

Artificial Intelligence

# China's Competitive Advantages in Artificial Intelligence Development

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In recent years, artificial intelligence (AI) has emerged as a significant field of study due to its increasing impact on national development. China has made significant progress in AI research, development, and application over the past few decades. The purpose of this article is to identify the causes underlying China's accelerated advancement in AI in order to stimulate further thought on AI's continued development in China.

**Keywords:** Artificial Intelligence; Development; China; Strategies

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THE utilization of advanced technologies such as artificial intelligence (AI), big data, cloud computing, the internet of things, and biogenetic engineering represents a new era in the scientific and technological progression of humanity. AI is a prominent technology in the fourth industrial revolution and is facilitating advancements in finance, healthcare, manufacturing, education, and other domains. This has led to the emergence of novel paradigms of social and economic evolution (1). The advancement of deep learning algorithms has led to a significant acceleration of this technology. The application of data and algorithms in various fields such as speech recognition, computer vision, autonomous unmanned systems, and intelligent adaptive learning has facilitated the advancement of AI applications, leading to significant alterations in human lifestyles and work patterns (2).

China started working on AI relatively recently, but during the past two decades, it has gained speed and is now one of the top countries for AI research and development (3). According to Stanford University's *AI Index 2023 Annual Report*, China maintained its top position in terms of overall publications in AI

journals, conferences, and repositories in 2023 (4). For China to grow in this field further, it should be of utmost importance to summarize the factors behind its quick rise in AI.

## An Effective National AI Development Strategy

Since the beginning of the 21st century, China has placed a high priority on the development of AI. As a result, it has developed a thorough promotion framework that outlines strategic objectives, guiding principles, broad deployments, and action plans for AI research and development (R & D), industry adoption, and commercial applications (5).

The State Council of China issued the “*Guiding Opinions on Promoting the ‘Internet Plus’ Strategy*” in July 2015, which for the first time identifies the advancement of AI technology as one of the nation’s top priorities, signaling the beginning of a new era of AI development in China (6). In the “*State Council’s Notice on Planning the Development of New-Generation Artificial Intelligence*” released in July of 2017, AI was recognized as the new focal point of international competition, an opportunity for promoting social construction, and a growth generator. It

also proposed a three-phase strategy: to enable AI technologies and applications in China to be on par with the world's advanced level by 2020; to ensure that China leads the world in certain AI applications and technologies and that AI becomes the primary driver of China's industrial and technological transformation by 2025; and to ensure that China has state-of-the-art AI theoretical research, development, and application across the board by 2035. To provide support and guidance for China's key AI deployments (8), the *New-Generation AI Development Planning and Promotion Office* and the *New-Generation AI Strategy Advisory Committee* were established in November 2017.

In order to ensure the safe, controllable, and reliable use of AI to support the sustainable development of China's economy, society, and ecology, the China New-Generation AI Governance Committee published "*New-Generation AI Governance Principles: Developing Responsible AI*" in June 2019 (9). This document emphasizes "responsibility and accountability" as the fundamental principles of AI governance. The November 2020 publication of the State Council's "*Recommendation on Formulating the Fourteenth Five-Year Plan for National Economic and Social Development and the Vision for the Year 2035*" emphasizes the necessity of fostering the deep integration of the Internet, big data, and AI into other industries, of systematically upgrading infrastructure, and of accelerating the development of the fifth generation of mobile communication, industrial Internet, big data centers, etc.

All provinces, autonomous regions, and major cities have furthermore created related action plans to ensure the implementation of these national AI policies and strategies, pushing the nationwide development of AI. To assure the long-term development of AI, advantaged locales have developed local-level AI policies and action plans, as well as built collaboration among governments, corporations, industry groups, think tanks, and other organizations in the AI field (11).

### **A Solid Economic Base**

The relationship between technological advancement and economic development is mutually reinforcing. The progress of AI technology, which is currently catalyzing a new wave of industrial transformation and promoting economic and social development, is contingent upon a robust economic environment.

### **The State's Financial Backing for AI-Related Scientific Research Projects**

In accordance with data from China's Ministry of Finance, China's public budget revenue in 2022 amounted to 20.37 trillion CNY, with 1,002.3 billion CNY spent on science and technology (12). National fiscal revenues and science and technology expenditures provide solid financial assurance for AI progress in China. The Made-in-China 2025 Initiative calls for increased investment in smart manufacturing and next-generation ICT infrastructure. To promote and support high-tech enterprises of various sizes to engage in AI-related activities, financial supportive measures such as innovation funds, incubation funds, initiation funds, and tax reduction and exemption have been implemented. Investment in AI higher education has expanded dramatically, particularly in the development of AI talent and the building of key national-level AI laboratories (13).

### **Active Corporate Investment in AI R & D**

In addition to the government's financial support, corporations and local financing institutions have contributed to AI's accelerated development. According to data from the Chinese Ministry of Science and Technology, China's total R&D investments reached 3 trillion CNY in 2022, up from 2.79 trillion CNY in 2021, with 76% coming from corporations (14). In 2017, China's AI industry witnessed 352 financing events involving investments totaling 75.4 billion CNY; in 2018, the number of financing events in the AI sector increased to 602 and the total investments reached 127.8 billion CNY. China's corporate financing in the AI industry is estimated to reach 174.8 billion CNY in 2020. China's AI industry has been substantially boosted by active corporate capital (15).

### **A Dynamic AI Market**

The extensive populace of China and its well-established information industry infrastructure ensure the availability of substantial quantities of data, which is a critical component in the development of AI systems and serves as the foundation for the swift expansion of the AI industry (16).

### **A Huge Population and a Large Internet User Base**

China's huge population and vast number of Internet users have created a massive market, fueling the rapid rise of Chinese high-tech companies. A dynamic market in the AI era entails tremendous data flow as well as numerous application scenarios, ensuring optimal returns on capital.

As of November 2020, China had a population of roughly 1.44 billion, as reported by the seventh national census (17). The China Internet Network Information Center (CNNIC) released "*The 51st Statistical Report on China's Internet Development*" in March 2023, which said that as of December 2022, China had a 75.6% internet penetration rate, 1.067 billion internet users, and 1.065 billion mobile phone users (18). The biggest digital community on the planet is made up of such a sizable online population. The enormous amounts of data it produces allow China (19) to apply AI in a variety of business contexts. Deep machine learning is the area of AI that has received the most research to date. Since it is a data-driven method, data is the foundation of AI. The thriving Chinese industry has attracted a sizable number of AI users, who utilize AI to generate enormous volumes of data (20). China created a total of 7.6 ZB (zettabytes) of data in 2018, surpassing the United States (6.9 ZB), per the white paper "*Digital World: From Edge to Core*" by International Data Corporation (IDC) published in 2019 (21).

### **Ever-Improving Information and Communications Industry**

The foundation for AI's widespread commercial uses in the market has been built by China's developed information and communications technology and industry. The number of data center racks has been steadily rising in China in recent years, according to "*The Data Center White Paper 2022*," published by the China Academy of Information and Communications Technology (CAICT). In China, there were about 5.2 million racks in use across all data centers, with 4.2 million of those

being used by major data centers, making about 80% of the total (22). According to CNNIC's "The 51st Statistical Report on China's Internet Development", China had 34.4 million domain names, 59.58 million kilometers of optical cable lines, 1.071 billion internet broadband access ports, 67369 blocks of IPv6 addresses, and 728 million active IPv6 users as of December 2022. 10.83 million base stations, including 2.312 million 5G base stations, or 21.3% of the total, made up China's communications infrastructure resources. These base stations supported mobile networks that could connect to 3.528 billion terminal devices (18).

### Strong AI Brainpower

A country's capacity for AI development is largely determined by the quality of its pool of top AI scientists. China has a sizable and rapidly growing pool of AI talent. Referring to the "Global AI Talent Report 2020" by Element AI, China will have 22191 top-tier AI experts in that year (23). 232 Chinese researchers were listed in "The 2021 List of the World's 2000 Most Influential Scholars in AI (AI 2000)" that was jointly published by the AMiner team at Tsinghua University, the Chinese Association of Artificial Intelligence, the Beijing Academy of Artificial Intelligence, and the Tsinghua-China Academy of Engineering Knowledge and Intelligence Joint Research Center (24).

The Institute of Automation of the Chinese Academy of Sciences and the Department of Computer Science and Technology of Tsinghua University are two of the top ten AI research institutions in the world. The fastest supercomputer in the world, "Shenwei-Light of the Taihu Lake," is owned by the Department of Computer Science and Technology at Tsinghua University (25).

The pool of AI talent in China has the potential to grow dramatically. The number of Chinese STEM (Science, Technology, Engineering, and Mathematics) graduates is the highest in the world, and many of them are prepared to work in the field of AI. Since 2018, Chinese colleges have seen an explosion in the number of AI-related specializations. As a result of four waves of expansion, there are presently 438 colleges in China that can provide AI majors, supplying professional personnel for AI development on a constant basis (26).

Promotion of partnerships between industry, education, and research has been a key focus of leading Chinese AI companies. Huawei unveiled its AI developer empowerment initiative, dubbed "Fertile Land," in 2018. The company has committed to investing one billion CNY over the next three years to train one million professionals for the AI industry (27). Baidu has founded the Cloud Intelligence College with the objective of educating a total of 100,000 individuals in the fields of AI engineering and product development (28). Several universities and corporations, including Shenzhen University and Tencent Cloud, Nanchang University and Huike Group, and Northeast Univer-

sity of Finance and Economics and IFlytek, have engaged in collaborative endeavors to establish AI schools for the purpose of talent training, joint laboratory operation, and internship base construction (29).

### A Significant Increase in Core AI Technologies

The growing impact of Chinese open-source AI initiatives exemplifies the rapid growth and comprehensive strength of AI in China. The number of open-source AI algorithms contributed by China increased from 139 in 2020 to 158 in 2021. China has the most supercomputing centers, according to the list of the top 500 supercomputing centers in the world. China had 188 supercomputing centers on the list as of June 2021, which accounted for 37.6% of the total (30).

China has independently acquired intellectual property rights in AI subfields such as text recognition, speech recognition, Chinese language-based information processing, intelligent surveillance, biometric recognition, industrial robots, and service robots and has successfully applied them (31). In China, computer vision technology has grown steadily, as seen by the establishment of a number of businesses with cutting-edge technologies, such as SenseTime, Megvii, and CloudWalk. SenseTime's 2017 funding totaled \$400 million, a record high for all AI businesses worldwide (32). China's natural language processing technology has benefited immensely from advances in learning algorithms and data resources as a result of its massive user base throughout its expansion phase. Chinese businesses such as Baidu, Sogou, and IFlytek have achieved 97% recognition rates in their speech recognition technology, the highest level in the world (33). In China, several world-renowned robot-specialized enterprises have arisen. For example, ECOVACS, one of the world's first firms to engage in service robot R&D and manufacture, has successfully sold its robot products in 145 countries and territories, with its market share in Germany outpacing any of its competitors (34).

### Conclusion

The growth of AI technology and industry has greatly benefited from China's unique political, economic, intellectual, and technological standing, which has produced enormous strategic resources and a wealth of experimental opportunities. However, its flaws in the field of AI are clear, including but not limited to a lack of investment in fundamental research, shaky industrial foundations, obstructed governmental data connectivity, and a shortage of expertise. The development of AI in China is faced with obstacles like delayed international cooperation, insufficient legal frameworks, and ethical hazards like privacy violations. It is crucial that China creates policies that are forward-looking, updates its laws, and fosters greater international cooperation in AI research, innovation, and education to further strengthen the conditions for the advancement of AI. ■

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