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RESEARCH BRIEF

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Best Frenemies Forever: Artificial Intelligence, Emerging Technologies, and China–US Strategic Competition

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As the United States and China continue their strategic competition for new and emerging technologies, artificial intelligence (AI) and other machine learning concepts have emerged as key enablers for both commercial and defense applications. In the commercial sphere, the two nations' research and development (R&D) of emerging technologies is now deeply integrated, providing mutual benefit to each country's consumer markets. Conversely, national security planners in each country continue to view each other as potential adversaries, with many of these same technologies seen as potential enablers for dual and defense-use military applications. This research brief presents AI R&D as a case study to build an analytical framework and six models for understanding interactions between key players in the China–US competition. The models demonstrate the broad range of activities that Chinese planners utilize to pursue strategic objectives in AI and other emerging technologies. From domestic R&D to formal espionage, the models contextualize the complex interactions within this competition, providing a framework to forecast and analyze the coming decades of cooperation and conflict.

INTRODUCTION

The United States and China have fundamentally different approaches to fostering market-driven innovation. In the former, private investors seeking economic returns on future breakthroughs drive the commercial market for new and emerging technologies. Although US government policies strive to incentivize innovation through legislation and executive action, the President does not issue mandates or targets for the commercial sector. In a modest attempt to bridge this gap, the Department of Defense (DoD) has announced a "Third Offset" strategy to maintain US defense technological advantages with key inputs from high-tech firms. In contrast, China's S&T planning spans the commercial and defense realm, and a series of interlocking planning documents guide the entire nation's R&D activities. This dedication to a "whole of state" and goal-oriented planning process flows from a long history of central economic planning, which now aims to leverage the best parts of the market, while also firmly guiding commercial and defense S&T development.

As the United States and China continue their strategic competition for new and emerging technologies, AI and other machine learning concepts have emerged as key enabling technologies for both commercial and defense applications. AI has the potential to provide exponential advances in a wide range of robotic, automation, and decision-making applications, all of which would be dramatically improved by AI processes that continually optimize outcomes to a higher quality than their inputs.

Once such machine learning begins, the productivity of an AI-enabled process could dramatically outpace the abilities of its human developers. In the commercial sphere, Kevin Kelly of *Wired* has joked that "the business plans of the next 10,000 start-ups are easy to forecast: Take X and add AI."[1] In the defense realm, DARPA Director Arati Prabhakar has spoken extensively about the potential applications and current limitations of AI, saying that "When we look at what's happening with artificial intelligence, we see something that is very, very powerful, very valuable for military applications, but we also see a technology that is still quite fundamentally limited."[2] These limitations are nearly certain to disappear in the coming decade or two.

A BASIC ANALYTICAL FRAMEWORK FOR CHINA–US COMPETITION IN EMERGING TECHNOLOGIES

Long-term forecasts for any strategic competition are challenging, and are especially so for areas as dynamic as emerging technologies. Distilling this competition to its simplest institutional entities, however, presents analysts with a basic framework on which to conceptualize models of future China–US strategic competitions related to AI and other emerging technologies. The next section discusses six such Chinese models in more detail, but all of this interaction is built on three basic institutional pillars or variables that will determine the success of each country's research, development, and acquisition (RDA) strategies. These variables are the following:

- **Commercial industry:** Emerging technologies will increasingly come from the private sector and not from government entities, making private companies a key player in this competition.
- **Academia:** Universities and laboratories have traditionally produced technological breakthroughs for both the US and Chinese militaries. Their role will continue to be important and evolve based on their relationships with each other domestically and across borders.
- **Defense Industry:** Defense companies and contractors will continue to be the primary providers of combat and support systems to the US and Chinese militaries.

This simplified relationship is marked by extreme fluidity within and between both countries' commercial industry and academia, which then selectively reaches back to the defense industrial base of each country. As DARPA Director Prabhakar has asked and answered, "Where are the breakthroughs going to come from?" going on to say that "[a] theme is if you combine access to leading-edge commercial technology and deeply integrate it with DoD secret sauce, that's where you get phenomenal advancements in capabilities."[3]

This fluid commercial and academic relationship, with points of connectivity into a sealed defense sector, is shown in Figure 1. The box highlights the high degree of interaction and even fusion between the commercial industries and academia of both countries. The framework is meant to illustrate the current relationship between US and Chinese

1 Vivek Wadhwas, "The Amazing Artificial Intelligence We Were Promised Is Coming, Finally," *Washington Post*, June 17, 2016, https://www.washingtonpost.com/news/innovations/wp/2016/06/17/the-amazing-artificial-intelligence-we-were-promised-is-coming-finally/.

2 Mark Pomerleau, "DARPA Director Clear-Eyed and Cautious on AI," *GCN*, May 10, 2016, https://gcn.com/articles/2016/05/10/darpa-ai.aspx.

3 Christian Davenport, "Robots, Swarming Drones, and 'Iron Man': Welcome to the New Arms Race," *Washington Post*, June 17, 2016, https://www.washingtonpost.com/news/checkpoint/wp/2016/06/17/robots-swarming-drones-and-iron-man-welcome-to-the-new-arms-race/?hpid=hp_rhp-more-top-stories_no-name%3Ahomepage%2Fstory.
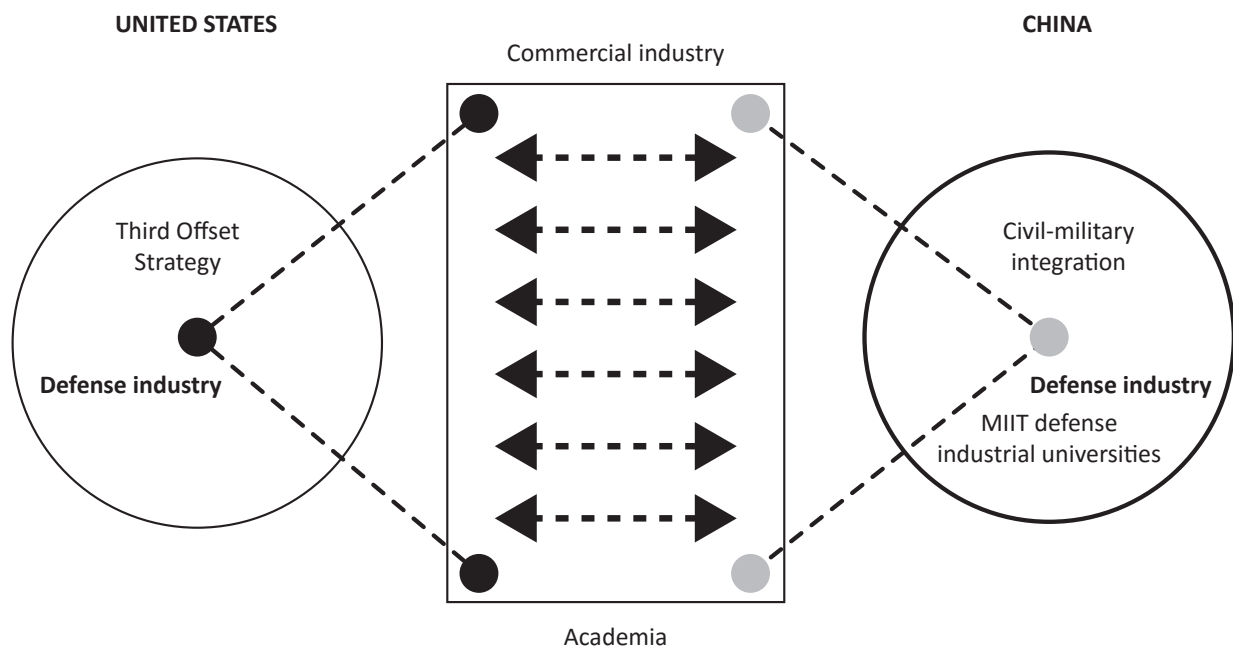
Commercial industry

FIGURE 1. The current relationship between US and Chinese RDA in emerging technologies

RDA in AI and other emerging technologies.

SIX MODELS FOR ACHIEVING STRATEGIC OBJECTIVES IN EMERGING TECHNOLOGIES

Based on our framework, we have identified six models Chinese planners use to pursue strategic objectives related to new and emerging technologies. This brief focuses on these six models to provide policymakers with insights into China's strategies for such a competition.[4]

1. Domestic Chinese R&D investment
2. Academic exchanges
3. Foreign R&D investment
4. Mergers and acquisitions
5. Strategic talent recruitment
6. Espionage

Model One: Domestic Chinese R&D Investment

Internal investment in domestic R&D is China's first model for achieving

its strategic objectives in AI and other emerging technologies. This work at home is the centerpiece on which all other models of technology acquisition and transfer are built. Framing these activities in the analytical framework presented earlier, this model directly allocates resources to national champions across all three variables in China's R&D of emerging technologies: commercial industry, academia, and the defense industry.

Model Two: Academic Exchanges

China's global integration into international academic R&D of AI is a second key model for pursuing national objectives. From an organizational standpoint, Chinese researchers attached to academic institutions, whether universities or state-backed research institutes such as the Chinese Academy of Sciences, are fully integrated into the international communities leading academic exchanges in AI, machine learning, robotics, and other emerging technologies. Within the analytical framework, the entities driving this model reach beyond pure-

ly civilian academic organizations, to include defense-affiliated universities such as the Ministry of Industry and Information Technology's seven universities, and even researchers directly involved with research institutes affiliated with the People's Liberation Army.

Model Three: Foreign R&D Investment

Direct foreign investment in R&D related to AI and other emerging technologies is a third model increasingly pursued by both Chinese and US entities. This burgeoning model is bidirectional, with the observed creation of new R&D entities in the United States and Europe created and funded by Chinese entities, and the establishment of R&D entities within China that are funded by US companies. Building on the analytic framework, this model is driven by commercial industry from the United States and China seeking improved economic returns and technological gains by directly placing their R&D investments abroad.

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4 A comparative analysis of US and Chinese models for strategic competition in emerging technologies, while useful, is beyond the scope of this brief.

Model Four: Mergers and Acquisitions

Under the "mergers and acquisitions" model of competition, the Chinese government directs and supports Chinese companies acquiring foreign firms and, in turn, targeted technologies. Targeted acquisitions could provide Chinese firms with the intellectual property, quality controls, and brand recognition they need to quickly reach international standards. The risks and drawbacks include political backlash in the targeted countries, and no guarantee that incorporating an innovative company will change the culture of the purchaser, that is, make it more innovative. Recent developments in China's semiconductor and integrated circuits industries provide a good example of the use of this model, as the Chinese government has established several investment funds to address longstanding weaknesses in the sector.

Model Five: Strategic Talent Recruitment

China's fifth model for pursuing advances in AI and other emerging technologies is the systematic recruitment of individuals possessing advanced know-how in priority technologies. From the standpoint of the analytic framework, this recruitment incorporates nearly every entity within academia and commercial industry. China's talent recruitment takes place through dozens of national and local-level programs, each of which possesses its own process for advertising, vetting, and selecting recruits. Furthermore, each recruitment plan has its own guidelines regarding whether a person must be full or part-time in China, the length of their contract, and the amount of financial compensation and other benefits received.

Model Six: Espionage

Under the traditional espionage model, government actors would forgo their own domestic entities (academe, commercial, and potentially the military industry) to acquire foreign technologies illicitly. It is unclear whether China is or would directly spy on or penetrate the networks of US firms engaging in AI research. What is clear, however, is that Chinese espionage reportedly remains active in forms of cyber espionage and conspiracies to commit export control violations, among others.

ETHICAL QUESTIONS

Chinese discussions of ethics for the application of artificial intelligence are nascent, likely reflecting that Chinese AI technologies—and the world's for that matter—are not advanced enough to force the issue. Two issues not receiving adequate attention are whether unmanned and AI-enabled systems should be allowed to kill targets without a human operator, and what challenges AI and machine learning pose for escalation control in future crises.

CONCLUSIONS

China–US competition in emerging technologies like AI is unlike any other not only because the technology is dual-use, but also because the interactions between actors is fluid to an unprecedented level. Instead of the Cold War's managed interactions between the academic, defense, and commercial communities, US and Chinese companies are incredibly intertwined. The economic gains, strategic risks, and fluid interactions of communities across borders make this competition unprecedented.

It is also clear that the United States and China have fundamentally different advantages and disadvantages. While the United States has long-held advantages in its commercial and academic R&D, major structural problems in the DoD procurement system often make it incompatible with startup endeavors. In contrast, China's defense procurement system may have problems but there are few structural barriers to leveraging commercial industries for defense purposes. China's advantage of picking national champions can also prove crucial if it is able to predict both the key players and potential breakthroughs. Its longstanding disadvantage continues to be a lag in indigenous innovation, which the six models assessed in this brief seek to address through means ranging from domestic investments to foreign acquisitions to espionage. Ultimately, the contest of "frenemies" will come down to the US ability to reform defense procurement and engage the private sector, versus the Chinese capability to truly indigenize innovation.

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