. The lack of data sharing and collaboration mechanisms hinders the formation of the synergy effect of the industrial chain's digital transformation. Moreover, the deep integration of digital technology and industry is insufficient. In the external environment, the targeted policy support system is still not perfect, the digital asset property rights protection system is incomplete, and the market supervision mechanism is not adapted to the new business models brought about by digital transformation, further complicating and intensifying the challenges of transformation.

5.0 Analysis of the Problems in Promoting the Transformation and Upgrading of Manufacturing Enterprises in Jilin Province by Digital Economy

5.1 Lack of independent innovation capacity and core technologies

In recent years, Chinese manufacturing enterprises have developed rapidly, and traditional industrial enterprises have also shown strong momentum in economic growth. However, during the process of digital transformation, significant problems have been identified. In terms of independent research and development and technological innovation, they have lagged far behind the development of manufacturing enterprises' transformation. As a result, manufacturing enterprises in Jilin Province are overly dependent on other developed countries in many core technologies, which has led to a weak capacity for independent innovation and a significant reduction in the market competitiveness of their products. Fundamentally, the digital transformation of manufacturing enterprises is based on a weak foundation. Whether it is research and development capabilities, supporting facilities, or professional talents, all these factors have restricted the progress of core technology research and development in manufacturing enterprises. The digital economy relies on high-tech. If they fail to seize the next opportunity for economic growth, the transformation of manufacturing enterprises will become even more difficult. Therefore, it is necessary to grasp the challenges and opportunities of the digital economy era, accelerate resource investment and talent introduction, attach importance to the research and development of core technologies, and increase rewards for research and development, in order to better adapt to the development trend of the digital economy.

5.2 Data security issues are difficult to guarantee

The digital economy has brought many benefits to the sustainable development of enterprises, but data security has also become a difficult problem for them. As data centers cover many business strategies and internal secrets of enterprises, ensuring information security has become a key factor hindering the digital transformation of enterprises. Manufacturing enterprises in Jilin Province, if they want to transform through the digital economy, must be centered on the Internet and have a close connection with it, thus inevitably generating security issues. On the one hand, with the development of digitalization, there are various types of network viruses and ways to attack the network, and there is a lack of advanced technical means to defend against external intrusions. On the other hand, digital attack methods are difficult to trace their sources, have high concealment, and it is hard to find fundamental solutions. Moreover, information leakage can cause irreparable damage to enterprises. When manufacturing enterprises transmit, store and share data, the importance of data security is beyond doubt. Because manufacturing enterprises cover multiple processes, such as raw material procurement, product production, marketing, financial and non-financial data, once there is a data security issue in any link, it will leak the major secrets of the enterprise, thus causing irreversible losses and harm to the enterprise and its customers.

5.3 There is a shortage of talent in the field of digital transformation

The digital economy is developing rapidly within China, but there is a relative shortage of talents and experts proficient in digital transformation. Due to the scarcity of specialized training institutions for digital talents, there is a serious insufficiency in the reserve of digital transformation talents, especially within some key manufacturing industries, where the shortage of talents is even more pronounced. This has greatly restricted the integration and application of digital technologies by Chinese manufacturing enterprises. The personnel of most manufacturing enterprises are basically divided into ordinary workers, technical workers, and management personnel. There is a lack of high-level digital technology R&D talents, high-skilled product production talents, and high-level project management talents, especially the shortage of professional compound technical talents who are proficient in both information technology and production technology and management technology and can directly engage in the digital operation and management of manufacturing enterprises. The lack of a training and management system for high-tech and high-precision digital technology talents to some extent hinders the digital development of enterprises. Currently, China's 5G technology is in a leading position in the world, but it lags behind developed countries in new technologies such as big data, artificial intelligence, cloud computing, and the Internet of Things. Chinese manufacturing enterprises have abundant labor resources, but due to the shortage of digital talents, there are still many problems in data storage and transmission. How to ensure the safety and efficiency of enterprise information management has become a key issue.

5.4 Laws and policies lag behind the practical development of the digital economy

The country has successively formulated the "E-commerce Law" and the "Data Security Law", aiming to protect the legitimate rights and interests of individuals and enterprises, promote the development and utilization of data, and ensure data security. However, in the process of digital transformation, data has become a production factor, and the secure storage and efficient transmission of data have become crucial. How to strengthen the standardized management of digital centers and clarify the penalties and responsibilities for data crimes and other related issues still need to be further improved.

In terms of policy support, the promulgation and implementation of documents such as the "Guiding Opinions on Actively Promoting the 'Internet Plus' Action" and "Made in China 2025" have provided certain policy guidance for digital transformation. However, the policies lack personalized provisions, and most of the methods for integrating digital technology with business processes in manufacturing are general. Digital transformation is a long-term and continuous process, and it faces the risk of personnel unemployment due to transformation failure. Currently, the government departments lack a complete top-level design for these possible risks, and the intensity of supporting funds still needs to be enhanced.

6.0 Countermeasures and Suggestions for the Transformation and Upgrading of Manufacturing Enterprises in the Context of the Digital Economy

6.1 Increase investment in and support for scientific research

Under the background of the digital economy, the key to promoting the digital transformation and high-quality development of manufacturing enterprises lies in science and technology. Therefore, it is necessary to accelerate the technological innovation and research and development of manufacturing enterprises. First, attach importance to the innovation of products and core technologies. Increase the investment and support for scientific research, and integrate digital technologies such as big data, the Internet, and artificial intelligence into various production and management processes to promote the rapid integration and development of the digital economy and manufacturing enterprises. Second, attach importance to the construction of informatization. On the basis of emphasizing research and development, continuously strengthen the development of information system basic platforms and gradually improve them in line with the actual development of enterprises, laying a solid foundation for the transformation and upgrading of manufacturing enterprises. Only by closely integrating the digital economy and information technology departments, production departments, management departments, financial departments, and some important business processes to meet the actual operational needs of enterprises can we better promote the research and development of core products and the improvement of self-innovation capabilities of enterprises, thereby achieving the innovation of enterprise production and operation activities through high-tech. Finally, make full use of the existing policy incentives and financial support. China has taken the digital economy as an important national development strategy. Under the policy support, some industrial Internet platforms have achieved large-scale commercialization, not only providing favorable resources for the digital configuration of manufacturing enterprise production and operation processes, but also providing guarantees and support for accelerating the intelligent production of manufacturing.

6.2 Attach great importance to the construction of data security

For manufacturing enterprises, the construction of data security is extremely crucial, as it serves as a powerful guarantee for ensuring stable business operations and maintaining market competitiveness. It can be seen from China's strategic orientation that the country attaches great importance to the construction of data security and places it in a core position. On this basis, relevant departments should still strengthen the intensity of network supervision, ensure the secure storage and transmission of manufacturing enterprises' data, and increase the punishment for malicious data leakage and crack down on illegal activities. From the perspective of enterprises, first of all, they should attach importance to the construction of information security human resources, cultivate data analysts and information security analysts through holding lectures and sending employees for external training, and enhance employees' awareness of data security prevention. Secondly, they should strengthen the construction of data security infrastructure, promote the improvement of data security defense systems, and prevent external hacker attacks by introducing advanced domestic and foreign data firewalls. At the same time, they should encourage enterprises to independently develop data security defense software, protect data centers by using high-tech data encryption methods, complex programming and algorithms. In each business process, they should also set the scope of system login rights and responsibilities to prevent data leakage caused by unauthorized operations. At the same time, they should do a good job in data backup to reduce the losses caused by accidental data loss to the enterprise.

6.3 Strengthen the cultivation of digital talents

In the era of digital economy, the talents that society needs are no longer single professional talents, but high-end compound talents who are proficient in big data analysis and master the integration of data and industries. In terms of digital technology talent cultivation, the government, schools and enterprises should all increase the efforts in talent cultivation. At the enterprise level, they should strengthen cooperation with research institutions and training institutions, regularly provide digital technology training for their management personnel and production technicians, and promote the construction of digital innovation teams, digital demonstration bases and talent training platforms. They should also introduce advanced digital talents through various recruitment methods to inject new vitality into the digital development of enterprises. The state should also provide certain support for the cultivation of digital talents in terms of policies and funds, and guide enterprises to build practical and effective social training platforms and digital talent cultivation

mechanisms through measures such as system guidance and tax reduction. In terms of talent cultivation in colleges and universities, each university should improve the talent cultivation model of school-enterprise cooperation, set up big data-related courses according to their own professional characteristics, and improve the professional talent cultivation plan according to the talent standards required by enterprises, so as to provide more high-quality and high-level compound talents in digital technology for society.

6.4 Improve relevant laws, regulations and policies to promote digital transformation

Manufacturing enterprises need to adapt to the trend of digital demand and develop in the direction of platformization, networking, intelligence and service orientation. Currently, the digital transformation of the manufacturing industry has entered a more pragmatic stage. It is necessary to accelerate the improvement of laws and regulations to provide a good legal environment for manufacturing enterprises. First of all, the state should promptly introduce relevant legal preferential terms to encourage the digital transformation of the manufacturing industry. The funds and risks that manufacturing enterprises need to face in the process of transformation and upgrading are huge. On the one hand, the government can reduce the tax burden of enterprises through tax reduction and additional deductions, and also provide low-interest loans to enterprises that meet the transformation conditions. Secondly, as the digital economy continues to develop, legislative protection work should also be continuously updated. The legislative department should constantly improve the legal protection system, increase the punishment for illegal infringement, further improve legal provisions, and add operational guidelines and application guidelines to ensure the smooth progress of digital transformation.

As the integration of industrialization and informatization in our country continues to improve, the manufacturing industry should pay more attention to its own digital transformation. During the process of manufacturing transformation, the government has played a very crucial role. Therefore, the government should introduce guiding policies related to the development plan of the big data industry, mainly providing support and guarantee in aspects such as platform construction, facility provision, network security, and demonstration promotion, to assist manufacturing enterprises in building an information infrastructure and offer support for subsequent updates, renovations, and application promotion. At the same time, in light of the actual development of enterprises, it should provide matching funds for top-level design and talent reserves, make strategic and directional plans and layouts for the transformation and upgrading of the manufacturing industry, and introduce relevant financial preferential policies to solve the problems of enterprise financing difficulties, talent shortages, and worker unemployment. With the continuous integration of the digital economy and the real industrial sector, and the improvement of digital production management levels, employees engaged in repetitive work may face unemployment. The government should implement proper placement measures for laid-off employees. At the same time, it should improve the construction of the vocational education system, enhance the talent innovation awareness of enterprises and training institutions, encourage on-the-job employees of enterprises to receive digital skills training, and increase support for the cultivation of compound innovative talents in key industries.

7.0 CONCLUSION

To meet the practical demands of digital transformation for manufacturing enterprises in Jilin Province in the era of digital economy, this paper analyzes the background and challenges of the transformation and upgrading of manufacturing enterprises in Jilin Province. The digital transformation and upgrading of manufacturing enterprises is an inevitable trend. Enterprises should combine their own advantages, increase investment in scientific research and support, attach importance to the construction of data security, strengthen the cultivation of digital talents, and fully utilize the support of national laws and policies to actively promote the effective integration of industrialization and digitalization, add vitality to the quality improvement and efficiency enhancement of traditional manufacturing, and hope that the research in this paper can provide effective references and suggestions for the digital transformation and sustainable development of traditional manufacturing enterprises.

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