The Current Situation, Problems and Suggestions of the Science and Technology Service Industry in Shandong Province

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Abstract. The science technology service industry is an important component of the modern service industry, which is the bridge to connect the science and technology resources and substantial economy. It plays an important role to promote the economic growth and the development of the whole service industry. This paper takes Shandong province as an example, and analyzes the current situation of science and technology service industry in Shandong province, and tries to find out the existing problems in this process, and finally, some suggestions have been put forward to strengthen the development of industry.

1. The conception of the science and technology service industry
As an emerging industry, the science and technology service industry has become one of important parts of modern service industries all over the world, which integratedly applies scientific knowledge, analysis methods and social information to provide intellectual service to the society. The science and technology service industry includes not only the service industries that promote the application of scientific and technological achievement, but also the industries that provide services to the society with technology and knowledge, which mainly covers the fields of research and development, technology transformation, inspection and verification, entrepreneurial incubation, sci-tech consultation, finance of science and technology and popularization of science and technology, and it plays an important role in promoting scientific and technological innovation and speeding up the commercialization of research achievements. (Bodytext style).

Gruber and Walker (1989) pointed that the science technology service industry is the key constituent part of manufacture-related service industry which is the flywheel introducing the increasingly specialized human capital and knowledge capital into the commodity production, and the science technology service industry is just the power of this flywheel. The research findings of Miles (1995) shows that knowledge-based service industry provides intermediary products or services based on knowledge and relied on those companies or organizations with special knowledge. In China, the science technology service industry has been put into the classification and code of national economy since 2005, including the following four subdivided industries: Information Transmission, Software and Information Technology, Financial Inter-mediation, Leasing and Business Services, and Scientific Research and Technical Services. Additionally, its coverage has been enriched in 2007 and 2011.
As an important part of the modern industry system, science and technology service industry has become the developing focus of modern service industry in the future. It has gradually become a social consensus that vigorously developing the science and technology service industry could enhance regional independent innovation ability and promote regional innovation system construction. With the arrival of the era of innovation all over the world, it is prominent day by day of the promoting function that the science and technology service industry could promote the economic sustainable development, because it is not only the important part of innovation system, but also is the important link and the support strength between connected innovation main bodies.

2. The development situation of science and technology industry in shandong province

2.1. The scales of science and technology service industry in shandong province is increasing day by day

To implement the innovation-driven strategy, the government of Shandong province has developed policies in 2016 to promote the development of science and technology service industry, because it is an important carrier to connect technology resources and the real economy, and the market should play a decisive role in the process of resource allocation. So the science and technology service industry develops rapidly in Shandong province.

![Graph 1](http://example.com/image1.png)

**Fig. 1.** The output value of Science and technology service industry in Shandong Province (2012-2016)

![Graph 2](http://example.com/image2.png)

**Fig. 2.** Output value contrast of Science and technology service industry and the third industry in Shandong province (2012-2016)
The Figure 1 shows that the output value of science and technology service industry has reached about 743 billion yuan in 2016 which is nearly twice as much as in 2012, and it shows a rising trend year by year, and the average increasing rate is about 20.5 percents. During the past five years, the output of science and technology services industry accounts for a small increase in the proportion of GDP in the third industry, from 18.34% in 2012 to 23.46% (shown as Figure 2). Additionally, it is obvious that the science and technology service industry in Shandong province could absorb more and more employees, and the number is from 1986000 in 2012 to 3015000 in 2016, which increases nearly 52 percents, and the average wage of employees in this industry is increasing slowly year by year, and the current salary level is about 27182 yuan in this industry in Shandong Province (shown as Table I). Furthermore, Table 1 indicates that the number of legal entity is increasing fast every year, and the fixed investment in this sector has the same growing trend, from 90643.37 million yuan in 2012 to 263131.26 million yuan in 2016, with the average year increasing rate of 38%.

Table 1. The development situation of Science and technology service industry in Shandong Province (2012-2016)

| Year | GDP (Billion Yuan) | GDP of the third industry (Billion Yuan) | Science and technology service industry |
|------|--------------------|----------------------------------------|----------------------------------------|
|      |                    |                                        | Output value (Billion Yuan) | Output value (Billion Yuan) | Output value (Billion Yuan) | Average wage of employees (Yuan) | Fixed investments (Million Yuan) |
|      |                    |                                        | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entity | Number of employees | Number of legal entities |

2.2. The development of various industries within the science and technology service industry is uneven

There are four detailed industries in the science and technology service industry: Information Transmission, Software and Information Technology; Financial Intermediation; Leasing and Business Services; and Scientific Research and Technical Services. However, the development of these industries is unbalanced. According to Table 2 and Figure 3, it is clear that the output value of Financial Intermediation is about 336.44 billion yuan, which accounts for around 45.3% of the total science and technology service industry, and its scale is the largest one among these for industries, and the average wage level has reached about 63510.4 yuan, which is the highest level in this field. However, this industry has the fewest number of legal entity (10033) and the least amount of fixed investments (10180.14 million yuan). The second one is Leasing and Business Services, which accounts for about 26.6% of the whole industry, about the 197.70 billion yuan of the output value, with the most number of legal entity (141897). The third sector is Information Transmission, Software and Information Technology, the output value of which makes up about 14.6% of the science and technology service industry, but it absorbs the most number of employees (1045000 people). The last one is Scientific Research and Technical Services, which accounts for about 13.5% of the total industry (based on Table 2).
Table 2. The current situation of Science and technology service industry in Shandong Province (2016)

| Detailed industry                                      | Proportion of the total output value of the science and technology services industry (%) | Output value (Billion Yuan) | Number of legal entity | Number of employees | Average wage of employees (Yuan) | Fixed investments (Million Yuan) |
|--------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------|------------------------|---------------------|---------------------------------|----------------------------------|
| Information Transmission, Software and Information Technology | 14.6%                                                                                   | 108.82                      | 39025                  | 1045000             | 14729.4                         | 29068.24                        |
| Financial Intermediation                               | 45.3%                                                                                   | 336.44                      | 10033                  | 639000              | 63510.4                         | 10180.14                        |
| Leasing and Business Services                          | 26.6%                                                                                   | 197.70                      | 141897                 | 849000              | 14385.9                         | 118310.95                       |
| Scientific Research and Technical Services              | 13.5%                                                                                   | 100.04                      | 78175                  | 482000              | 28557.4                         | 105571.93                       |
| Information Transmission, Software and Information Technology | 14.6%                                                                                   | 108.82                      | 39025                  | 1045000             | 14729.4                         | 29068.24                        |

3. The problems of science and technology service industry in Shandong province

3.1. The overall scale of science and technology service industry in Shandong province is relatively small

Although the output value of the science and technology service industry in Shandong province is increasing rapidly during the last five years (Shown as Figure 1), there is still a big gap with the advanced province, such as Beijing, Shanghai, Guangdong, Zhejiang and Jiangsu. The total industry scale in Shandong province is still not big enough compared with its economy situation and the development of manufacture industry. Additionally, based on Figure 2, it is clear that the output value of science and technology service industry only accounts for a proportion of 23.46% for the third industry, and about 11% for the total GDP in Shandong province in 2016, which means it does not play an important role in the economic and social development until now, and the science and technology services sector contributes less to the economic growth in Shandong province.

3.2. Lack of unified platform for the coordinated development of science and technology service system

The science and technology service organizations in Shandong province lack unified integrated platform. Although Shandong province has a large number of excellent science and technology service
resources, the lack of unified agency advocacy and management is still a big problem which would hinder the development of its industry especially in the area of resources integration. It is mainly manifested in the lack of clear positioning in the business of the vast majority of technology intermediary service agencies, the service business and characteristic business are not stable, and the strength and scale are relatively dispersed. In addition, scientific and technological service institutions are separate from each other and lack uniform industry standards, service standards and self-regulatory management. All of these due to the lack of a unified platform to integrate the common problems. To this end, it needs to establish a unified platform for scientific and technological service industry, straighten out the relationship between different agencies and departments, clarify the functions, and improve the synergy between different agencies and departments.

3.3. Science and technology service industry in shandong province lacks professional talents
As a typical knowledge-intensive service industry, the professional talents with not only the multidisciplinary knowledge background but also the actual work experience of the enterprise are needed by the science and technology service industry. However, The science and technology service industry practitioners in Shandong province come from different sources, and most practitioners in this field are career changing people with uneven business ability, lower professional knowledge and the service level, so it lacks of high level, professional and technical talents in this field. It is a part-time job for many practitioners to conduct technical intermediary activities, but not their main business.

At present, many universities in Beijing and Shanghai has set up the relative major to cultivate interdisciplinary talents for technology trading market, which directly docks intermediary institutions and provides a steady stream of high quality talent team for the technical trading market. At the same time, regular staff training is carried out to improve service level and professional quality in this sector. However, there is a lack of talent cultivation in Shandong province, and there is no relevant talent training plan for universities. In the meantime, the training of intermediary service personnel is not in place, which seriously hinders the development of technology trading intermediaries in Shandong province.

4. Countermeasures to accelerate the development of the science and technology service in shandong province

4.1. Strengthen the construction of science and technology service platforms and foster new types of innovative public service industries
Promote the construction of Qingdao marine science and technology national laboratory, the Yellow River delta modern agricultural engineering technology research institute and other major innovation platform to provide technical support for regional leading industries. The service mode should be innovated, and the assessment and evaluation of research and development platforms should be strengthen on the development of key industries and enterprises collaborative innovation, which could provide guidance and support to accelerate the development of economy. The function of scientific and technological achievements transformation service platform of Shandong province should be made good use to improve the trading mechanism of online technology market and to form a unified and open technology market service system combining online and offline. Relying on "Internet plus" to build a technology innovation cloud service platform, realize the connectivity of innovation service platform within the whole province.

4.2. Create maker space to provide carrier support for mass innovation and entrepreneurship
It is important to accelerate the scientific and technological enterprise incubators to professional development, and comprehensive science and technology enterprise incubators with large scale and more incubating companies should be supported by the government. And more attention should be paid to the technology areas where incubated enterprises focused on. Construct the research and development services platform with pertinence to enhance the level of professional incubator. Relying
on high and new technology industry development zone, the university science park and universities, in accordance with the mode of "Internet + innovation entrepreneurship", high-tech business incubators are encouraged to form incubation service alliance with productivity promotion center and science and technology service agents such as technology transfer institutions, intellectual property rights institutions, scientific and technological information organizations and scientific and technological finance department. Through the government purchasing services and providing business support, promote innovation and entrepreneurship service resources to gather into the departments of technology business incubator, which could provide omnibearing, multi-layered and diversified one-stop technology services to incubating companies. Support entrepreneurs to serve as entrepreneurial mentors and create an ecological environment for the common development of large enterprises and small and micro businesses.

4.3. Strengthen science and technology financial services and build a diversified investment and financing system

Establish and improve the enterprise credit information collection and sharing mechanism and carry out the credit rating of enterprises to promote the credit financing of science and technology service enterprises. Make good use of science and technology achievements transformation guide fund of Shandong province to attract domestic and foreign venture capital institutions, large enterprises and social capital to set up or participate in the existing investment fund in our province, which could support the transformation of scientific and technological achievements. Give play to the role of angel investment fund in Shandong province, through the guidance of the government money and appropriate incentives, to attract all kinds of investment institutions and social capital to gathered themselves together to high-tech zone, science and technology business incubators, and it is good for the innovation development of technology service enterprises.

Channels which connect finance and science and technology should be expanded. It is important to build perfect chain of "Angel Investment, Venture Capital investment and Private Equity investment" to guide private capital to set up the bank, assurance institutions, petty loan, financing lease and financial companies according to the law, which could provide specialized services for scientific and technological innovation. It should be encouraged that financial institutions, such as Banks and guarantee institutions, carry out intellectual property pledge financing for technology service enterprises. It is necessary to explore the securitization of intellectual property and improve the mechanism of credit guarantee for intellectual property. The insurance institutions should also be encouraged to develop their services through investment in venture capital institutions, establishment of equity investment funds, or cooperation with domestic and foreign fund management companies. Strengthen the support of the multi-level capital market for science and technology service industry, and actively promote qualified technology service enterprises to go public to the regional equity trading market, the new third board market, the gem board, small and medium-sized boards, main boards and overseas public capital markets. Additionally, support technology services companies to issue the short-term financing certificates, medium-term notes, collection bills of small and medium-sized enterprises, corporate bonds, corporate bonds and other debt financing instruments.

4.4. Strengthen the quality of intellectual property service

Guide and encourage the traditional intellectual property agency enterprises to expand service areas, and shift the operating focus from the traditional agents and primary consulting business gradually to the advanced value added service, such as intellectual property rights application, intellectual property analysis of early warning, intangible assets assessment and enterprise intellectual property strategy layout. Fully combining the development trend of the high-end field in the current intellectual property service industry, the emerging service modes should be focused to develop, such as intellectual property operation, intellectual property finance and intellectual property analysis and early warning. Relying on the state intellectual property office of the regional patent information service center in Jinan and existing national patent database in Shandong province, construct the comprehensive
intellectual property rights of public service platform and intellectual property information public service system with reasonable layout, advanced technology and complete functions to encourage all kinds of commercial banks to set up special institutions to provide intellectual property financing services for regional enterprises and scientific research institutions.

4.5. **Strengthen the construction of talent teams in the science and technology services industry**

The effective policies should be made to attract high-level scientific and technological innovation service talents, especially for the leading innovative talents and professional scientific and technological service personnel. At the same time, the government should innovate technology service personnel incentive mode, set up and perfect the technology service high-end talent individual income tax return policy, innovative talent personal purchase loan discount policy and so on.

The expert database should be set up to evaluate scientific and technological achievements, and it is also useful to carry out the dynamic management for the consulting experts. The following four types of experts are needed by personnel database. The first type is the scientist and engineer team who are able to turn a technology into a product or service. The second category is the marketing team, and these people could do research and select the products and services which could meet the needs of the market, and then they would release these products and services to the customers who need them and are willing to invest or start a business, which means the capital socialization process. The third group is the experts who help to start up business, and they could provide you a set of management mode flow according to the products and services you choose. The fourth group is the financing expert to help entrepreneurs connect with VC, PE and other institutions.

5. **Conclusion**

Based on above analysis, it is considered that the development of science and technology service industry plays an important role for the replacement Old Growth Drivers with New Ones in Shandong province, so the science and technology service platforms for financial services, intellectual property service and talent teams should be built to promote the science and technology service developing quality.

**Acknowledgments**

This research was financially supported by Jinan Philosophy and Social Science Program (Grant NO. JNSK18C09).

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