Innovation and Coordination a SWOT Analysis of Artificial Intelligence Industry in Guangdong Province

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Abstract. This paper discusses the current development of artificial intelligence industry in Guangdong province, and uses SWOT analysis to explore the advantages, disadvantages, opportunities and threats of the artificial intelligence industry in the Guangdong province. Based on the analysis, this paper gives some suggestions for the policy makers: firstly, it is necessary to speed up breakthroughs in core technologies and key components; secondly, Guangdong should gather high-end intelligence resources of AI industry; finally, it is recommended to increase policy support and build an ecosystem with deep integration of AI and real economy.

1 Introduction

Artificial Intelligence (AI) is a strategic technology that influent the future world. To enhance national competitiveness and maintain national security, many developed countries pay attention to the deployment of AI. In 2016, the United States released two important reports, namely *National Artificial Intelligence Research and Development Strategic Plan* and *Preparing for the Future of Artificial Intelligence*, which are the first two nation-level development plans over the world. After that, the British government also released a strategic report *Artificial Intelligence: Opportunities and Impacts of Future Decision Making*. European Union, Japan, South Korea have also released their own AI development report. China has also issued *New Generation Artificial Intelligence Development Plan*, which proposes strategic goal and plan for AI development in 2030.

Guangdong is a major participator in China's AI economy. In 2017, Guangdong's AI industry was about 26 billion RMB, accounting for about 1/3 of the whole country [1]. Guangdong's AI industry and related industries are in the forefront of the country. Developing AI industry could help Guangdong province enhance the regional competitive advantage and boost future economy growth. Thus, Guangdong must seize the opportunity of scientific and technological revolution and place the development of AI industry at the strategic level. The rest of the paper is organized as follows: Section II describes the status of AI industry; section III discusses the strength, weakness, opportunities, and threats of AI industry in Guangdong; policy recommendations are provided in section IV.

2 Current Development of Ai Industry

2.1 AI has crossed the early stage of commercialization, and the market size has grown exponentially.

Although the concept of AI has been proposed for more than 60 years, the recent development of computing power and data scale of human society have supported the application of AI to commercialization. The global market scale was 168.39 billion RMB in 2015, and it is expected to exceed 800 billion RMB by 2025 [2].

2.2 The world's top technology companies and Internet giants have entered the AI market.

Apple has acquired more than 15 AI companies since 2010 and integrated its AI technology into various products. Google and Amazon have deployed AI technology in cloud services, auto driving, augmented reality (AR) and virtual reality (VR) products, drones, warehousing robots, and many other fields. Facebook gets training data from products and then reacts its AI products to social network users. Microsoft is committed to applying AI technology to cloud computing, intelligent assistants, AR/VR products and other fields.

2.3 China has huge market potential due to its population amout.

Compared with other countries, the advantage of China's AI market lies in the massive data brought by its large

population and the diversified demand for intelligent terminals. In 2016, the China's AI market was 15.21 billion RMB [1]. According to the *New Generation Artificial Intelligence Development Plan* issued by the State Council, China's core AI industry scale will exceed 150 billion RMB in 2020, and the related industries scale will exceed 1 trillion RMB. By 2030, China's core AI industry scale will exceed 1 trillion RMB, and the related industries scale will reach more than 10 trillion RMB.

2.4 Governments have introduce support policies to promote the development of AI industry.

In recent years, the Chinese government regards AI as a strategic emerging industry and has successively issued several support policies (Table 1). The *New Generation Artificial Intelligence Development Plan* issued by the State Council in July 2017 proposed guidelines, strategic objectives, and key tasks for the development of AI industry in 2030. It clarified the phases of the "three steps" strategic goal. In addition, the Ministry of Industry and Information Technology, National Development and Reform Commission, Ministry of Finance and other departments of the State Council have also issued relevant industry support policies. At the local government level, the Guangzhou Government released the *Guangzhou City Five-Year Action Plan to Accelerate the Development of the IAB Industry (2018-2022)*. According to this action plan, AI will become a strategic emerging industry for the next five years and medium-long term.

Table1. Several Support Policies for AI Industry

Released Time	Policy
Aug, 2019	Guidelines for the Construction of the National New Generation Artificial Intelligence Innovation Development Experimental Zone
Mar, 2019	Guidance on Promoting the Deep Integration of Artificial Intelligence and the Real Economy
Dec, 2017	Three-year Action Plan to Promote the Development of the New Generation of Artificial Intelligence Industry
Jul, 2017	New Generation Artificial Intelligence Development Plan
Nov, 2016	"13th Five-Year" National Strategic Emerging Industry Development Plan
Apr, 2016	Robot Industry Development Plan (2016-2020)
May, 2015	Made in China 2025

3 SWOT Analysis of Developing AI Industry in Guangdong

This paper uses SWOT analysis to evaluate the strengths, the weakness, the opportunities, and the threats of Guangdong province developing its own AI industry.

3.1 Strengths

Guangdong has basically formed a relatively complete industrial chain of AI industry. First, the high-level cloud computing platform and competitive integrated circuit industry clusters in Guangzhou, Shenzhen and Zhuhai provide strong support for the development of AI industry in Guangdong. Second, the increasing support of scientific and technological projects in the fields of algorithms, computing power and data have helped leading innovation successfully transform into commercialization. Third, the application scenarios of AI technology scenes have been increasing and the penetration of AI technology in various fields have been further expanded.

The scale of innovative companies continues to expand. As AI technology enters a period of vigorous development, many innovative enterprises have emerged in Guangdong. In 2018, there were more than 126 AI companies in Guangdong, accounting for 16.9% of the whole country (Figure 1) [3]. Guangzhou and Shenzhen are the main gathering places for AI companies, with 5 unicorn companies including DJI, Royole, iCarbonX, Ubetech and Meizu. Among them, DJI accounts for more than 50% of the global consumer drone market, and its operating income reached 18 billion RMB in 2017 [4]. The financing scale and frequency of Guangdong AI enterprises rank 2nd in the country, with an average single financing amount exceeding 10 million US dollars [3].

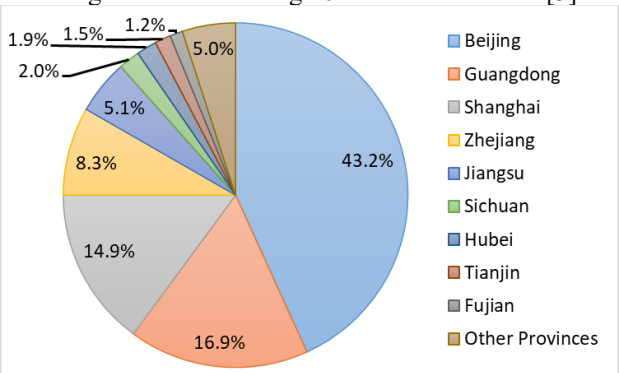

Fig1. Proportion of AI companies in the country

In recent years, AI technology has been integrated into other industries, such as manufacture, medical care, home automation and agriculture. In terms of intelligent manufacture, there are 10 intelligent manufacture demonstration bases in Guangdong province, with over 1.02 trillion RMB total output value in 2017 [5]. In the field of intelligent medical care, Guangdong is in a leading position within China in the field of computer-aided diagnosis and treatment, medical image analysis and other fields. In terms of home automation, M-Smart Home Automation Platform by Media, and Smart Environmentally Friendly Home System by Gree are the two remarkable home automation systems in China. In terms of intelligent agriculture, many scientific and technological achievements, such as intelligent picking robots and intelligent farmland management systems, have come into use. The intelligent level of agricultural equipment, production management, and agricultural product processing continues to increase.

3.2 Weakness

There are technical bottlenecks in the field of frontier AI technology. About 73% of AI companies in Guangdong focus on the application layer and only 25% focus on the

technology layer (Figure 2) [5]. Thus, the original theoretical research foundation is relatively weak, compared with developed countries and some domestic provinces and cities. What is more, Guangdong's AI industry is highly dependent on foreign countries. More than 80% of key components rely on imports, such as servo motors, reducers, and drives. There are still technical bottlenecks in the field of AI, which needs to be further strengthened in terms of brain-like intelligence, quantum intelligent computing, etc. There is no obvious breakthrough in higher-level deep learning, artificial awareness, and emotion perception links.

There is still room to improve the quality of AI products. Firstly, the overall industry level and product quality are not high enough. The service life of mechanical basic components is only 1/3 to 2/3 of similar foreign products. Secondly, brand building needs to be further strengthened [6]. Guangdong has only 4 brands listed in the Top 500 Global Brands announced by the World Brand Lab in 2017, including Tencent, Huawei, Vanke, and Ping An. Thirdly, the technical foundations of measurement, standards, certification, inspection, and testing are still relatively weak. At present, there are only 53 international standards for ISO and IEC developed by Guangdong companies, accounting for 0.2% of the world total [6].

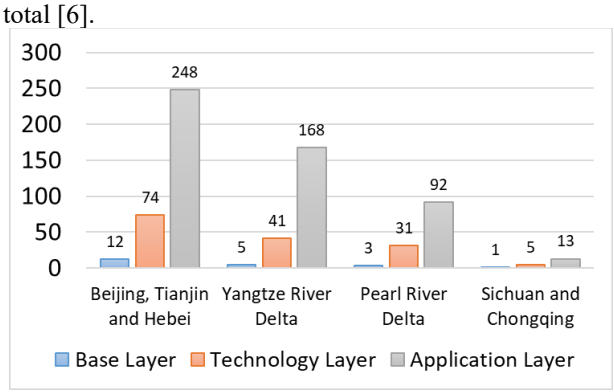

Fig2. The amout of AI companies with different technology path in the 4 economic circle

3.3 Oppurtunities

In order to implement the *Made in China 2025* strategy, the Chinese government has released the *Robot Industry Development Plan (2016-2020)* to guide and promote the development of robot industry. Guangdong also issued some relevant plans to provide support for the development of robot companies in the fields of finance, talents, and fiscal policies. In the *Special Action Plan for the Development of the Robot Industry in Guangdong Province (2015-2017)*, it is proposed to implement the promotion and application plan of industrial robots, mainly in the pillar industries in Guangdong Province. It includes not only the automotive industry and the 3C manufacturing industry, but also some traditional industries in Guangdong Province, such as home appliances, textiles and garments, packaging and printing, ceramic sanitary ware. These labor-intensive industries have encountered difficulties with the continuous rise in labor costs in the Pearl River Delta region. Guangdong government have planned to provide direct subsidies to encourage and support traditional industrial enterprises to use industrial robots.

Private entrepreneurs from Guangdong have huge strength and entrepreneurial spirit. Guangdong Province is the pioneer of China's reform and opening up, and it is also an economically developed province. After a period of capital accumulation, private capital is strong and can provide support for the development of the robot industry. There are many enterprises in the province, many of which are innovative. These entrepreneurs and their enterprises play a role in the promotion and development of the robot industry.

There is huge market potential for industrial robot in Guangdong. From the perspective of industrial robots, Guangdong Province, as China's largest industrial manufacturing base, has been accelerating the pace of machine substitutions under the current rising labor costs. In 2015, Guangdong's robot sales and robot holdings amount were at the forefront of the country. However, compared with developed countries such as Europe, America, Japan, and South Korea, there is a large gap in robot use density, thus there is huge market potential.

3.4 Threats

The core technology is controlled by foreign countries. Guangdong is a major province of the electronic information industry in China, and there is a huge demand for electronic components. But more than 90% of the chips rely on imports [7]. In 2017, the import value of Guangdong's electronic information industry accounted for 50.8% of the province's total imports and 36.6% of the electronic information industry's output value, of which integrated circuit imports accounted for. 26.4% of total imports [8]. Dongguan's smartphone output accounts for 20% of the world, but core technologies such as operation systems and touch screens are controlled by foreign companies such as Google and Samsung [7]. In the fields of high-end chips and semiconductors, American companies such as Qualcomm and Intel are in the leading position. Once the United States restricts the output of core technologies and components to China, Guangdong's AI industry will face critical difficulties.

There is a structural shortage of AI professionals. The demand for AI professionals in Guangdong enterprises is greater than the supply. The *2017 Global White Paper on Artificial Intelligence Talents* released by the Tencent Research Institute pointed out that the national demand for AI professionals in 2017 was twice that of 2016 and five times that of 2015. The gap between supply and demand is around 1 million. According to the survey, in 2017, the core AI technology positions are mainly distributed in Beijing, Zhejiang and Shanghai. The total number of positions recruited by these three places accounted for nearly 90% of total, while Guangdong only accounted for 4% [9]. Moreover, the local colleges and universities start to establish AI related disciplines late and a systematic curriculum training system has not yet been formed [10]. This fail to meet the local demand for AI professionals.

4 Policy Recommendation

4.1 Speeding up breakthroughs in core technologies and key components

The development of Guangdong's AI industry requires frontier basic research of AI science and technology. One is to develop the core hardware and software of AI technology. Government should support enterprises, universities and national key laboratories to carry out joint research and focus on the development of core software and hardware with independent intellectual property rights such as chips, sensors, basic software, and industry software. Core hardware includes neural network chips, smart sensors, micro devices, and graphics processors; software includes operation systems, development tools, embedded software. The other is to improve the establishment of public AI platforms. It is necessary to accelerate the construction of professional technical service platforms such as AI inspection and evaluation, product certification, intellectual property, and other innovation platforms for medical imaging, intelligent voice, drones, and home automation. In addition, Guangdong need to improve the standard system of technology, industry and quality. To take product quality as the primary goal, Guangdong needs to build up its standard system, laws and regulations system, supervision system, inspection and measurement system, etc.

4.2 Gathering high-end intelligence resources of AI industry

Talent is the first resource for a province. First, Guangdong should enhance the introduction of AI leading talent, especially in the fields of basic theory and key technologies. Guangdong should also enhance the training of AI professionals, and support local colleges and universities to establish related disciplines. It is also a good idea to encourage qualified technical colleges to set up robot professional courses, cultivate a group of application-skilled professionals who can skillfully operate, manage, and maintain industrial robots. Second, Guangdong should establish a market and legal environment suitable for the cooperation of innovative elements. For the next few years, Guangdong government needs to focus on building a legal environment that protects innovation rights and interests, and a market environment for fair competition and honest operation. More importantly, Guangdong should promote the transformation of government functions and the innovation of systems and mechanisms, realize the transformation from R & D management to innovative services, and promote the realization of "two-wheel drive" of institutional innovation and technological innovation, making innovation a powerful energy for high-quality development.

4.3 Increasing policy support and building an ecosystem with deep integration of AI and real economy

Firstly, Guangdong may consider setting up an AI industry development fund. In order to increase the support of "fiscal + financial" services, it is recommended that Guangdong establish an AI industry development fund. It is necessary to take advantage of seed funds, angel funds, venture capital funds, equity investment and other capital market financing channels to guide social capital to support the development of AI. Secondly, Guangdong government should establish a system to speed up the opening of data resources. Guangdong should improve the policy of opening up data resources, establish an open sharing mechanism for data resources and focus on establishing a unified data platform in the fields of education, transportation, environment, medical treatment, and business. Thirdly, Guangdong should improve the AI industry statistical indicator system. In view of the lack of statistical data on the development of AI-related industries, it is recommended that relevant government departments study and formulate statistical indicator systems for AI-related industries, clarify the statistical scope, and earnestly make statistics on the real situation of the industry.

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