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Research on countermeasures of high quality development of high-tech enterprises in Shandong Province under the double-cycle pattern

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Abstract: *Under the new situation, Shandong Province needs to accelerate the pace of high-quality development of high-tech enterprises, and the double-cycle pattern provides new opportunities for the high-quality development of high-tech enterprises in Shandong Province. The government of Shandong Province actively cultivates and supports high-tech enterprises, but there are still some problems in high-tech enterprises, such as insufficient innovation driven force and ability, imperfect innovation ecology, and lack of core driving engine, which restrict the high-quality development of high-tech enterprises. This paper analyzes the development status and existing problems of high-tech enterprises in Shandong Province, such as the low proportion of technical personnel, the less R&D investment, the limited financing of high-tech enterprises, and the lack of scientific research institutions of high-tech enterprises. Through the analysis of the causes of the problems, the precise solutions to the problems such as brain drain and insufficient R&D investment are proposed, which has great theoretical and practical significance for the high-quality development of high-tech enterprises in Shandong Province.*

Keywords: *Double-cycle pattern, high-tech enterprises in Shandong Province, current situation and problems, development countermeasures*

1. Introduction

In March 2022, the Ministry of Science and Technology formulated the "*Key Points of the Torch Center of the Ministry of Science and Technology in 2022*", and the high-quality development of high-tech enterprises has become the theme of the development of the times. In recent years, Shandong Province government has strengthened the cultivation, guided the increase and enlarged the enterprise group of high-tech enterprises, but it still faces the challenges of insufficient innovation power and ability, imperfect innovation ecology, and lack of core driving engine. Based on this, this paper constructs the countermeasures for the high-quality development of high-tech enterprises in Shandong Province under the dual-cycle pattern. It has great practical and theoretical significance.

2. The background and purpose of the research

Under the new situation, Shandong Province needs to speed up the high quality development of high-tech enterprises. In recent years, unilateralism and protectionism have risen, the trade disputes between China and the United States has escalated, and the impact of the epidemic has made the external situation for the development of high-tech enterprises in China grim. This situation, for the development of high-tech enterprises, is not only a challenge but also an opportunity. It is necessary to find out the countermeasures under the current environment. The dual-cycle pattern provides a new opportunity for the high-quality development of high-tech enterprises in Shandong Province, and has a significant impact on improving the development resilience, enhancing their competitiveness and promoting their high-quality development. As the main body of scientific and technological innovation, high-tech enterprises are the backbone of technological innovation, and the high-quality development of high-tech enterprises is crucial to the high-quality development of economic society. The government of Shandong Province actively cultivates and supports high-tech enterprises, but there are still some problems in high-tech enterprises, such as insufficient innovation power and ability, imperfect innovation ecology, and lack of core driving engine, which restrict the high-quality development of high-tech enterprises[1]. Based on the above background, this paper systematically constructs the high-quality development countermeasures

ISSN 2616-5783 Vol.7, Issue 9: 42-49, DOI: 10.25236/AJHSS.2024.070908

of high-tech enterprises in Shandong Province under the dual-cycle pattern, which is not only conducive to the high-quality development of high-tech enterprises in Shandong Province, but also conducive to the implementation of the dual-cycle strategy and promote the high-quality economic and social development of Shandong Province.

3. The connotation of high-quality development of enterprises under the new development pattern of double-cycle

3.1 Connotation of the new double-cycle development pattern

In recent years, the world's new generation of information technologies, including big data, the Internet of Things and artificial intelligence, has developed rapidly. Coupled with the pandemic, a number of new technologies, new business forms and new models have been spawned, affecting the development of many aspects of the world. After the pandemic, the development model of economic globalization has gradually shifted to a regional and nearshore development model, and the development of regions including Europe, East Asia and North America will be mainly internal cycle[2]. The tension between China and the United States has become the biggest uncertain factor curbing the development of our science and technology, and the external environment of our country is changing, which lays the realistic conditions for the proposal of a new development pattern of "double-cycle"[3].

The research results of China's economic circulation mode are abundant. On the basis of these research results, the transformation of China's domestic economic cycle model is divided into three stages. The first stage is dominated by domestic cycle (1949-1978). In this stage, China's industrial foundation is weak, the level of economic development is low, and it is in the period of planned economy. In this period, our country built the domestic circulation system; The second stage mainly focuses on international circulation (1978-2020). After 1978, in order to develop the national economy, we implemented the policy of reform and opening up, and promoted the open coastal areas of our country to participate in international exchange and competition. In this stage, our country joined the WTO and gradually integrated into the global economic system. The third stage established the domestic and international double cycle (2020-present), driven by the impact of the international environment and the new business forms and new technologies under the pandemic situation, China has entered the domestic and international double cycle stage.

The domestic and international double cycle pattern is based on the domestic cycle, combined with the international cycle to build a complete internal and external linkage of China's economic cycle model[4]. The core is to expand domestic demand, is to open up the domestic and international cycle, better use of domestic and international resources, to achieve high-quality development. First, the double cycle pattern pays more attention to domestic demand, so it is based on the domestic market, and the domestic economic cycle is the main part[5]. Second, to focus on domestic circulation is not to return to seclusion, but to fully tap domestic demand, open up the domestic and international circulation, and make full use of both domestic and international resources[6]; Third, the double-cycle new development pattern is actually serving the high-quality development of the economy, and has a strong dependence on the development of high-tech, so the development of high-tech enterprises is of great significance to the double-cycle new development pattern[7][8].

3.2 Connotation of high quality development of enterprises under double cycle pattern

High-quality development is clearly put forward in the "19th National Congress", in view of the lack of research on quality factors and quality phenomena of economics, the lack of research on quality for a long time in the past. In recent years, a wealth of research results have been formed around high-quality development. Based on these research results, the connotation of high-quality development can be expounded from three different levels: macro, meso and micro(Table1). First of all, from the macro level, no matter from the perspective of political economy or the new development concept, the connotation of high-quality development always revolves around the economy, politics, society, culture and ecology, emphasizing the coordinated development of economic benefits, social benefits and ecological benefits, and improving the efficiency of various production factors under the existing conditions of a country to meet the needs of the people for a better life[9][10]. From the middle perspective, most scholars focus on the efficiency of industrial development, overall technical ability and innovation ability. From the micro level, scholars explore the characteristics of high-quality development of enterprises and summarize the state and mode of high-quality development of enterprises[11].

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Table 1: High quality development connotation for enterprises

Research perspective	Representative study	Concept
Macro level	He Lifeng (2018) Lin Zhaomu (2019) Zheng Fei et al. (2021)	Economic, political, social, cultural and ecological, perspectives, emphasizing the coordinated development of economic, social and ecological benefits, improving the efficiency of various production factors under the existing conditions of a country, and meeting the needs of the broad masses of the people for a better life
Meso-level	Zhang Junkuo (2018) Han Lei, Zhong Jingfu (2021) Zhang Tao (2020)	The efficiency of industrial development, overall technical capacity and innovation capacity
Micro level	Stead(2000) Liu Yingqiu (2018) Tian Qiusheng (2018)	It has perfect and efficient management and governance mechanisms, innovation-driven development, high resource allocation efficiency, quality products and services, and outstanding financial performance.

In summary, by combing the new development pattern of double cycle and the connotation of high-quality development of enterprises, this topic defines the connotation of high-quality development of high-tech enterprises under the new development pattern of double cycle:

(1) The high quality development of high-tech enterprises should have the ability of technological innovation. High-tech enterprises have strong research and development capabilities and technological innovation capabilities, and can continuously introduce scientific and technological achievements with independent intellectual property rights, and master the key to core technologies[12]. This kind of technological innovation promotes the transformation of high-tech enterprises from simply pursuing growth speed to pursuing quality and efficiency, helps to enhance the competitiveness of enterprises, and can also promote the technological progress of the entire industry.

(2) The high quality development of high-tech enterprises should have profitability. Enterprises pursue the maximization of benefits as the goal. High-tech enterprises need high investment, long return cycle. Compared with other industries, their expectation to obtain high income is also high[13]. High-tech enterprises with technology and property rights advantages and high total factor productivity, the formation of a strong attraction to the market, can be successful in the development of new technologies, new products into production, in order to obtain higher returns.

(3) The high quality development of high-tech enterprises should be open. The current technological environment is ever-changing, the development of new technologies has changed from decentralized and independent to penetrative cooperation, and there is correlation and interdisciplinary integration between high and new technologies, which promotes the innovation paradigm from close to openness[14]. It is difficult for high-tech enterprises to realize technological innovation and maintain competitive advantage only by relying on internal R&D activities, so they must change their thinking and seek suitable enterprises for innovation cooperation from the outside as much as possible, to obtain technical resources and ideas for technological innovation, and make up for their lack of technical capabilities, thus improving the efficiency of technological innovation and reducing innovation risks.

(4) The high quality development of high-tech enterprises should have environmental protection function and sociality. With the increasingly prominent environmental problems, the social awareness of environmental protection and sustainable development has gradually increased, and the practice of social responsibility is a supplement and perfection of financial value investment, and has a positive impact on the performance and investment results of high-tech enterprises. High-tech enterprises need to adapt to this trend, master cutting-edge technologies, achieve economic development. At the same time, they need to avoid excessive damage to the environment, and assume social responsibilities such as creating jobs and driving regional development.

4. Development status and problems of high-tech enterprises in Shandong Province

In order to master the development status, problems and reasons of high-tech enterprises in Shandong Province, this paper analyzes the data of "*China Torch Statistical Yearbook*" and sorts out the development status of high-tech enterprises in Shandong Province. It is found that the development of high-tech enterprises in Shandong Province has achieved good results in recent years. By 2021, the

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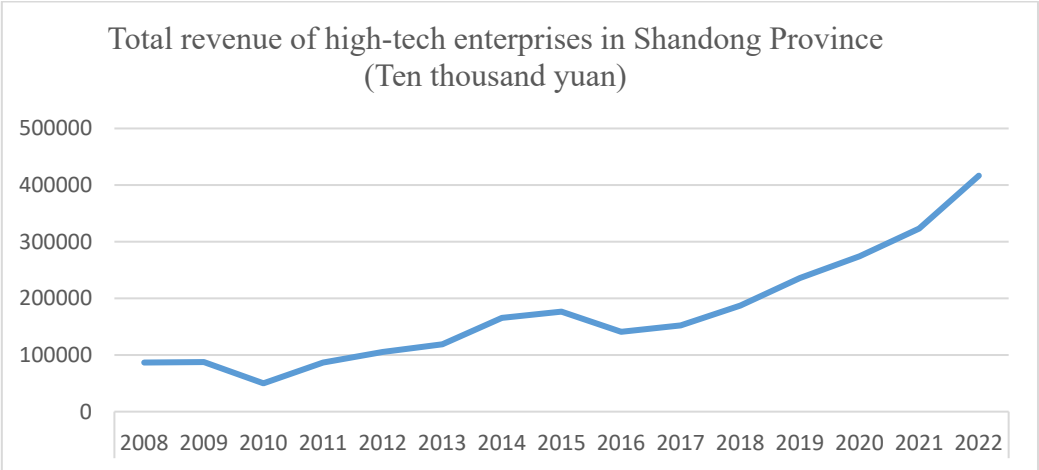
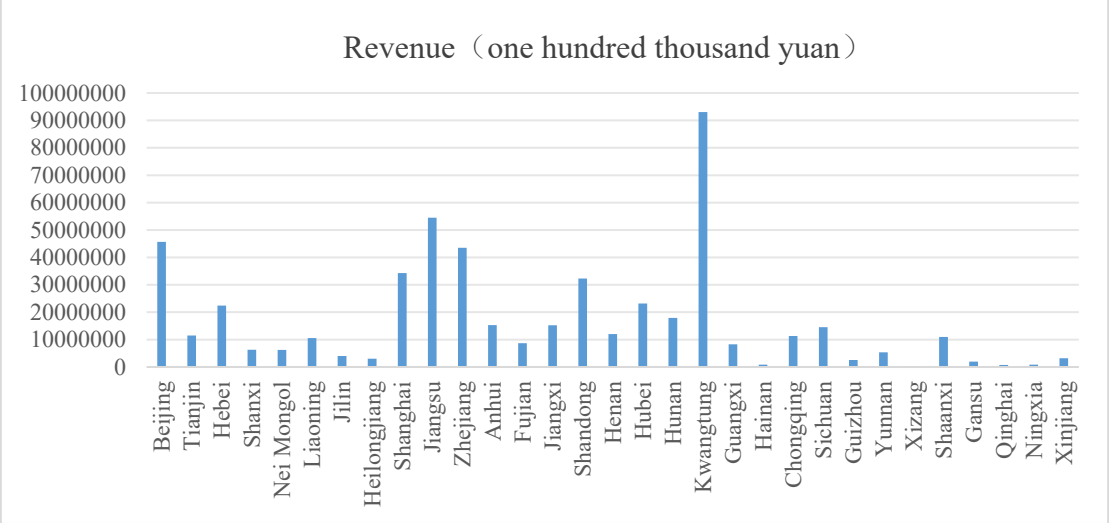
number of high-tech enterprises in Shandong Province has reached 14,560, employing 2,290,047 people (including 4,265 returnees, 1,110 resident foreigners and 1,132,786 college graduates), with an operating income of more than 3.23 trillion yuan and an internal R&D expenditure of 71.8 billion yuan.

4.1 The benefits of high-tech enterprises continues to improve rapidly, but there is still a big gap with developed areas



Note: The chart is made based on the Chinese Torch Statistical Yearbook

Figure 1: Total revenue of high-tech enterprises in Shandong Province 2008-2022



Note: The chart is made based on the Chinese Torch Statistical Yearbook

Figure 2: Revenue of high-tech enterprises by region in 2022

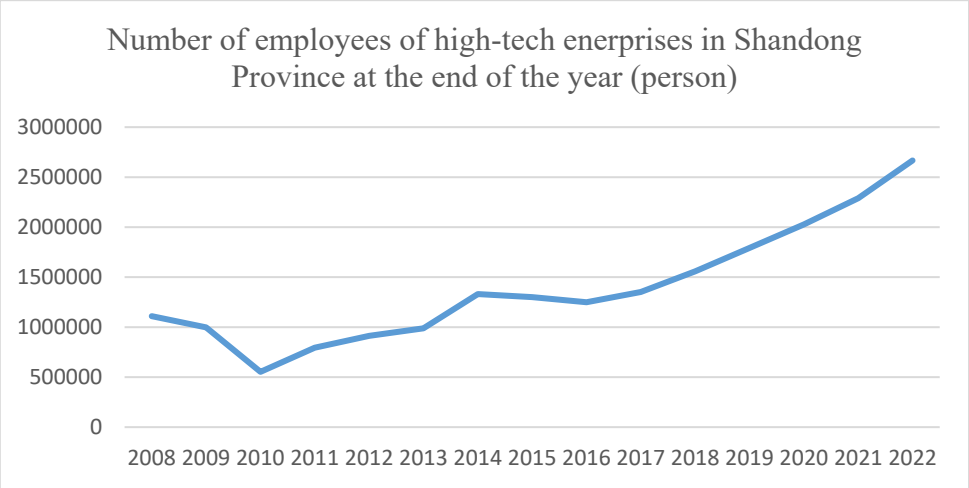
According to the data from the "*China Torch Statistical Yearbook 2008-2022*" (hereinafter referred to as the Torch Yearbook), the operating income of high-tech enterprises in Shandong Province as a whole showed a trend of continuous and rapid growth, and the operating income reached 4166.38 million yuan in 2022(Figure1). However, there is a big gap between the operating income of high-tech enterprises in Shandong Province and Guangdong (11041.7 million yuan), Jiangsu (6882.29 million yuan), Zhejiang (5774.47 million yuan), Beijing (5666.77 million yuan) and other places(Figure2), and Shandong's R & D investment in 2022 is 218.04 billion yuan. The input-output ratio is relatively low (*from Statistical Bulletin of National Science and Technology Investment in 2022*).

In terms of the scale of the development of high-tech enterprises in Shandong Province, the China Torch Statistical Yearbook 2021 Data show that the number of high-tech enterprises in Shandong Province has grown rapidly in recent years. As of 2021, the number of high-tech enterprises into the system is 14,560, and the development of high-tech enterprises in Shandong Province has begun to take shape. However, compared with Beijing, Guangdong, Zhejiang, Jiangsu and Shanghai, there is still a gap in the number of high-tech enterprises.

ISSN 2616-5783 Vol.7, Issue 9: 42-49, DOI: 10.25236/AJHSS.2024.070908

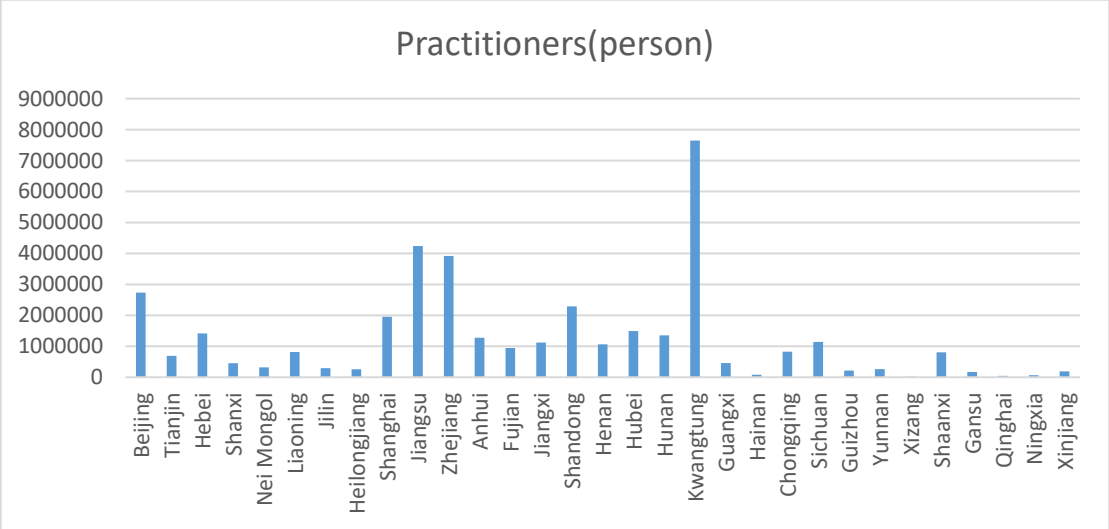
4.2 The scale of employees in high-tech enterprises is large, but there is a shortage of high-tech talents

According to the data of *the Torch Yearbook*, the number of employees at the end of the year of high-tech enterprises in Shandong Province continued to increase from 2008 to 2022. By 2022, the number of high-tech employees in Shandong Province was 2,666,809, an increase of 16 percent over 2021. Although the number of employees of high-tech enterprises in Shandong Province continues to grow(Figure3), the proportion of scientific researchers in the employees is only 10%, which is still a certain gap compared with Guangdong Province (8,391,929), Zhejiang Province (4,474,081) and Jiangsu Province (4,503,483), and the proportion of high-tech talents in the three provinces is high, 48%, 44%, 56%(Figure4), respectively. Shandong Province is still short of high-tech talents.



Note: The chart is made based on the Chinese Torch Statistical Yearbook

Figure 3: Number of Employees in high-tech Enterprises in Shandong Province (2008-2022)



Note: The chart is made based on the Chinese Torch Statistical Yearbook

Figure 4: Number of employees in high-tech enterprises by region in 2022

4.3 The development speed of high-tech enterprises is fast, but the development is unbalanced

The scale of high-tech enterprises in Shandong Province is growing year by year. From 2008 to 2022, the number of enterprises increased by 7.8 times, the main business income increased by more than 30 times, and the total main business income and profit rose to the fourth place in China, ranking below only to Guangdong, Jiangsu and Zhejiang. From the perspective of the structure of various industries, the development of electronic and communication equipment manufacturing enterprises is the most prominent and the largest, followed by the pharmaceutical manufacturing industry, which has gradually become the backbone. However, the net profit of aerospace manufacturing enterprises and information chemical manufacturing enterprises in 2022 only accounts for 2.4% and 0.08% of the net profit of high-

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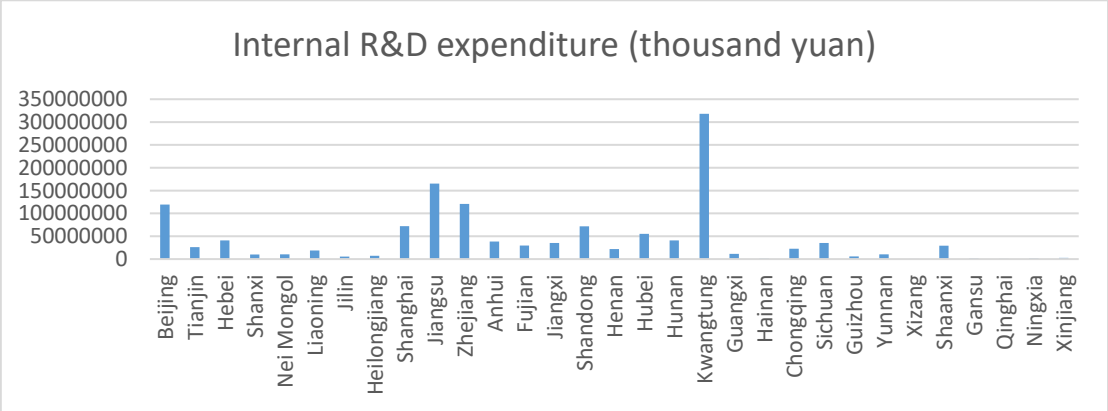
tech enterprises in the province, and the development momentum is weak; From 2005 to 2020, the profits of electronic and communication equipment manufacturers and computer and office equipment manufacturers have declined by different degrees, reflecting the instability of their profit models.

4.4 R&D investment of high-tech enterprises is growing rapidly, but financing is still limited

In terms of R&D expenditure of high-tech enterprises in Shandong Province, *China Torch Statistical Yearbook 2021* shows that R&D expenditure in Shandong Province is significantly lower than that in Guangdong, Beijing, Jiangsu, Zhejiang, Shanghai, Jiangsu and other regions, and R&D investment has become one of the bottlenecks restricting the development of high-tech enterprises in Shandong Province(Figure5). Therefore, increasing the R&D investment of high-tech enterprises in Shandong Province has become another problem to be solved. The product and technology update iteration of high-tech enterprises is fast, and a large amount of R&D investment is needed for technology research and development, talent introduction, equipment update and so on. In recent years, Shandong Province has introduced a series of methods such as the "innovation credit system" to solve the financing difficulties of high-tech enterprises. However, due to the risks of technological innovation in the aspects of enterprises themselves, financing revitalization and financing mechanism, the fierce market competition, the difficulty of collateral meeting the financing requirements of banks, and the imperfect financing mechanism, the financing of high-tech enterprises in Shandong Province is in trouble. It has become a restricting factor for the innovation and development of high-tech enterprises in Shandong Province.



Note: The chart is made based on the Chinese Torch Statistical Yearbook

Figure 5: Comparison figure of R&D expenditure of high-tech enterprises in Shandong Province and other regions

5. Countermeasures for the high quality development of high-tech enterprises in Shandong Province under the double cycle pattern

5.1 Continuing to enhance the creative vitality of high-tech enterprises

The first is to build a high-quality innovation consortium of high-tech enterprises in Shandong Province. The problems and difficulties faced by high-tech enterprises in the development of our province need to be accurately grasped. We need to provide talent support, financial support and policy support for high-tech enterprises to solve difficulties; Enterprises should actively seek cooperation, and build high-quality scientific research platforms and high-level laboratories with domestic and foreign excellent scientific research teams and research and development institutions, so as to achieve resource sharing and jointly break the bottleneck of scientific research. Second, the government needs to build a macro-level coordination mechanism. Limited to the production factors of enterprises themselves, it will affect their independent innovation ability. High-tech enterprises need to carry out cross-regional cooperation, which requires the government to consider the stakeholders at the macro level and formulate a coordination mechanism to ensure the improvement of the innovation ability of high-tech enterprises in our province.

5.2 Attracting "talents" from outside and cultivating them inside

First, based on the actual needs of the development of high-tech enterprises in Shandong Province,

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relying on leading enterprises, scientific research institutes and scientists, science and technology leaders and research teams with major original innovation capabilities in the introduction of major science and technology projects, Shandong Province is to achieve breakthroughs in major science and technology frontiers, key core technologies and independent intellectual property rights. Second, government should actively formulate a talent introduction policy to attract Ethnic Chinese and Chinese scientists to return home and work. The third is to increase the investment in the cultivation of local talents, focusing on the key development fields of high-tech industry in Shandong Province, set up a number of disciplines serving key fields such as information technology, biology, high-end equipment, new materials, modern Marine, green and low-carbon, digital creativity, and train talents needed for high-tech industry.

5.3 Further improving the efficiency of R&D input and output

First, on the basis of continuously increasing R&D investment, rational allocation of resources is carried out. For example, in order to avoid the ineffective use and waste of R&D manpower and financial resources, the management mode can be adjusted, and the input-output scale suitable for its own management level can be actively explored. The second is to provide a technology transfer and transformation platform for scientific and technological achievements and promote the transfer and transformation of scientific and technological achievements. And government should provide efficient technology transfer and transformation services, promote the free flow and efficient configuration of technical elements. They should also support the promotion of advanced technology demonstration application scenarios, and open the "last mile" of R & D tail and mass production first from application to promotion. Third, scientific evaluation programs to promote the transfer and transformation of scientific and technological achievements should be formulated. The evaluation scheme of high-tech enterprises should be able to encourage enterprises to further transform innovation achievements into products with commercial value, transform patents into commodities and put them on the market to obtain higher economic benefits.

5.4 Digital enables the high quality development of high-tech enterprises in Shandong Province

First, we should accelerate the construction of Shandong high-tech enterprise data sharing platform, data acquisition, screening, classification, analysis, etc., to provide data support for the high-quality development of high-tech enterprises. Second, high-tech enterprises in Shandong Province should formulate long-term strategic plans for the development of big data enabling enterprises, and formulate different plans according to the goals, tasks and steps of different stages of enterprise development. Enterprises should have clear boundaries for big data mining, and disclose and protect relevant data through designated standards to ensure that customers' personal privacy is not leaked and maintain network order. The third is to improve the ability of data resource integration, data in-depth analysis, real-time monitoring and prediction of data. The ability of deep analysis, real-time monitoring and prediction of big data is based on the integration of big data resources. The integration of big data resources can coordinate and allocate key internal and external data resources of high-tech enterprises, and thus judge the hot spots and trends of industrial development and the status of competitors.

5.5 Establishing and improving a diversified investment and financing policy guarantee system

We will continue to increase government financial investment in R&D and innovation, actively guide the transfer of social funds to high-tech industries, stimulate the enthusiasm of social capital investment through relevant preferential policies, and stimulate the investment of all sectors of capital into high-tech industries with strong industrial correlation, so as to accelerate the speed and quality of technological innovation. We should give play to the main role of enterprises in technological innovation, focus on supporting their own advantageous industries and key technological fields that can drive the development of emerging industries, and promote the technological innovation of high-tech industries and the continuous optimization and upgrading of industrial structure.

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