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潘禺：AI 时代，中国占到了意想不到的先手

Pan Yu: China has Gained First-mover Advantage in the AI Race

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Translated by Saranya

PhD Scholar, Centre for Chinese and South East Asian Studies, School of Language, Literature, and Culture Studies, Jawaharlal Nehru University, New Delhi

Email: saranyashandilya@gmail.com

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This translation is part of a series where articles on Artificial Intelligence in China shall be translated from Chinese to English. This limited series on AI will be translated by Saranya. The first issue on AI in China, *ICS Translations* Issue No. 47, can be accessed here, and the second issue, *ICS Translations* Issue No. 50, can be accessed here.

A photovoltaic power station (solar farm) in Emaozhai Village, Baotian Town, Panzhou City, Guizhou Province, China
Source: *Xinhua* News Agency

In recent years, the emergence of a bewildering array of new terms, exemplified by ChatGPT, has heralded the latest wave of Artificial Intelligence (AI) fervour. The AI era has arrived, as is evident from the enormous valuations in the United States (US) stock market and the public endorsements by US officials.

In an article published in the *Financial Times*, US Secretary of State Antony Blinken and US Secretary of Commerce Gina Raimondo quoted Abraham Lincoln to equate AI with the inventions of the written word and the printing press, arguing that such peculiar inventions facilitate all other inventions and discoveries. The definitive actions of the US, including the ban on the sale of high-end chips to China and restrictions on investment and research cooperation, show that AI has become another focal point of geopolitics and great power competition.

However, this round of technological great power competition driven by the AI revolution differs significantly from the tech revolutions once led by the US through the Manhattan Project and the Apollo Programme. The old ways of Cold War mentality and tech blockades failed to guarantee US tech dominance in the past, and are even less likely to do so today.

Wernher von Braun explaining the Saturn system to US President John F. Kennedy at the Cape Canaveral Missile Test Annex, November 16, 1963.
Source: *The National*

The equipment and personnel involved in atom bomb and space technologies were highly specialised, making secrecy and control easier. On the contrary, AI has a very diverse range of applications, spanning across various industries, from healthcare and finance to manufacturing and entertainment. It boasts a large developer pool that includes not only large corporations and government agencies but also academia, small and medium-sized enterprises, as well as individual developers. AI technology is open-source and accessible, with numerous open-source projects and open datasets widely disseminated and popularised through communities, papers, and online courses. It is driven by rapid technological iteration and strong market demand. Moreover, this technology draws from a diverse knowledge base, addressing problems across a myriad of industries empowered by AI. All these factors will significantly undermine the effectiveness of any attempts at blockades and restrictions.

So, beyond blockades, what about a fair and open competition in AI technology?

It is easy to spot some superficial characteristics of AI development in the US and China when comparing their respective strengths and weaknesses. For instance, the US has some leading tech companies and a favourable environment for innovation that can attract top AI talent from around the world. However, the overly strict data privacy regulations in the US may limit its AI development. On the other hand, China has a stronger manufacturing base, giving it a significant advantage in integrating AI with industry. Owing to a large market size and diverse range of applications, Chinese companies are well-positioned to spur the deployment and commercialisation of AI technologies. However, China still has some dependency on foreign countries for fundamental research and core technologies, necessitating further technological self-reliance.

The above-discussed characteristics can be modified. For example, data privacy is after all a policy issue with a lot of room for technical manoeuvring. Similarly, the innovation in the US and the execution in China are just broad generalisations. The actual situation is likely more complex and provides opportunities for mutual learning. China is committed to building sci-tech innovation centres, while the US is investing in national capabilities to bolster manufacturing, including the localisation of chip production. If we delve deeper and assume that both the US and Chinese governments attach great importance to this round of technological and industrial AI competition, offer maximum assistance and investment, learn from each other to leverage their strengths and compensate for their respective weaknesses, what are the underlying fundamental issues that will be challenging to resolve in the near future?

After seeing the massive market valuations of the “Magnificent 7” – leading US tech giants such as Nvidia, people often form the impression that US tech companies have an insurmountable lead and barriers to entry. Regardless of whether this is truly the case, from another perspective, the valuation structure of the US stock market, which is concentrated in a very small number of companies, best reflects capital's pursuit of profit. These market valuations are backed by rapid financial growth and optimistic future expectations, rather than the importance of the business or some significance beyond profit. For example, one cannot gauge the significance of Boeing at present merely by looking at its valuation given by the capital market. Similarly, there are many factors in the AI race that cannot be well assessed by a profit-seeking capital market. AI's growing demand for data storage and computing resources requires more data centers and supporting infrastructure, such as power systems.

In the US, the sudden surge in electricity demand from data centres is now exceeding the available power supply in many areas. This has resulted in long waiting times for companies to connect to the grid and growing concerns about power outages and price hikes among residents living in data centre-dense areas.

According to a Goldman Sachs report, data centres will account for 4% of global energy consumption by 2030, up from the current 2%. Given that global electricity demand has been relatively stable for many years, each percentage point represents a significant increase. Compared to a 9% increase over the past 20 years, electricity demand in the US is projected to grow by 40% over the next 20 years, with data centres being the primary driver of this surge. Sweden's data centres power demand may double within this decade and quadruple by 2040.

In the UK, AI is expected to consume five times more energy over the next decade. In the US, data centres are projected to consume 8% of total electricity by 2030, up from 3% in 2022, which Goldman Sachs describes as "a level of electricity consumption growth unseen in a generation."

Data centres consume more electricity than most countries. Globally, there are over 7,000 data centers either built or under construction, up from 3,600 in 2015. If these data centres were to operate continuously, their annual electricity consumption would reach 508 terawatt-hours, exceeding the total annual electricity production of Italy or Australia.

By 2034, global data centre power consumption is expected to exceed 1,580 terawatt-hours, nearly equivalent to India's total electricity consumption. (1 terawatt-hour is equal to 1 trillion watt-hours or 10^12 watt-hours).

In response to this situation, tech giants like Microsoft, Google, and Amazon are exploring technical ways to use less power and balance grid demands, mainly by squeezing more efficiency out of chips, servers, and cooling equipment, or shifting loads to different regions. Microsoft and Amazon are also betting on nuclear energy, though a clear path forward is yet to emerge. Based on trends in Silicon Valley, power demand is only going to increase. Each Nvidia H100 chip consumes up to 700 watts, nearly eight times the power consumption of a typical 60-inch flat-screen TV. The latest chip, the B100, consumes almost twice as much power as the H100. Microsoft's supercomputer built in 2020, which trained OpenAI's GPT-3 model, used 10,000 of the latest AI chips at the time. Microsoft's new supercomputer built in November 2023 used 14,400 Nvidia H100 chips, and the next-generation supercomputer is already being designed, which will be 30 times more powerful than the current one.

While these tech giants are ambitiously surging forward, the lives of ordinary Americans are being affected. The large investments by power companies in new substations, transmission lines, and infrastructure are driving up electricity prices. The costs of these upgrades are typically spread among all power users in the region, appearing as a line item on their monthly electric bill.

An under-construction data centre in Virginia, US.

The construction of data centres requires large areas of land and specific environmental conditions. As available land dwindles, growing environmental concerns and land use disputes will result in restrictions on new power infrastructure. Bloomberg reported on the case of Loudoun County, Virginia, once known for its horse farms and Civil War battlefields. Over the past 15 years, vast tracts of farmland and forests have been cleared to make way for data centres. In the spring of 2022, the local power company Dominion Energy experienced

18 load warnings or controlled power outages, including rolling blackouts. Opposition to data centres is growing in Virginia. At a Prince William County Board of Supervisors meeting in March 2024, angry residents objected to a zoning change that would allow taller data centres to be built on certain plots. A woman told officials that data centres were turning her quiet community into a "dystopian nightmare". However, after hearing from over a dozen people opposed to the zoning change, the Board of Supervisors voted to approve the construction of larger data centres.

For cloud computing giants like Microsoft, Google, and Amazon, taking measures to optimise their data centre cooling systems and purchasing renewable energy to offset their carbon emissions can reduce energy costs and boost their public image. These factors certainly motivate them to do more in terms of energy efficiency optimisation. However, considering their profit models, the fundamental goal remains acquiring more customers, generating more data traffic, and therefore building more data centers, deploying more energy-intensive equipment, and training more powerful AI models. The capital market evaluates these companies on the basis of their profits, but it does not account for the underlying costs. On the other hand, even though China needs to develop AI and build data centers, its approach involves a series of industrial layouts and technological innovations to ensure the stable operation of data centers and the sustainable development of the power system. It is also challenging to quantify these achievements in terms of capital.

China's milestones in developing renewable energy sources such as solar and wind power are widely recognised. By the end of 2023, China's installed solar power capacity had exceeded 300 gigawatts, making it the world's largest country in terms of solar power capacity. China's installed wind power capacity had also surpassed 350 gigawatts, making it the global leader in wind power capacity. With the largest ultra-high-voltage (UHV) transmission network in the world, China has established itself as a global leader in UHV transmission technology.

Moreover, China's smart grid is at the forefront of the world. It enhances the flexibility and reliability of the power system through intelligent scheduling, distributed energy management, microgrids, and demand-side management, thus meeting the peak load demands of data centres more efficiently. The power system in China not only supports AI development but is also optimised by AI.

China is actively promoting the application of technologies such as AI, big data, and the Internet of Things (IoT) in the power system to increase its level of intelligence.

The data centres in Gui'an New Area of China's Guizhou Province leverage the region's abundant hydropower resources and adopt efficient energy-saving technologies and intelligent management systems, making them model green data centres. Several distributed energy projects have been developed in the Beijing-Tianjin-Hebei region, thus enhancing the reliability of power supply for data centers through microgrids and energy storage systems. China is also the global leader in energy storage technology. China boasts the largest battery production capacity globally, providing a significant advantage in large-scale manufacturing and supply chain integration. China has invested heavily in grid-side energy storage projects to enhance grid stability and regulation capabilities through Battery Energy Storage Systems (BESS). By deploying large-scale BESS in data centres, surplus electricity generated from renewable sources can be stored to provide stable power supply during peak demand periods.

At a glance, it may seem that before the advent of the AI era, China made a number of forward-thinking strides in industrial layout by leveraging its strong manufacturing base and perhaps fortuitously making the right strategic decisions. However, there is a deeper logic at play which cannot be overlooked – the unforeseen role of China's systemic advantages. From a purely capitalist or market-economy perspective, investing heavily in building roads, bridges, and numerous data centres in Guizhou, one of China's most backward and under-developed regions, would not be considered a sound investment, except for a few favourable climatic and geographical conditions. However, China's approach to industrial development is not driven by profit and return on investment. The decision to make Guizhou a major hub for the big data industry is based on a different logic rooted in socialist market economy. Without the impetus of high-end industries such as big data to drive growth, initiatives to improve the lives of farmers in remote areas of Guizhou by providing access to water, electricity, roads, and internet would be economically unsustainable and could not be fully realised. Take electrification, for example. China has built a large number of transmission lines and distribution facilities. Distributed energy sources such as photovoltaic power stations and small hydropower plants have been widely adopted in remote mountainous regions, to achieve 100% rural electrification in Guizhou.

Recently, some economists in China and abroad have frequently argued that China should invest more in policies and resources to stimulate consumer spending rather than continuing to invest in the production sector. While these arguments are not entirely without merit, it is important to understand that without infrastructure development and industrial layout like those in Guizhou, and without investments in production of photovoltaics and power grids, the lives of millions of rural residents in China would not improve, and their consumption would remain out of the question. China's system does not pursue short-term economic stimulus, nor does it pursue short-term capital returns. While the global power system faces challenges from the rapid development of AI, China, with its robust new energy and power industry, remains unfazed. This is not merely good luck but is a result of a certain inevitability.

In the AI era, China enjoys numerous advantages in its technological competition with the US. For instance, China’s extensive infrastructure and network development offers ample application scenarios for AI technologies, from smart homes and smart cities to industrial IoT – an advantage that is difficult for other countries to emulate. The widespread deployment of cameras and sensors in rural areas has enabled smart solutions for agricultural production, such as irrigation and livestock monitoring. This large-scale smart IoT market is a direct result of earlier investments in water, electricity, roads, and internet connectivity, regardless of immediate returns.

US officials have compared AI to inventions, such as the written word and the printing press, highlighting its potential to empower industries and drive innovation – in reference to AI's industrial enablement and innovation promotion capabilities. But if we consider the application of AI in production and creation, China has already entered the AI era.

Series Editor: **Hemant Adlakha**

Hemant Adlakha teaches Chinese at the Jawaharlal Nehru University, New Delhi, and is Vice-Chairperson, and Honorary Fellow, Institute of Chinese Studies, New Delhi.

Email: haidemeng@gmail.com

The views expressed here are those of the original author and not necessarily of the translator or of the Institute of Chinese Studies.

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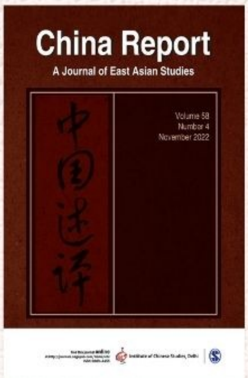

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INSTITUTE OF CHINESE STUDIES
B-371 (3rd Floor), Chittaranjan Park,
Kalkaji, New Delhi 110019
Landline: +91-11-40564823

info@icsin.org

https://www.icsin.org

@icsin_delhi
InstituteofChineseStudiesDelhi
@icsdelhi
InstituteofChineseStudiesDelhi
@ics_delhi