Research on the Path of Industrial Intelligence Promoting the Upgrading of Manufacturing Industry

Wenhao Liu[1,a], Delong Han[2,b *], Mengmeng Sun[3,c], Qianlong Liu[4,d]

{lwh15552590056@163.com[a], handl@sdas.org[b], 2531412102@qq.com[c], liuql@sdas.org[d]}

Key Laboratory of Computing Power Network and Information Security, Ministry of Education Shandong Computer Science Center (National Supercomputer Center in Jinan), Qilu University of Technology (Shandong Academy of Sciences), Jinan, China[1,2,4]
Shandong Provincial Key Laboratory of Computer Networks, Shandong Fundamental Research Center for Computer Science. Jinan, China[2]
Qilu University of Technology (Shandong Academy of Sciences), Jinan, China[3]

Abstract. With the deepening development of a new round of global technological revolution and industrial transformation, the new generation of information technology is constantly breaking through. At the same time, the international environment is becoming increasingly complex, and competition in technology and industry is becoming more intense. Currently, China has shifted to a stage of high-quality development and is in a critical period of transforming its development mode, optimizing its economic structure, and transforming its growth momentum. As an important manufacturing province in China, Shandong has a complete range of industries and a complete structure. However, there are also constraints such as outdated traditional industries, surplus low-end manufacturing, and insufficient technological innovation. Therefore, promoting the digital and intelligent transformation and upgrading of the manufacturing industry has become an inevitable choice for industrial development. This article studies the current situation and practical difficulties of industrial intelligence empowering the development of the manufacturing industry, explores paths suitable for the upgrading of Shandong's manufacturing industry, and has certain reference value for promoting the intelligent transformation and high-quality development of Shandong's manufacturing industry, and accelerating the construction of an advanced manufacturing strong province.

Keywords: Industrial Intelligence, Manufacturing Industry, Industrial Upgrading, Shandong Province.

1 Introduction

Industrial intelligence is an important lever to promote the high-quality development of the manufacturing industry [1]. This article provides an in-depth analysis of the current status of the upgrading of the manufacturing industry in Shandong Province. In response to the existing problems such as cognitive biases in the industrial internet, insufficient network infrastructure construction, insufficient digital transformation of manufacturing enterprises, and a lack of high-end composite talents, policy recommendations are proposed from the perspectives of infrastructure, industrial structure, and talent cultivation, It can provide important reference for promoting the digital transformation and high-quality development of Shandong province's manufacturing industry.

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2 The development status of the manufacturing industry in Shandon -g Province empowered by industrial intelligence

In order to explore the path of upgrading the manufacturing industry, it is necessary to conduct the research on the current development status of the manufacturing industry in Shandong Province. The research mainly focuses on four aspects: government policies, digital empowerment construction, industrial internet platform construction, and scientific and technological innovation.

2.1 Strong support from top-level policy planning

In March 2023, the Department of Industry and Information Technology of Shandong Province issued a notice on the issuance of the 2023 Action Plan for "Empowering Shandong with Industry", emphasizing the breakthrough of promoting the digital transformation of the manufacturing industry, coordinating the construction of networks, platforms, applications, and other systems, deeply implementing the "Empowering Shandong with Industry" special action, accelerating the large-scale application of industrial internet, and promoting the construction of national industrial internet demonstration zones to a new level.

2.2 The degree of digital empowerment continues to deepen

At this point, the transformation and upgrading of the manufacturing industry in Shandong Province has moved towards a wider range [2].

In terms of network facilities, a total of 162000 5G base stations have been built, achieving continuous coverage of 5G networks in urban and county areas of 16 cities, and establishing a deterministic network of 5600 kilometers nationwide; Two national level internet backbone direct connection points, Jinan and Qingdao have been built, to become the only "dual hub" province in China; Accumulated construction and operation of 38 secondary nodes for industrial internet identification resolution, access to 21 national top-level nodes, and identification resolution volume exceeding 36 billion times; Twelve cities, including Zaozhuang, Jining, and Weihai, were selected as the national "gigabit cities", ranking second in terms of quantity in China.

In terms of data centers, the total number of various data centers in Shandong has reached 210, and the number of standard racks in use has exceeded 240000; In April 2022, China Mobile (Jinan, Shandong) Data Center and Taian Zhengtu Data Center were selected as the first batch of national new data centers.

In terms of IoT terminals, Shandong has over 130 million IoT terminal users, with over 164 million IoT terminals and the highest access traffic in the country; The first 5G network in China to fully cover high-speed railways and smart highways has been built, with a 100% coverage rate of ETC lanes on highways; The number and application level of the first provincial 5G power demonstration network terminals in China are leading, and the 5G smart grid has achieved full coverage in 16 cities.

2.3 Maintain a leading position in platform construction and application

In terms of platform construction, four national level cross industry and cross domain industrial internet platforms have been cultivated, including Cosmoplat, Inspur Yunzhou, Uniorange, and Bon-cloud, accounting for 1/7 of the national total; National level platforms have been approved to build such as Jinan Qingdao Artificial Intelligence Innovation Application Pilot Zone and Shandong Peninsula Industrial Internet Demonstration Zone; A total of 29 platforms have been selected as national level characteristic professional platforms, and 23 platforms including Jier Machine-Tool Group Co.,Ltd have been selected as innovative pilot application cases of the Ministry of Industry and Information Technology.

In terms of platform application, as of 2022, cosmoplat has developed into a mass customization solution platform, creating a total of 15 industry ecosystems, empowering 12 regions across the country and more than 20 countries worldwide; 23 industrial internet application enterprises, including Jier Machine-Tool Group Co.,Ltd and Qingdao Doublestar, were selected for the 2021 list of 140 industrial internet platform innovation and pilot application cases; Promote 115 provincial-level platforms to delve into enterprise sites, accumulate industry knowledge, cultivate over 700 provincial-level pilot demonstration projects, form over 4000 digital transformation solutions, serve more than 500000 small and medium-sized enterprises in the province, and establish a leading multi-level and systematic industrial internet development system in China; Build 11 industrial internet parks [3].

2.4 Significant enhancement of technological innovation capability

In terms of innovation carriers, during the 13th Five Year Plan period, Shandong has cultivated a total of 53 national technology innovation demonstration enterprises, 24 national industrial design centers, 15 provincial-level manufacturing innovation centers, and 1581 "one enterprise, one technology" research and development centers. As of 2020, Shandong has 198 national enterprise technology centers, ranking first in China; There are 18203 national technology oriented small and medium-sized enterprise libraries, ranking third in China, 225 technology enterprise incubators, and 419 maker spaces.

In terms of traditional technological transformation, since the 13th Five Year Plan, 60% of Shandong Province's 10 trillion yuan industrial investment has been invested in traditional technological transformation. Industrial enterprises above designated size have implemented over 70000 technological transformation projects with an investment of over 5 million yuan, and completed technological transformation investments of over 3 trillion yuan.

In terms of technological achievements output, a large number of major technological breakthroughs with independent intellectual property rights and breaking foreign monopolies have been achieved, such as Weichai Group releasing the world's first commercial diesel engine with a thermal efficiency exceeding 50%, becoming a leader in the diesel engine industry, marking a new level of technological innovation capability for Shandong enterprises.

In terms of tackling key core technologies, during the 13th Five Year Plan period, more than 4000 provincial-level technological innovation projects were implemented annually. Major technologies such as high thermal efficiency diesel engines, large stamping machine tools, adiponitrile preparation, and high-speed maglev transportation systems that broke foreign monopolies and filled domestic gaps achieved breakthroughs. Key technologies such as heavy-

duty commercial vehicle powertrain and front wheel drive 8-speed automatic transmissions won the first prize of the National Science and Technology Progress Award.

3 The dilemma of industrial intelligence empowering the upgrading of manufacturing industry in Shandong province

3.1 Cognitive bias towards industrial internet

Some grassroots government departments and enterprises in Shandong have relatively backward development concepts, and there are cognitive biases in their understanding, implementation path, and development direction of the industrial internet.

From the perspective of the government, many grassroots government officials have simplified and fragmented their understanding of the industrial internet, without a deep understanding of the enormous opportunities for industrial internet to innovate production, organizational forms, and business paradigms.

From the perspective of enterprises, many companies still have a limited understanding of the industrial internet, such as purchasing automation equipment and using ERP (Enterprise Resource Planning) and MES (Manufacturing Execution System) software. There is still a significant gap in connecting and utilizing the entire process data of design, development, production, sales, etc.

3.2 Network infrastructure and platform construction still need to be strengthened

Firstly, the application of the "5G+ Industrial Internet" scenario is insufficient. The biggest bon-cloud in the 5G era is the industrial internet, and in the future, 80% of 5G applications will be used for the IoT, especially the industrial internet. However, over 60% of the existing 5G applications are in the field of daily consumption, and it is urgent to penetrate the production and manufacturing fields. Secondly, the construction of identification resolution nodes needs to be accelerated. Identification resolution nodes are the "data cornerstone" of the industrial internet and belong to national strategic resources. Shandong must firmly grasp the window period of secondary node construction. Thirdly, the platform construction and service capabilities urgently need to be improved [4]. The first mover advantage of major industrial internet platforms in Shandong is no longer obvious.

3.3 Obstacles to digital transformation of manufacturing enterprises

At first, Shandong is a major province in industries such as metallurgy and chemical engineering, with large enterprises, complex processes, and numerous equipment, making digital transformation more difficult. Next, the transformation highlights "personalization" and increases the difficulty of digital transformation. In the process of digital transformation, not only do different industries have different transformation paths, but even the transformation plans of different enterprises in the same industry cannot be fully replicated, and there is a greater need for "personalized customization". Again, many safety concerns affect the enthusiasm for renovation. Most companies are concerned about the leakage of their production data, customer relationships, and other trade secrets after connecting to industrial internet

platforms built by other companies. This concern has become the main obstacle for companies to "dare not transfer".

3.4 Shortage of high inter-disciplinary talents in the manufacturing industry

In the manufacturing industry, there is a "talent dilemma", especially a lack of high inter-disciplinary talents in research and development and application fields.

In the first place, the industrial structure does not match the needs of young people. The main business income of Shandong is mostly from resource-based industries, such as the light industry, chemical industry, machinery, etc., which does not match the demand of the computer communication manufacturing industry favored by young people.In the next place, there is a lack of super-strong cities and insufficient talent absorption. Thirdly, the industry lacks attractiveness and salaries lack competitiveness. The research environment and resource allocation of large projects in enterprises are often inferior to those of research institutions, and high-end technical and R&D talents tend to go to universities and research institutes.

4 Suggestions and implementation paths for industrial intelligence e mpowerment and upgrading of manufacturing industry

4.1 Strengthen the construction of new infrastructure and enhance resource allocation capabilities

Fully leverage the advantages of "new infrastructure" such as 5G and industrial internet in cultivating new driving forces, to promote the transformation and upgrading of the manufacturing industry.

First, accelerate the construction progress of 5G base stations, support the integration and development of 5G with vertical industries such as industry, healthcare, education , and the Internet of Vehicles, deeply promote various vertical applications, and build a good ecosystem for industrial integration and innovative development. Secondly, focus on strengthening the construction of industrial internet platforms, vigorously supporting the development of two national "double cross" platforms, Haier and Inspur, promoting the joint construction of sub platforms with industry chain owners to rapidly expand scale and enhance strength.

4.2 Promote the transformation and upgrading of small and medium-sized enterprises

Promoting the transformation and upgrading of small and medium-sized enterprises is of great significance for promoting the high-quality development of manufacturing industry.

One is to focus on the intelligent transformation of production equipment in small and medium-sized enterprises, increase financial investment in technological transformation of small and medium-sized enterprises, guide and support enterprises to increase technological transformation and equipment updates. Encourage small and medium-sized enterprises to increase investment in research and development. The second is to build and improve a digital service platform for small and medium-sized enterprises, promote digital products and services that are suitable for the needs of small and medium-sized enterprises, and support small and medium-sized enterprises to improve efficiency and efficiency through digital transformation.

The third is to select a group of intelligent manufacturing enterprises around key industries, summarize experience, set benchmarks, and leverage the exemplary and leading role of large enterprises and leading enterprises to demonstrate their capabilities

4.3 Optimize the level of industrial structure

First, promote the high-end upgrading of high energy consuming industries such as steel, refining, coke, cement, tires, and chemicals, based on environmental protection, safety, technology, energy consumption, and efficiency standards [5]. Afterward, consolidate the leading position in advantageous industries, focusing on key industries such as textiles and clothing, food, paper making, chemical engineering, building materials, steel, and non-ferrous metals, comprehensively improving the modernization level of traditional advantageous industries, and accelerating the extension to the mid to high end of the industrial value chain. In the next part, promote the integration and cluster development of strategic emerging industries, focusing on new generation information technology, artificial intelligence, biotechnology, new energy, new materials, high-end equipment, green environmental protection and other fields, and striving to build new industry development pillars that support a strong manufacturing province. Finally, lay out future industries, focusing on fields such as life sciences, quantum information, genetic technology, future networks, deep-sea and aerospace development, hydrogen energy and energy storage, and accelerating the promotion of innovative breakthroughs and integrated applications, forming new growth points for the development of the manufacturing industry, and making the future industry a pioneer in the high-end upgrading and transformation of old and new driving forces in Shandong's manufacturing industry [6].

4.4 Cultivating composite industrial intelligence talents

Firstly, improve policies related to talent recruitment and education, encourage outstanding high-end talents from overseas in the digital field to return to China, and accelerate the introduction of cross-border talents in key areas of the digital economy. The second is to promote the digital and intelligent transformation of vocational training, strengthen the professional setting of combining artificial intelligence, digital technology, and manufacturing, support vocational colleges and enterprises to jointly build training bases, and cultivate "digital" new blue-collar workers. The third is to accelerate the implementation of the integration of the four chains of "talent chain, education chain, industry chain, and innovation chain", coordinate and promote the construction of talent teams such as entrepreneurs, business management talents, technological innovation talents, outstanding engineers, great country craftsmen, and high skilled talents.

4.5 Enhance industrial innovation capabilities and promote high-end development of the manufacturing industry

One is to strengthen the construction of industrial common technology platforms for basic and cutting-edge fields in the manufacturing industry, promote provincial-level manufacturing innovation centers that meet the conditions to strive for national level centers, and accelerate the integration and agglomeration of innovation resources. Afterwards, accelerate the action of promoting the hierarchical cultivation of technology-based enterprises, and create a hierarchical cultivation system for technology-based small and medium-sized enterprises, high-tech enterprises, and technology leading enterprises. Support technology leading enterprises to lead

the formation of innovation consortiums and increase the coverage of research and development institutions in large and medium-sized enterprises. In the end, strive to create a batch of high-end comprehensive platforms that integrate technology research and development, talent gathering, achievement transformation, and entrepreneurship incubation, providing technical platform support for the high-end upgrading of Shandong's manufacturing industry.

4.6 Accelerate the work of ensuring essential factors

One is to strengthen top-level design and build a policy and institutional system for the deep integration of industrial intelligence technology and manufacturing. The second is to strengthen financial and tax support. Based on the summary of the implementation effect of the "Enterprise Cloud" policy, new support policies should be proposed as soon as possible, and special support funds should be established to accelerate the development of industrial internet, guiding enterprises in digital transformation and upgrading [7]. The third is to actively create conditions to participate in the formulation of global intelligent manufacturing standards, closely focus on research in the fields of basic standards, key technology standards, and industry application standards, and strive to cultivate local suppliers of comprehensive intelligent manufacturing solutions, continuously enhancing their participation and discourse power globally.

5 Conclusions

Through the above research, it can be found that a great progress has been made in digital empowerment in Shandong Province. However, there are still many difficulties in upgrading the manufacturing industry, which are mainly reflected in the cognitive biases in the industrial internet、 insufficient sustained construction of network infrastructure and platform、 difficulties in digitizing manufacturing industry and shortage of high-end composite talents.

In response to the challanges, this article proposes corresponding improvement suggestions in six aspects. In terms of infrastructure construction, strengthen the construction of new infrastructure fields such as 5G and industrial internet. In the area of enterprise cultivation, promote the transformation and upgrading of small and medium-sized enterprises. In the field of industrial structure and layout, promote the transformation of old industries, the development of new industries, and the layout of future industries. In the way of talents, accelerate talent introduction and cultivate a group of high-tech talents. On the score of innovation and high-end development, enhance technological progress and innovation, cultivate new enterprises, and create a comprehensive technology platform. In terms of guarantee, increase the guidance of government, the finical support of policy, the construction of standardization system.

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