

Research on the Upgrading Path of Value Chain and Competitiveness Enhancement of Qingdao Manufacturing Enterprises under the Background of Digital-Intelligent Economy

Lina Chen¹, Lianjie Sun^{2*}

¹Qingdao City University, Qingdao 266106, Shandong, China

²Qingdao Jimo District No.1 Vocational Secondary School, Qingdao 266200, Shandong, China

**Author to whom correspondence should be addressed.*

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: With the rapid development of science and technology, the digital-intelligent economy has become a highly important direction in current social and economic development. In the process of the scientific and technological revolution and industrial transformation, it has formed a model supported by data as the core production factor and the collaboration of digital and intelligent technologies, driving the manufacturing industry to transform toward intelligence and networking. As an important manufacturing base on China's eastern coast, Qingdao has established a sound and systematic manufacturing industrial system. However, it still faces certain problems in the digital-intelligent transformation, which directly affect the integrity of the value chain and the sustainability of competitiveness improvement of Qingdao manufacturing enterprises. Therefore, starting from the current development status of Qingdao manufacturing enterprises, this paper deeply analyzes the significance of improving the value chain upgrading level and competitiveness of manufacturing enterprises under the background of digital-intelligent economy, and systematically discusses the effective paths for value chain upgrading and competitiveness enhancement of Qingdao manufacturing enterprises in this context, hoping to provide new ideas for the high-quality development of Qingdao's manufacturing industry.

Keywords: Digital-intelligent economy; Qingdao manufacturing enterprises; Value chain upgrading; Competitiveness enhancement

Online publication: June 3, 2026

1. Introduction

Guided by the in-depth integration of big data, artificial intelligence and Internet of Things technologies, the manufacturing industry has shifted from the traditional model to a new form based on data and intelligent algorithms. The digital-intelligent economy has gradually become a core engine driving the transformation

and upgrading of the global economy, and has reshaped the production and organizational models of various industries to a certain extent. As the core carrier of the real economy, the manufacturing industry can effectively enhance its own value and competitiveness through the integration of digital and intelligent development. Qingdao has become a key node connecting the Bohai Rim Economic Circle and the Yangtze River Delta Economic Circle in China, and its local manufacturing industry has become a pillar industry for economic development. Nevertheless, with the rapid development of the digital-intelligent economy, its manufacturing enterprises still lag behind advanced domestic counterparts in relevant aspects. Against this background, a systematic study on the value chain upgrading paths and corresponding competitiveness enhancement strategies of Qingdao manufacturing enterprises under the digital-intelligent economy can effectively support the high-quality development of Qingdao's manufacturing industry.

2. Current development status of Qingdao manufacturing enterprises

At present, Qingdao manufacturing enterprises are at a critical stage of promoting the in-depth integration of the digital-intelligent economy and industrial upgrading. Based on the city's industrial foundation and geographical advantages, the manufacturing industry has shown an overall trend of stable traditional advantageous industries and comprehensive advancement of digital-intelligent transformation^[1]. From the overall development trend of the industry, there are still certain problems in the development of manufacturing enterprises. Some enterprises remain in the initial stage of transformation without realizing the in-depth integration of technology and business. Small and medium-sized enterprises are insufficient in mining, integrating and applying data elements, making it difficult for them to improve the quality of each link in the value chain through data-driven approaches. In addition, some enterprises still adhere to the traditional manufacturing model, which easily leads to serious product homogeneity. This not only affects the future development of enterprises, but also makes them lack competitiveness in the R&D of high-end products and breakthroughs in core technologies. Meanwhile, the synergy and linkage between enterprises are weak, the efficiency of resource integration along the industrial chain is low, and an efficient and collaborative digital-intelligent industrial production state has not been formed^[2].

3. The significance of improving the value chain upgrading level and competitiveness of manufacturing enterprises in the background of the digital-intelligent economy

3.1. Breaking the dilemma of low-end lock-in in the value chain and enhancing enterprise value creation capability

In the traditional economic model, most manufacturing enterprises rely heavily on low-cost labor and resource input to carry out production, mainly engaging in low-end value chain links such as processing and manufacturing. These links feature low added value and narrow profit margins, easily trapping enterprises in the dilemma of low-end lock-in and hindering sustainable development^[3]. Guided by the digital-intelligent economy, the emergence of new technologies provides new support for the value chain upgrading of manufacturing enterprises. Digital-intelligent technologies can penetrate and transform all links of the value chain, including R&D and design, production and manufacturing, brand operation and after-sales service, enabling enterprises to break the traditional production layout and upgrade their value chains to the high-end^[4]. The application of digital-intelligent technologies can also help enterprises optimize existing R&D and design processes, such as shortening R&D cycles and reducing R&D costs, so as to improve the technical content and innovation of products.

3.2. Adapting to the trend of industrial transformation and enhancing enterprise market competitive advantage

With the rapid development of modern information technology, digital-intelligent transformation is constantly reshaping the competitive landscape of the manufacturing industry. The market has shifted from traditional price competition and product competition to technology competition and innovation competition^[5]. Therefore, in the new era, consumers' demands are trending toward personalization, diversification and intelligence, putting forward higher requirements for product quality, performance and services. However, the production and service models of traditional manufacturing enterprises can hardly adapt to the changing market demands. Thus, by upgrading the value chain and enhancing their own competitiveness, manufacturing enterprises can deeply integrate digital-intelligent technologies into the whole process of production and operation, continuously optimize production and service models, make their products accurately match consumer demands, and maximize the adaptability of products and services^[6]. In addition, technological and model innovation can foster new competitive advantages to solve the problem of homogeneity in traditional market competition. Meanwhile, a synergistically developed industrial ecosystem can be built on this basis to fully integrate resources along the industrial chain, thereby continuously improving the risk resistance and market competitiveness of manufacturing enterprises. For Qingdao manufacturing enterprises, they face competition from advanced domestic manufacturing enterprises and pressure from global industrial competition. Only by accelerating the upgrading of their existing value chains and enhancing core competitiveness can they gain a firm foothold in the fierce market competition and ultimately consolidate and improve their industrial status^[7].

3.3. Promoting high-quality development of the manufacturing industry and supporting the implementation of the manufacturing powerhouse strategy

For the real economy, the manufacturing industry is the core of sustained development, and it also effectively drives high-quality economic development, playing a crucial role in realizing the manufacturing powerhouse strategy. As micro entities of the manufacturing industry, the value chain upgrading and competitiveness enhancement of manufacturing enterprises are directly related to the overall development level of the manufacturing industry^[8]. Under the background of a digital-intelligent economy, promoting the value chain upgrading and competitiveness enhancement of manufacturing enterprises can transform the manufacturing industry from the traditional development model to an economic and intelligent one. This new direction can optimize and upgrade the industrial structure of the manufacturing industry, and continuously improve the overall quality and efficiency of the manufacturing industry^[9]. Meanwhile, the integration of new technologies plays a positive role in fostering new industries, new business forms and new models. The deep integration of digital-intelligent technologies and the manufacturing industry can also integrate digital industrialization and industrial digitization into the enterprise development system, continuously activating new drivers for the development of the manufacturing industry.

4. Effective paths for value chain upgrading and competitiveness enhancement of qingdao manufacturing enterprises under the background of digital-intelligent economy

4.1. Deepening the integrated application of digital-intelligent technologies and promoting intelligent upgrading of all links in the value chain

Promoting the in-depth integration and application of digital-intelligent technologies is an important way for

Qingdao manufacturing enterprises to accelerate industrial upgrading and competitiveness enhancement. It can not only improve the overall development quality of the manufacturing industry, but also break the constraints of the traditional production model. Therefore, relevant enterprises should actively guide the penetration of digital-intelligent technologies into all links of the value chain, including R&D and design, production and manufacturing, brand operation and after-sales service, so as to drive the intelligent upgrading of the entire production chain^[10]. In R&D and design, Qingdao manufacturing enterprises should further increase investment in digital-intelligent technologies, integrate big data, artificial intelligence, virtual simulation and other technologies into production, build a digital R&D platform, and incorporate global R&D resources to ensure efficient utilization of resources in R&D and design. This will maximize the shortening of R&D cycles, reduce corresponding R&D costs, and continuously improve the technical content and innovation of enterprise products^[11].

Based on large industrial models on industrial Internet platforms, Qingdao enterprises can also break through data constraints in the R&D link, forming a more complete R&D system from perception and thinking to self-optimization, thus effectively promoting the transformation of the R&D model from traditional experience-driven to data-driven. In the production and manufacturing link, Qingdao enterprises need to accelerate the construction of smart factories and digital workshops, carry out intelligent transformation of existing production equipment and realize their interconnection. This will ensure the docking with new technologies such as industrial robots, digital twins and intelligent sensors, and gradually promote the automatic and intelligent management of the production process^[12]. The application of these new technologies can also help enterprises further optimize existing production processes, improve corresponding production efficiency, effectively reduce production costs and maximize product quality. Meanwhile, enterprises can learn from the intelligent reform experience of advanced enterprises, integrate the mature practices of intelligent production plan scheduling and real-time production process monitoring into their own optimization, and realize the optimal allocation of production resources. Finally, in the brand operation link, Qingdao enterprises can use big data, artificial intelligence and other technologies to collect and deeply analyze current market demands and consumer preferences. This enables enterprises to build a targeted digital marketing system, improve product quality while promoting the precise and diversified development of brand communication, thus better enhancing brand influence and market recognition. Based on digital platforms, corresponding support can be provided for the international development of enterprises or brands, laying a solid foundation for enterprises to expand global market space in the follow-up.

4.2. Improving the collaborative innovation system and strengthening technical and talent support for value chain upgrading

For Qingdao manufacturing enterprises to achieve value chain optimization and competitiveness enhancement, relevant enterprises need to carry out collaborative innovation, build a new enterprise development system, integrate the innovation system led by enterprises and coordinated by industry-university-research-use into the follow-up development plan, and continuously strengthen technological innovation and talent support. Specifically, in terms of technological innovation, Qingdao manufacturing enterprises should further increase investment in core technology R&D, focus on key areas of the integration of digital-intelligent technologies and manufacturing, and also pay attention to weak links in enterprise development. They should carry out targeted R&D in different directions, aim at breaking through core technology bottlenecks, and continuously improve their independent innovation capabilities. Meanwhile, it is necessary to strengthen cooperation between enterprises, universities and research institutions to maximize the transformation and application of

scientific research achievements, and deeply integrate technological innovation with industrial development^[13]. In addition, in terms of talent training, Qingdao manufacturing enterprises should establish and improve the training and introduction mechanism of digital-intelligent talents. While increasing the training of interdisciplinary talents, they should focus on cultivating professionals who master both manufacturing technology and digital skills. In cooperation with universities and vocational colleges, the order-based talent training model should be adopted to enable relevant colleges to deliver the required digital-intelligent talents to enterprises in a targeted manner. This can not only meet the needs of enterprise transformation and development, but also further improve the talent incentive mechanism to attract more outstanding digital-intelligent talents, thus continuously enhancing enterprise and talent competitiveness^[14].

4.3. Optimizing value chain layout and building a synergistically developed industrial ecosystem

In the current layout, Qingdao manufacturing enterprises should base their own industrial advantages and continuously optimize the value chain layout. While promoting the high-end extension of the value chain, attention should also be paid to guiding small and medium-sized enterprises to get rid of dependence on low-end processing and manufacturing. This enables the entire industrial development system to focus on higher-value links such as R&D and design, brand operation and service appreciation, which can also effectively improve the overall value of the value chain^[15]. For example, based on advantageous industries such as Qingdao's home appliances and electronics, automobile manufacturing and marine engineering equipment, industrial clusters can be built to realize in-depth cooperation among upstream and downstream enterprises in the industrial chain, forming an industrial development pattern led by leading enterprises and supported by small and medium-sized enterprises, thus promoting resource sharing and complementary advantages among enterprises.

Specifically, leading enterprises should play their leading role by building a digital collaboration platform, providing an excellent model for upstream and downstream small and medium-sized enterprises in their transformation, helping them complete digital-intelligent transformation smoothly and ensuring the smooth upgrading of the industrial chain. Small and medium-sized enterprises should also take the initiative to integrate into the industrial chain development system in this process, focus on segmented fields, and take building professional and refined competitive advantages as the main development direction, so as to achieve common development with leading enterprises.

5. Conclusion

The rise of the digital-intelligent economy has provided new opportunities for the development of various industries. For manufacturing enterprises, the upgrading of the value chain and enhancement of competitiveness are inseparable from the guidance of the digital-intelligent economy trend, which also puts forward higher requirements for the industrial upgrading of the manufacturing industry. Therefore, guided by this background, promoting the value chain upgrading and competitiveness enhancement of Qingdao manufacturing enterprises can not only effectively get rid of the dilemmas in enterprise development, but also achieve high-quality development and truly implement the optimization and upgrading of Qingdao's manufacturing industrial structure.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Wei SG, Wei QQ, 2025, Research on the Impact of Digital-Intelligent Development on Manufacturing Enterprise Performance — A Mechanism Test Based on Value Chain. *Science & Technology and Economy*, 38(01): 21–25.
- [2] Liu J, 2025, Research on the Influence Mechanism of Enterprise Intelligent Transformation on Enterprise Value, thesis, North Minzu University.
- [3] Zhou YC, Jiang HM, 2024, Discussion on the Transformation, Upgrading and Development Strategies of Manufacturing Enterprises under the Digital Economy. *Marketing*, (15): 83–85.
- [4] Shang YY, 2024, Research on the Innovation Mechanism of Manufacturing Enterprise Business Model Driven by Data Empowerment, thesis, Xi'an University of Technology.
- [5] Ding HY, 2024, Research on the Path and Mechanism of Digital Innovation Driving Green Development of Manufacturing Enterprises, thesis, Central South University.
- [6] Xiang XQ, 2024, Research on the Impact of Digital-Intelligent Transformation on Value Chain Cost Management of Manufacturing Enterprises, thesis, Zhejiang Gongshang University.
- [7] Long YJ, 2024, Research on the Influence Mechanism of Digital Business Strategy on the Operational Efficiency of Manufacturing Enterprises, thesis, Jilin University.
- [8] Luo JQ, Hu YM, 2025, Research on Value Creation of Digital-Intelligent Empowered Service Innovation in Manufacturing Enterprises. *Computer Integrated Manufacturing Systems*, 31(04): 1396–1407.
- [9] Han YH, 2024, Research on the Influence Mechanism of Digital-Intelligent Empowerment on Organizational Quality Reform of Intelligent Manufacturing Enterprises, thesis, Liaoning University of Technology.
- [10] Shi ZW, 2023, How Does Digitalization Empower Servitization of Manufacturing Enterprises?, thesis, Dongbei University of Finance and Economics.
- [11] Zhang Y, 2023, Research on the Realization Mechanism of Digital Transformation of Traditional Manufacturing Enterprises Based on “Cognition-Behavior-Performance”, thesis, Northeastern University.
- [12] Li JW, 2023, Research on the Realization Mechanism of Digital-Intelligent Empowered Service Value Creation in Equipment Manufacturing Enterprises, thesis, Northeastern University.
- [13] Wang ZY, 2023, Research on the Mechanism and Path of Digital-Intelligent Empowerment for Value Enhancement of Manufacturing Industry, thesis, Changzhou University.
- [14] Jing X, 2023, Empirical Research on Value Drivers of Service-Oriented Manufacturing Enterprises, thesis, Hebei University of Science and Technology.
- [15] Zhong YS, 2023, Research on the Impact of Digital Transformation on Value Creation of Manufacturing Enterprises, thesis, Southwestern University of Finance and Economics.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.