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Artificial Intelligence: China's High-Tech Ambitions

China aims to become a world leader in the field of artificial intelligence (AI) by 2030. This goal is linked to Beijing's efforts to make its economy more innovative, modernize its military, and gain influence globally. While the US currently retains an edge in AI, China's ambitions are likely to set off a new technology race, writes **Sophie-Charlotte Fischer, PhD student at the Center for Security Studies, ETH Zurich, Switzerland.**

In the development of new technologies, the balance of power is shifting eastward. The People's Republic of China (PRC), once "the workbench of the world", is transforming itself into a serious competitor in the development of future key technologies. Especially in the field of AI, China's ambitious activities receive widespread attention. The country is continuously gaining on the current leader, the US, and plans to become the world's "Premier AI Innovation Center" by 2030.

Although the full potential of AI has yet to be revealed, it is already being touted as the "new electricity". It is expected that AI will raise efficiency and precision across multiple sectors and could thus significantly boost societal wealth and national security. At the same time, fundamental issues arise. The transformation of labor markets, the diminishing human control over critical decision-making processes, the increasing influence in society of those who develop and deploy AI, and the resulting changes to the global balance of power are predictable effects of AI that have yet to be adequately explored.

Countries like Canada, Russia and the United Arab Emirates (UAE) have already identified AI as a key technology for the future. This is reflected, for instance, in the targeted efforts at industrial development and the formation of new structures, such as the UAE's appointment of a Minister of AI in 2017. However, currently, the US retains an edge in the global advancement of AI, closely followed by China.

In order to assess China's ambitious progress in the field of AI, therefore, it is necessary to grasp the country's capacity for innovation and its ambitions. According to Russian President Vladimir Putin, "whoever becomes the leader in this sphere [AI] will become the ruler of the world".

From Imitation to Innovation
Since 1978, when China's leader Deng Xiaoping announced the "Open Door Policy", signaling the start of the reform era, China has been transformed from a sealed-off agricultural society into the world's second-largest national economy. It should be remembered, however, that its imposing economic growth was largely generated through a surplus of cheap labor and the transfer and imitation of technologies.

The Chinese government hopes that with its "Made in China 2025" program, it can eventually become a leading industrial power. In the future, it is hoped, "Made in China" will no longer be a byword for imitation and cheap, mass-produced goods, but will stand for innovation and high quality products. The program is part of China's broader goal to become an "innovative nation", as was already stated in the 2006 National Medium- and Long-Term Plan for the Development of Science and Technology. The current 13th Five-

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Year Plan (2016 – 2020) is another example of how this goal is prioritized at the highest Party levels.

This is a crucial development, not only in economic terms but also when it comes to the modernization of the People's Liberation Army (PLA). At an event attended by lawmakers of the PLA in 2017, President Xi Jinping stressed that science and innovation were the keys to China's military upgrading.

In order to build up an indigenous innovation capacity, China has been constantly raising its research and development (R&D) budget. In terms of overall expenditures, it is only surpassed by the US today. The government also fosters specific high-tech industries such as aerospace, quantum technology, and robotics. At the same time, since 1999, the "Go Out" strategy has encouraged companies and investors to expand and invest in overseas markets.

Reforms have laid the groundwork for the creation of private technology companies that are now competing on an equal footing with leading Western companies. In addition to established market players like internet and AI giants Baidu, Alibaba, and Tencent, China's corporate landscape also features a dynamic start-up scene. Already, one in three "unicorns" (up-and-coming corporations with a market value of over US$1 billion) are Chinese companies.

However, China still lags behind other countries like the US in several sectors, including the semiconductor industry. In other areas, however, such as telecommunications and e-commerce, China has already developed a remarkable degree of innovation power. Today, the main question is not whether the country can be an innovator, but how innovative it will be when it comes to key future technologies.

A Global AI Power in Three Steps
In 2016, to the surprise of many, the Alpha Go computer program, developed by Google DeepMind, managed to beat professional Go player Lee Sedol at this complex strategy board game. Experts had believed that the development of a program that could master the game of Go was still years in the future. In retrospect, Lee Sedol's defeat to Alpha Go is seen as a major wakeup call for China's leadership, which proceeded to declare AI a national priority. In July 2017, the PRC's State Council released the Next Generation Artificial Intelligence Development Plan (AI Plan), a comprehensive, all-of-nation strategy to advance the development of AI in China in three major steps: catching up with the West by 2020, overtaking it by 2025, and becoming the global leader by 2030. The document lists a number of ambitious targets but remains vague when it comes to strategies for achieving them. However, the plan's main purpose is to show that AI is a top priority for the highest level of the Communist Party's leadership. Thereby, an industrial development that is already underway should be accelerated.

The Chinese government perceives AI as an opportunity to leapfrog foreign competitors. To this end, the domestic AI sector's innovation capacity is supported with substantial financial resources for R&D. Training of new AI talents is set to begin already in primary school and will be intensified at the country's universities. On the other hand, the plan is for international AI resources to supplement China's indigenous innovation capabilities. The "Go Out" strategy incorporates mergers and acquisitions, venture capital and the establishment of overseas research and development centers (see map below).

Selected Chinese AI Companies, Projects and Cooperations
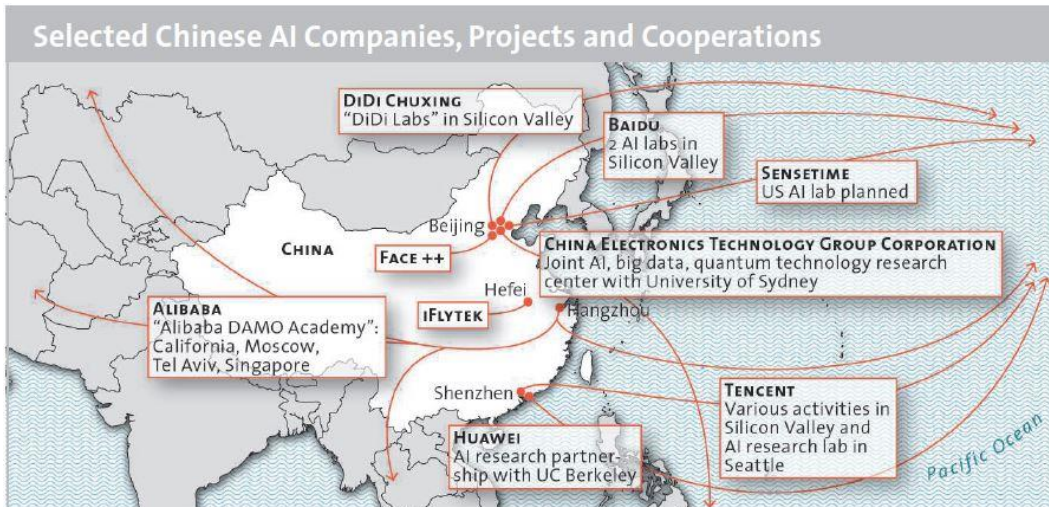
Source: CSS/ETH

The plan stipulates the introduction of AI across the economy and society including in manufacturing, the judicial system, and public safety. Another aspect of the AI Plan covers the technology's military applications. Though the PLA so far has no official AI strategy, the urgency of rapidly and comprehensively adopting AI is acknowledged by its leadership. The PLA is already funding several research projects involving AI. Specifically, AI could be deployed for applications including data fusion and analysis, command-level decision support, swarm intelligence and the development of AI-equipped weapons. Looking forward, China's ambitious innovation efforts and resources could prevent the US from developing an uncontested edge in AI and therefore have significant strategic implications.

The AI Plan also includes a critical review of China's weaknesses. For instance, there has so far been no breakthrough in the development of high-end AI chips, which are required to train algorithms through machine learning. There is furthermore a severe shortage of experienced AI talents in China, a fact reflected in the aggressive recruitment strategies of Chinese companies both domestically and overseas.

No Paper Tiger
Half a year after the release of the AI Plan, first implementation steps were undertaken. In December 2017, the Ministry for Industry and Information Technology (MIIT) issued a detailed action plan to foster the development of AI from 2018 to 2020. The plan outlines four major tasks for this period. First, the plan formulates concrete targets for the development of "smart products" in eight categories. These include, for example, networked vehicles, intelligent service robots, and video image identification systems. Second, the hard- and software basis for the AI industry should be strengthened by achieving first breakthroughs in "core foundations" like neural network chips. The third task is to foster the development of "intelligent manufacturing", while the fourth is to build a public support system, for example, by accelerating the development of an "intelligent next-generation internet".

The action plan overlaps with other measures. In 2017, the Ministry of Science and Technology issued a call for tenders for 13 "transformative" technology projects that are privileged as recipients of state funds and should be realized by 2021. One of these projects is the development of an AI chip that should specifically be more powerful than one product offered by US chipmaker Nvidia. One month later, Baidu, Alibaba, Tencent

as well as iFlytek, a leading company in speech recognition technology, were chosen as the first members of the "AI National Team". The aim of the team is to advance the implementation of AI in certain priority areas, such as autonomous driving. China also builds up a comprehensive AI infrastructure. In January 2018, the Xinhua news agency reported the construction of a gigantic new AI campus in Beijing that will accommodate up to 400 companies.

Internationally, Chinese AI companies continue to expand. In 2017, Baidu announced the opening of its second AI research facility in Silicon Valley, while Tencent stated its plans for a new research lab in Seattle. Another remarkable development has been the acknowledgement of China's efforts by Western companies. Google, which now brands itself an "AI first company", is building an AI center in Beijing to recruit talent there. This step is all the more remarkable when one considers that some of Google's core services, such as its search engine, have been blocked in China since 2010.

A Favorable Starting Point
China's AI ambitions must be analyzed in a differentiated manner, given the existing weaknesses and previous obstacles in the area of technological innovation. However, the PRC has several resources at its disposal that are especially well suited to the development and implementation of this technology.

The close ties between the government and private companies that are leading AI developers are a crucial factor in the realization of China's strategic goals. In developing AI, China is relying heavily on the concept of military-civil fusion (MCF), a "national strategy" since 2013, which blurs the lines between civilian and military science and technology resources. Linking institutions such as the PLA, private companies, and academic institutions should foster the development of dual-use technologies and thereby accelerate at the same time China's military modernization process and its economic growth. Such an approach could give China an important edge in dealing with states such as the US, where the private sector's market-oriented portfolios are more clearly distinct from the government's strategic interests.

A substantial part of ongoing research in the field of AI is published in open-source publications. This is an important difference when compared to other sensitive technologies, such as nuclear energy. Therefore, AI research in China benefits from the advances of companies and research groups worldwide.

China has the largest number of internet and smartphone users and only weak data protection rules, so the country has tremendous volumes of data at its disposal. These are indispensable for training algorithms through machine learning. Looking beyond data privacy, the relatively weak regulatory environment in China and limited concern for ethical considerations are also advantageous when it comes to the rapid implementation of new technologies, transforming the Chinese society into a gigantic test bed for AI applications.

Already today, AI is omnipresent in public life in China, especially in the area of public safety. Social stability and control are to be further tightened through widespread deployment of facial recognition software. Such software is already used in millions of surveillance cameras. On the one hand, such AI applications can help improve public safety, for example by assisting the police solve criminal cases faster. On the other hand, they facilitate increasingly close surveillance of the population and impose further limitations on personal privacy. Political scientist Sebastian Heilmann has coined the term "digital Leninism" to describe the Chinese government's strategy of exploiting AI and big data in a targeted manner for social control and national economic coordination, and has

raised concerns over the possible consequences if this model were to spread internationally.

A New Technology Race?
The US has so far largely been reactive in its response to China's AI ambitions. It has focused on obstructing Chinese investment in its own AI sector instead of fostering the US's potential and expanding its current technology lead. Former US president Barack Obama identified AI as one of the key challenges for the next administration. But the National Artificial Intelligence Research and Development Strategic Plan, which was published in 2016 and resembles China's AI Plan, was shelved as soon as US President Donald Trump took office. While the new National Security Strategy references AI as a technology of strategic relevance to US national security, there is still no comprehensive vision of how the technology should be developed and used. As a result, the trajectory of AI development in the US is currently being guided by tech companies.

Corporations such as Google, Amazon, and Facebook are largely responsible for the US's current competitive edge in the field of AI. According to the US-China Economic and Security Review Commission, the US remains the leader when it comes to the amount of funding provided, the number of AI firms and the number of patents filed. US companies such as Nvidia and Google also have a leading edge in manufacturing the most powerful AI chips. China has already overtaken the US in terms of publication volume in the field of AI but measured by the number of citations, research results coming from China still have a lower impact. Moreover, most experienced AI talents remain employed in the US.

However, that competitive edge is being blunted. One reason is to be found in Washington's political decisions. Science and technology are increasingly being disregarded at the government level, hampering the development of an AI strategy and the preservation of the US's technology lead. For instance, the Office of Science and Technology Policy, which advises the president on the effects of science and technology on national and international affairs, has been shrunk to one third of its former staff. At the same time, the restrictive migration policy pursued by the current president creates additional obstacles when it comes to meeting the growing demand for AI talents. Already, Chinese companies are seizing on this opportunity to recruit the most talented experts for themselves.

In parallel with these developments, the US military is struggling to stem the erosion of its technological edge. It had already identified AI as a key technology for preserving that advantage in its third Offset Strategy of 2014. However, due to a risk-averse innovation culture, the bureaucratic hurdles in procurement processes, and the fact that it is simply not an attractive employer for the best qualified AI talents, the US military is experiencing difficulties in keeping up with developments in the commercial sector, and with the ambitions of other countries. Since a linkage of private and state resources, as practiced in China, is inconceivable in the US, initiatives such as the Defense Innovation Unit Experimental (DIUx), created by former defense minister Ashton Carter, serve as important models for acquiring certain commercial technologies for military applications.

There is also growing concern in Washington over AI assets in the US being acquired by Chinese actors and the lack of equal market access for US investors in China. Growing investments in US AI firms, close links between the private sector and the state, and China's strategy of using civilian technologies also for military applications have contributed to a new law being drafted in the US. The Foreign Investment Risk Review Modernization Act calls for reforming the Committee on Foreign Investment in the United States. Based on national security considerations, foreign investments in US companies developing critical technologies such as AI should be subjected to stricter controls.

The enormous potential of AI, the private sector's leadership role in technology development, and the increasing interest of states in AI have created a new field of tension between national security and free market ideology. Control of AI resources is, however, significantly hampered by the mobility of AI talent and capital, the publication of research results, and the intangible nature of the software components of AI. Moreover, for many foreign tech firms, the Chinese consumer market is an increasingly attractive target.

While the US is still the leader as measured by many AI indicators, China's ambitions should not be underestimated, given the considerable state support for the advancement and use of national and international AI innovation resources. Other enabling factors include the close linkage of private and state actors. However, in the long term, China might benefit not only from its own efforts but also from the fact that the US lacks an AI strategy of its own. The decline of openness of the US innovation system and disregard for the importance of promoting science and technology research and education could tilt the balance of power in the development of key technologies further towards China.

If the PRC's ascent to become an "AI superpower" is successful, the implications for the international community will be significant. It remains to be seen, however, whether China will shape this development in a cooperative or a confrontational manner.