Issue Brief

Pulling Back the Curtain on China's Military-Civil Fusion

How the PLA Mobilizes Civilian AI for Strategic Advantage

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Executive Summary

Over the past several years, China has worked to transform the People's Liberation Army into a sophisticated, highly capable force that can compete with the U.S. military. In so doing, Beijing has reformed the PLA and rolled out various policies to fast-track military modernization. Key to the Chinese government's aims is the use of artificial intelligence (AI) and related technologies to boost the Chinese military's development and adoption of advanced capabilities to outmatch rivals in future conflicts. To accelerate military modernization, Beijing has encouraged the PLA and state-owned defense conglomerates to work more closely with the civilian sector under its military-civil fusion (MCF) strategy. By fostering closer coordination between the defense and civilian sectors, China's top leaders believe that the PLA can match and eventually surpass U.S. military capabilities.

This report leverages a novel dataset of 2,857 AI-related contract award notices published by the PLA between January 2023 and December 2024. From these documents, we identified 1,560 different organizations that won at least one such AI-related contract. We focus our analysis on the 338 entities awarded at least two AI-related contracts, collecting open-source information on each to shed light on China's AI-related defense industrial base. Furthermore, we assign each entity to one of three categories: state-owned enterprises (SOEs), research institutions, and nontraditional vendors.

Our analysis shows that SOEs and research institutions with longstanding ties to the PLA continue to lead AI-related military procurement. Of the fifteen top awarded entities in the dataset, eleven were either SOEs or defense-affiliated research institutions. The SOEs that won the most contracts were China Electronics Technology Group Corporation (CETC), China Aerospace Science and Technology Corporation (CASC), and China North Industries Group Corporation (NORINCO). The Seven Sons of National Defense—a group of universities closely affiliated with China's defense sector—and various affiliates of the Chinese Academy of Sciences were also among the top awarded entities in the dataset, reflecting their importance in supporting China's military modernization efforts. In short, many of the same organizations that have historically driven Chinese defense technology advancements are also the top suppliers of AI-related goods and services within our dataset.

Nonetheless, the dataset reveals that an emerging class of firms and universities appears to also play a consequential role in China's AI-related military procurement. Close to three-quarters of the 338 entities analyzed in this report are nontraditional

vendors (NTVs), or firms with no self-reported state ownership ties. NTVs won 764 contracts, the most of any of the three categories. Most NTVs were established relatively recently, with two-thirds founded after 2010. On their websites, NTVs often highlight their focus on developing dual-use technologies, indicating that these firms see both the civilian and defense sectors as avenues for growth. Finally, the dataset reveals that some research institutions without well-documented linkages to China's defense sector actively bid on and win contracts to supply the PLA with AI-related products with clear military applications.

Several implications merit mention.

SOEs continue to lead AI-related defense procurement in China, but our findings suggest that while barriers remain for smaller, newer NTVs, these entities appear to be playing a substantial role in providing AI-related technologies to the PLA, potentially accelerating technological development and AI diffusion throughout the Chinese military. Although it is unclear whether Beijing's efforts to promote its MCF strategy are responsible for these trends, this report indicates that NTVs and research institutions are active participants in China's military procurement for AI-related goods and services.

The apparent diversification of China's AI-related defense industrial base presents several challenges. First, it may complicate the United States' ability to hamstring China's military modernization by restricting certain legacy defense players' access to critical technologies and funding. Moreover, our findings could indicate that China has, to some degree, succeeded in fostering competition within its historically inefficient defense sector. If so, these findings may have implications for our understanding of China's ability to incorporate dual-use technologies developed in the civilian sector for military end uses. Finally, this dynamic complicates U.S. due diligence for research funding, export licensing, and outbound-investment screening.

The vast majority of NTVs and research institutions in the dataset are not subject to U.S. sanctions. As the boundaries between civilian and defense technologies blur, the United States will face difficult trade-offs between preserving the openness necessary for innovation while mitigating national security risks. Accordingly, the United States should develop a sophisticated, evidence-based approach to safeguarding research and economic security to both impede the PLA's acquisition and adoption of advanced technologies and ensure that benign and beneficial collaborations with Chinese entities are able to continue.

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Introduction

China's efforts to develop AI-related military capabilities have garnered significant interest in the United States, but there are few data-driven analyses of this subject due to the dearth of relevant data.[1] This study attempts to shed light on a subset of China's military modernization efforts by examining the suppliers of AI-related goods and services in China's defense sector. To do this, we extracted information from 2,857 AI-related and publicly available defense contract award notices published between January 2023 and December 2024. To our knowledge, this is the largest dataset of its kind used in a publicly available analysis, and it offers a rare view into China's AI-related defense industrial base.

Beijing views deploying AI and other emerging technologies as essential to matching and surpassing the warfighting capabilities of the U.S. military.[2] Chinese President Xi Jinping has exhorted the People's Liberation Army to speed the process of military intelligentization (智能化), or the development of AI and other emerging technologies for use in future conflicts.[3]

China's intelligentization push relies on state-owned enterprises (SOEs) that have long dominated China's defense industrial base, as well as a new class of companies and research institutions focused on providing cutting-edge capabilities to the PLA.

Since the end of the Mao era, Chinese policymakers have attempted to improve synergies between China's defense and civilian sectors to boost military modernization. In 1978, for example, Deng Xiaoping introduced the civil-military integration strategy (CMI; 军民结合), which encouraged China's military-linked SOEs to produce non-defense and dual-use products to boost the civilian economy and make China's defense sector more efficient.[4] Successive reforms continued throughout the late 20th and early 21st centuries, paving the way for the military-civil fusion strategy (MCF; 军民融合), which was first introduced in 2007 by then Chinese President, Hu Jintao.[5]

MCF has since become a key pillar of Xi Jinping's defense policy agenda.[6] Whereas Deng's CMI encouraged defense SOEs to aid the civilian economy's development, Xi's MCF aims to better integrate China's defense and civilian sectors, thereby

strengthening its military, technological, and economic capabilities to create an "integrated national strategic system."[7] *

For Beijing, MCF offers a framework for advancing military modernization. First, the Chinese government seeks to foster stronger ties between the civilian and defense sectors, thereby facilitating technology transfer and allowing the PLA to tap into China's broader economic and technological resources, thus advancing its own capabilities.[8] Second, Beijing aims to use MCF to foster competition in the defense sector by opening it to greater participation by the civilian sector. One key element of the strategy involves reforming China's military procurement system to reduce barriers for civilian sector entities to compete for defense contracts.[9] Over the last decade, Beijing has introduced reforms to promote competition in the defense industry, albeit with mixed success.[10]

The paper proceeds as follows. First, we discuss our methodology. Second, we provide an overview of the dataset and highlight key trends. Third, we analyze the top AI suppliers in the dataset—the 338 entities that won at least two AI-related contracts. We find that while SOEs and defense-affiliated research institutions are the leading suppliers in the dataset, an emerging class of nontraditional vendors (NTVs) and civilian research universities appear to play a significant role in supplying the PLA with AI-related goods and services. Finally, we offer key takeaways and concluding thoughts.

* In recent years, Beijing has used the term MCF less frequently, at least publicly. While the reasons for this decline are unclear, Beijing's goals—as they relate to reforming China's defense sector—remain consistent. MCF encompasses a wide range of policy reforms and strategic objectives, most of which are beyond the scope of this study. For more, see, Tai Ming Cheung, *Innovate to Dominate: The Rise of the Chinese Techno-Security State*, Ithaca, NY: Cornell University Press, 2022;
Annual Report to Congress: Military and Security Developments Involving the People's Republic of China, p. 25, https://media.defense.gov/2024/Dec/18/2003615520/-1/-1/0/MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2024.PDF.

Methodology

This report draws from a dataset of 2,857 AI-related award notices published by the PLA between January 2023 and December 2024. The documents analyzed in this report represent a small fraction of all Chinese military procurement documents published during that period. We used a combination of keyword searches and large language model (LLM)-assisted categorization to identify AI-related award notices in scope for this study. We classify an award notice as AI-related if it supports the development or deployment of AI-enabled or autonomous technologies. As a result, the dataset includes a diverse array of goods and services, such as language and vision models, autonomous vehicles, virtual and augmented reality platforms, test and evaluation technologies, logistics systems, data collection and processing systems, smart manufacturing and robotics, and more. For a detailed explanation of the methodology used to classify AI-related award notices, see Appendix B1.

From the 2,857 AI-related award notices, we used a chain of LLM assistants to extract relevant document metadata, including contract value, bid values, contract awardee, and bidding organizations.* 1,560 entities won at least one AI-related contract. To more thoroughly analyze the top suppliers of AI-related technology in the dataset, we gathered additional open-source information on each of the entities that were awarded at least two contracts. We collected self-reported data from their official websites and publicly accessible business registration information, recording each entity's founding date, headquarters location, registered capital, and parent organization, where available.

In cases where entities self-reported their parent organizations on their official websites, we attribute the contracts won by the subsidiary entity to its parent. After attributing contracts to parent entities, we arrived at a final count of 338 entities that were awarded at least two contracts. Attributing contracts to parent organizations helps to avoid undercounting major players and provides a clearer picture of the most active suppliers in the dataset. See Appendix B2 for more information on this methodology.

* Our use of LLMs for these tasks greatly increased our ability to extract analytically useful information from the dataset. Using LLMs for data annotation in this report is fast, replicable, and accurate. Importantly, we manually annotated a subset of contracts to confirm the accuracy of the LLM-enabled data annotation.

We used the gathered open-source information to assign each entity to one of three categories:

- **State-Owned Enterprise (SOE)**: A company that self-reports that it is owned by the state.
- **Research Institution**: A research organization, usually a university or research institute.
- **Nontraditional Vendor (NTV)**: A company that does not self-report state ownership.*

Currency conversions in this report use monthly RMB-to-USD exchange rates, as reported by the Federal Reserve Bank of St. Louis.[11]

Our analysis has several limitations:

First, the dataset of award notices solely relies on publicly available sources; the data does not include classified documents.[12] As a result, our analysis almost certainly underestimates the full scope of AI-related goods and services procured by the Chinese defense sector. Because this report relies on publicly available procurement documents, we cannot claim that this dataset is representative of the entirety of the PLA's procurement of AI-related goods and services. Although this report offers a rare look into an inaccessible, poorly understood subject, it should not be viewed as a comprehensive analysis of China's AI-related defense-industrial base.

Second, the corporate structures of Chinese companies are notoriously opaque. Many of the analyzed entities in our dataset have complicated, sometimes obfuscated ownership structures, making it difficult to determine some of their parent organizations. Still, our methodological approach of relying on self-reported information allows us to more accurately classify each entity and better account for the activities of certain organizations. That said, some entities disclosed more information on their

* We adopt the term nontraditional vendor from the Defense Innovation Board's report, "Scaling Nontraditional Defense Innovation," to refer to a class of entities that do not typically work in the defense sector. However, our methodology for classifying nontraditional vendors, which relies on self-reported ownership ties, differs from that used by the Defense Innovation Board.
See, Defense Innovation Board, "Scaling Nontraditional Defense Innovation," Washington, DC: Department of Defense, January 8, 2025, https://innovation.defense.gov/Portals/63/DIB%20Scaling%20Nontraditional%20Defense%20Innovation%20250113%20PUBLISHED.pdf.

websites than others, and we do not claim to have fully captured the ownership structure of each entity.

Third, this study departs from others that attempt to disambiguate the blurred distinctions between privately owned enterprises and SOEs in China. Instead, we are primarily concerned with characterizing the entities supplying the PLA with AI-related goods and services in order to better understand the extent to which the Chinese military is tapping into an emerging class of suppliers. We recognize that many NTVs in our dataset almost certainly have indirect, informal, or obfuscated ties to the state.

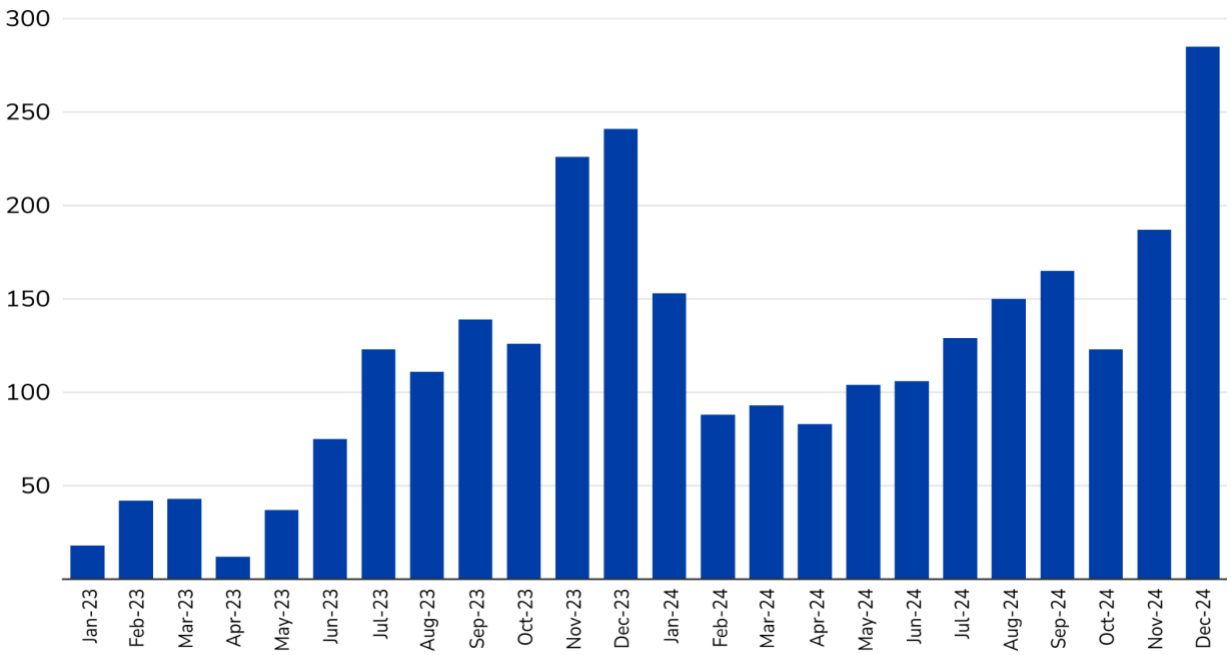
Fourth, because this report is focused on the suppliers of AI-related technologies to China's defense sector, the dataset only includes published award notices. A forthcoming CSET report will analyze the information in specific AI-related bid solicitations, as these include more details about the AI-related technologies and capabilities that the PLA is purchasing.

Despite these limitations, this study offers a detailed, data-driven examination of the companies supplying AI-related technologies to the PLA by using a unique dataset of military procurement documents. In doing so, this study provides a rare look into China's military AI industrial base, a topic of increasing concern given intensifying U.S.-China geopolitical and technological competition.

Overview of AI-related Procurement Data

To our knowledge, the full dataset of AI-related award notices analyzed in this report is the largest of its kind, at least among those featured in publicly available studies. In all, of the 2,857 AI-related award notices published between January 2023 and December 2024 by the PLA, 2,090 include contract values. These contracts amount to $535.5 million, a small fraction of China's total reported military spending, which is estimated to be worth several hundred billion dollars per year.[13] Most of the contracts that included contract values were for relatively small sums. Figure 1 presents the number of AI-related award notices by month. For contract value by month, see Appendix A1.

Figure 1. AI-Related Award Notices by Month



Source: CSET dataset of AI-related Chinese military award notices.

As Figure 1 and Appendix A1 demonstrate, both the overall number and total value of AI-related award notices published each month between January 2023 and December 2024 have generally trended up. Importantly, due to a missing set of contracts for the period of January 2023 through April 2023, we are unable to make definitive conclusions about these figures. From May 2023 to December 2023, 1,039 AI-related award notices were published. For the same period in 2024, the number rose to 1,249, an increase of 16 percent. The value of AI-related award notices increased by 12.5 percent over the same seven-month period, from $162.8 million in 2023 to $183.2 million in 2024.

While the dataset includes a large number of entities that submitted bids on AI-related projects, only a subset of those entities won contracts. 3,789 distinct entities appeared as bidders on at least one award notice across the 2,857 AI-related award notices in our dataset. However, only 1,560 entities were awarded an AI-related contract. Table 1 organizes the entities into tiers by number of awarded contracts.

Table 1. Contracts Awarded and Number of Entities, Tiered

Contracts Awarded (Tier)	Number of Entities	Total Contracts Awarded, Tier
20-99	10	441
10-19	15	197
5-9	45	295
4	28	112
3	76	228
2	164	328
1	1,222	1,222
0	2,229	0

Source: CSET dataset of AI-related Chinese military award notices.

While the data in Table 1 shows that many entities participate in AI-related military procurement, contract awards are more concentrated among a narrower pool of vendors. For instance, just 25 entities won 23 percent of all contracts, representing less than two percent of all entities that won contracts. 45 percent of the total contracts were won by 174 entities that were awarded at least three AI-related contracts—less than five percent of the overall number of bidders featured in the dataset.

These figures suggest that entities are strongly incentivized to submit bids, even for relatively small contracts. Winning a public bid can lead to significant benefits for a company, and successfully executing a publicly tendered military procurement contract can lead to follow-on opportunities through access to nonpublic, invitation-only, or sole-source contracts.[14] These types of contracts can also yield higher margins than sales to the civilian sector, where open competition reduces profitability. In addition, registered military suppliers enjoy a suite of advantages, from government subsidies to reputational benefits.[15]

The above figures highlight two key points. First, the PLA significantly expanded its procurement of AI-related goods and services between January 2023 and December

2024, an increase that is consistent with Beijing's push to modernize and enhance China's military capabilities. Second, numerous entities appear motivated to participate in the PLA's development and deployment of AI-related capabilities. Though several thousand distinct entities submitted bids, only a small portion of these entities account for the majority of contracts awarded. Throughout the rest of the report, we focus our analysis on the 338 entities that were awarded at least two contracts to better understand the PLA's top suppliers of AI-related goods and services.

The PLA's Top Suppliers of AI-Related Technology

This section focuses on the PLA's top suppliers of AI-related technologies in our dataset. Table 2 presents the top five contract awardees in each of our three categories of entities—SOEs, research institutions, and NTVs. Appendix A2 presents the top fifteen entities by contracts awarded.

Table 2. Top Contract Awardees by Entity Category

State-Owned Enterprises		Research Entities		Nontraditional Vendors	
Name	Contracts Awarded	Name	Contracts Awarded	Name	Contracts Awarded
China Electronics Technology Group Corporation (CETC)	90	Chinese Academy of Sciences (CAS)	92	Hefei iFlytek Digital Technology (iFlytek Digital)	20
China Aerospace Science and Technology Corporation (CASC)	47	Northwestern Polytechnical University	33	PIESAT Information Technology (PIESAT)	18
China North Industries Group Corporation (NORINCO)	46	Beihang University	23	NovaSky Technology (NovaSky)	15
China State Shipbuilding Corporation (CSSC)	44	Beijing Institute of Technology	18	Chengdu JOUAV Automation (JOUAV)	12
Aviation Industry Corporation of China (AVIC)	26	Shanghai Jiao Tong University	15	Nanjing Huage Information Technology	11

Source: CSET dataset of AI-related Chinese military award notices.

As shown in Table 2 and Appendix A2, most of the top suppliers in the dataset have strong links with China's defense sector, including seven of China's most prominent defense SOEs, three Seven Sons of National Defense universities, and the Chinese Academy of Sciences (CAS).[16] *

The China Electronics Technology Group Corporation (CETC) was the top-awarded SOE in the dataset, submitting 155 bids and winning 90 AI-related defense contracts in 2023 and 2024. Other prominent SOEs in the dataset, which each won 26 or more

* The Seven Sons of National Defense (国防七子) include Northwestern Polytechnical University, Harbin Engineering University, Beijing Institute of Technology, Harbin Institute of Technology, Beihang University, Nanjing University of Aeronautics and Astronautics, and Nanjing University of Science and Technology. They have deep ties to the PLA and China's defense industry, investing heavily into defense research and R&D for military products. For more, see Alex Joske, "The China Defence Universities Tracker," Policy Brief No. 23/2019 (Canberra: Australian Strategic Policy Institute, International Cyber Policy Centre, November 25, 2019), https://www.aspi.org.au/report/china-defence-universities-tracker/.

contracts, include China Aerospace Science and Technology Corporation (CASC), China North Industries Group Corporation (NORINCO), China State Shipbuilding Corporation (CSSC), and Aviation Industry Corporation of China (AVIC). All five of these entities are major defense SOEs that supply the PLA with a range of technologies and capabilities.[17]

CETC plays a central role in China's military-civil fusion strategy, aiming to incorporate civilian technologies into advanced military electronics systems.[18] One of China's flagship defense SOEs, the organization has dozens of semi-autonomous research institutes and hundreds of commercial subsidiaries.[19] CETC develops a range of technologies, from military radars and lasers to power plant equipment.[20] The SOE has also emerged as an important player in China's drone industry, as it produces both unmanned aerial vehicles and software to enable swarming.[21] It advertises a range of command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) capabilities, including those designed specifically for the army, navy, and air force, as well as a "joint command and control system."[22] Several notable CETC subsidiaries are covered in detail later in the report.

While CASC is a mainstay of China's aerospace industry and a major producer of missile systems, it also appears to be an important player in China's military AI procurement.[23] Several of its subsidiaries that were awarded AI-related contracts are major defense suppliers. For example, Rainbow UAV Technology Co., Ltd. (彩虹无人机科技有限公司), which won four contracts, is a leading military drone producer. It is involved in the design, development, and manufacturing of the "rainbow" (彩虹) series of multi-role combat UAVs.[24] The CASC subsidiary won contracts for "The Development of the Performance Verification Index System and Model of Airborne Unmanned Detection and Perception Payload Based on the Rainbow-4 UAV Platform" (基于彩虹-4 无人机平台的机载无人探测感知载荷效能验证指标体系及模型开发比价), and a "Ground Control Simulation System for a Certain Type of UAV" (某型无人机地面控制模拟系统). Another subsidiary, Aerospace Times Feihong Technology Co., Ltd. (航天时代飞鸿技术有限公司), which won six contracts, including a "Small Multi-Type UAV Simulation System Project" (小型无人机多机型模拟系统项目) and a "Micro and Small UAV System" (微小型无人机系统), focuses on developing UAVs equipped with AI-enabled capabilities.[25]

As shown in Table 3, the average value of the contracts awarded to SOEs far outstrips those to both NTVs and research institutions. SOEs won $242.9 million in contracts, compared to $100.8 million for NTVs and $43.4 million for research institutions in 2023 and 2024. As a reminder, just over a quarter of the documents do not include contract

values. 36 percent of contracts awarded to research institutions lack contract values, compared to just over 20 percent for those awarded to SOEs and NTVs.

Table 3. AI-related Contract Awards by Granular Entity Category

Entity Category	Contracts Awarded	Contract Value
State-Owned Enterprises	**414**	**$242,885,380**
Defense Research Institutes	*145*	*$148,909,545*
Research Institutions	**423**	**$43,426,801**
CAS	*92*	*$19,770,122*
Seven Sons	*114*	*$10,956,299*
Universities	*206*	*$10,277,658*
Other	*11*	*$2,422,721*
Nontraditional Vendors	**764**	**$100,838,755**

Source: CSET dataset of AI-related Chinese military award notices.

Note: "Defense Research Institutes" refers to research institutes or laboratories that are subsidiaries of SOEs.[*] Figures for contract value and contracts awarded in the state-owned enterprises row also include those of defense research institutes. The data in the row for research institutions includes contracts awarded to CAS, the Seven Sons of National Defense, and other research institutions, including universities and a few research laboratories.

Between January 2023 and December 2024, the value of the average contract awarded to SOEs was $747,340, over four times that of the average contract awarded to NTVs ($170,048) and research institutions ($161,438).[†]

[*] Defense research institutes are not classified as research institutions in this report because they are subsidiaries of SOEs. For more on defense research institutes, see Tai Ming Cheung, "Keeping Up with the Jundui: Reforming the Chinese Defense Acquisition, Technology, and Industrial System," in Chairman Xi Remakes the PLA, ed. Philip C. Saunders et al., National Defense University Press, 2019, https://ndupress.ndu.edu/Media/News/News-Article-View/Article/1748736/keeping-up-with-the-jundui-reforming-the-chinese-defense-acquisition-technology/.

[†] These averages are calculated using the total contract value and the number of contracts with value data. We exclude from these averages the portion of the contracts in our dataset that did not include contract value information. 36 percent of contracts awarded to research institutions lack values, compared to 21 percent for those awarded to SOEs and 22 percent for those awarded to nontraditional vendors.

Notably, defense research institutes, defined as research institutes or laboratories overseen or administered by SOEs, were awarded a sizable quantity of AI-related contracts. In 2023 and 2024, these SOE subsidiaries won 121 contracts worth $132.9 million. For example, the 54th Research Institute of China Electronics Technology Group Corporation, a subsidiary of CETC that is on the U.S. Bureau of Industry and Security's Entity List, won seven AI-related contracts, including a "Medium-Range General-Purpose UAV Control Simulation System Project" (中程通用无人机操控模拟系统项目) and a "Data Processing and Fusion Algorithm Module" (数据处理与融合算法模块).[26] The data indicates that these SOE-affiliated defense research institutes are key to the Chinese defense sector's development of AI-enabled capabilities.

Many of these SOE-affiliated research institutes and laboratories have relatively limited public profiles. But some, such as the CETC-affiliated Nanjing Research Institute of Electronic Engineering (南京电子工程研究所; NRIEE) which won five contracts, provide more public information.[27] The organization notes that it is China's "first command automation system research institute" and advertises information processing systems that aid in data fusion and other products that claims to assist with military decision-making.[28] The contracts awarded to NRIEE are closely related to the main products listed on its website, including $1.5 million for the "Development of Overall and General-purpose Support Modules for a Typical Big Data Application Integration" (某大数据典型应用研制集成总体及共性支撑模块研制) and $5.1 million for the "Construction of a Big Data-Based Aggregation and Application Information System" (某大数据构建与聚合应用信息系统建设). In December 2022, NRIEE was added to the Entity List, with U.S. officials citing it as an active player in the R&D, manufacture, and acquisition of AI chips for China's military modernization efforts.[29]

Top Research Institutions: CAS and the Seven Sons

As shown in Table 3, research institutions won 423 AI-related contracts in 2023 and 2024. Almost half of these were awarded to CAS and the Seven Sons of National Defense, institutions that have long contributed to China's defense R&D ecosystem.[30]

The top research institution in our dataset is CAS. As a recent CSET report elaborates, CAS is among the most important S&T institutions in the world.[31] 44 different CAS-affiliated entities featured bidders on at least one AI-related award notice in the dataset. In all, CAS and its affiliates won 92 AI-related contracts worth a total of $19.8 million. Several prominent CAS institutes received contracts, including the Shenyang Institute of Automation (沈阳自动化研究所), the Institute of Automation (自动化研究所), and the Changchun Institute of Optics, Fine Mechanics and Physics (长春光学精密机械与物理研究所). Notably, the Shenyang Institute of Automation, as well as the

Changchun Institute of Optics, Fine Mechanics and Physics were placed on the Entity List in June 2022 and January 2025, respectively.[32] Appendix A3 shows the top CAS-affiliated entities in our dataset.

The Shenyang Institute of Automation and the Institute of Automation have emerged as leaders in China's AI development efforts. The Shenyang Institute of Automation, awarded four AI-related contracts between January 2023 and December 2024, specializes in robotics, wireless sensing, and intelligent manufacturing.[33] According to its website, the organization has produced a variety of robots, including those for applications in space, industry, and underwater environments.[34] The Institute of Automation, meanwhile, won five AI-related contracts. This CAS-affiliated institution focuses on computer vision, intelligent robots, and intelligent system integration, among other applications.[35] It holds myriad patents, including those related to drone clustering and air combat algorithms.[36] Both institutes maintain a network of in-house R&D centers and national key laboratories, as well as ties to domestic and foreign universities and research centers.[37] Contracts awarded to the Institute of Automation include a project to develop algorithms to process audio data and a study to develop AI algorithms to distinguish magnetic anomaly signals, likely to assist in the development of advanced sensing capabilities.

Three of the other research entities that feature among the top 15 overall suppliers of AI-related technology to the PLA in our dataset—Northwestern Polytechnical University (西北工业大学), Beijing University of Aeronautics and Astronautics (北京航空航天大学; aka Beihang University [北航大学]), and the Beijing Institute of Technology (北京理工大学)—are members of the Seven Sons of National Defense (国防七子), a grouping of public universities that work closely with the PLA on S&T research and are overseen by the Ministry of Industry and Information Technology. Each of the Seven Sons was awarded AI-related defense contracts: altogether, they won 114.

The Xi'an-based Northwestern Polytechnical University, the top-awarded Sevens Sons university in the dataset, won 33 AI-related contracts. The university maintains several AI-focused research institutes, including the National Engineering Research Center for Unmanned Aerial Vehicle Systems (无人机系统国家工程研究中心) and the National

Engineering Laboratory for Integrated Aero-Space-Ground-Ocean Big Data Application Technology (空天地海一体化大数据应用技术国家工程实验室).[38] *

Contracts awarded to Northwestern Polytechnical University include almost $700,000 for "the Design and Verification of a Certain Model Algorithm," awarded in November 2023 and close to $167,000 for "The Development of a Multimodal Human-Machine Integrated Intelligent Decision Control System," awarded in January 2024.

Harbin Engineering University (哈尔滨工程大学), another Sevens Sons university, was awarded 10 contracts. Like Northwestern Polytechnical University, Harbin Engineering University hosts numerous scientific research institutes, listing 59 on its website. These include the Key Laboratory of Multidisciplinary Collaborative Cognitive Artificial Intelligence Technology and Application (多学科协同认知人工智能技术与应用重点实验室) and the China-Russia Belt and Road Joint Laboratory for Polar Technology and Equipment (中国–俄罗斯极地技术与装备"一带一路"联合实验室).[39] † Finally, Nanjing University of Science and Technology (南京理工大学) won nine contracts. The university is a research hub for weapons science and technology and intelligent ammunition systems.[40] It offers courses on target detection and recognition technologies, intelligent rocket systems, and other militarily relevant topics.[41]

Notable contracts awarded to Harbin Engineering University include one for the "Development of a Mission Reconstruction Model for UUV Swarms with Formation Autonomy" (面向阵型自持的 UUV 集群任务重构模型开发), while Nanjing University of Science and Technology won its bid to develop a "High-Performance Rapid Prototyping Simulation Controller for Dexterous Robotic Manipulation" (面向机器人灵巧操作的高性能快速原型仿真控制器开发). The contracts highlighted in this section underscore that China's defense universities are not only involved in basic research but also applied R&D efforts that directly support the PLA's military capabilities.

This data confirms that organizations that have deep, longstanding ties to China's defense sector continue to lead in military procurement of AI-related goods and

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* Neither the National Engineering Research Center for Unmanned Aerial Vehicle Systems nor the National Engineering Laboratory for Integrated Aero-Space-Ground-Ocean Big Data Application Technology appeared in AI-related award notices published in 2023 or 2024.

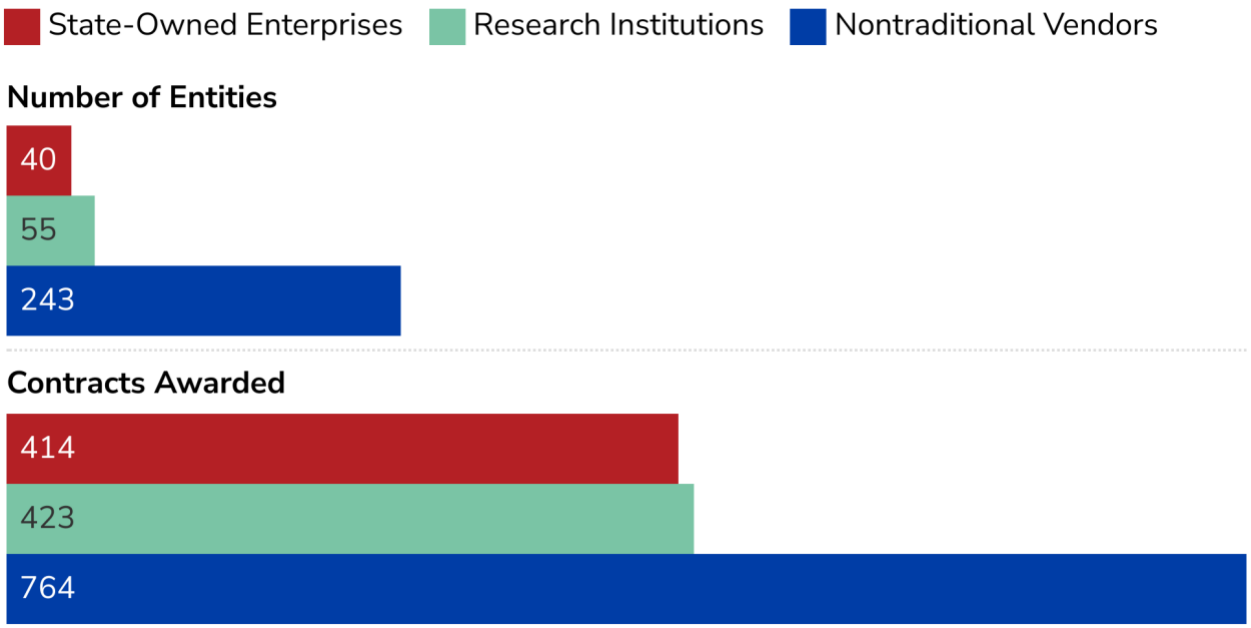
† The Key Laboratory of Multidisciplinary Collaborative Cognitive Artificial Intelligence Technology and Application and the China-Russia Belt and Road Joint Laboratory for Polar Technology and Equipment do not feature in the dataset.

services. This is perhaps not surprising considering the entrenched nature of defense contracting, the preferential treatment given to SOEs and leading defense universities in China, and the vast resources such entities dedicate to state-sanctioned R&D priorities.[42] That said, our analysis of all 338 entities that were awarded at least two AI-related contracts reveals that a new class of suppliers to the PLA is emerging. In the following section, we further analyze these entities.

Not Just SOEs: Analyzing Emerging Suppliers of AI-Related Technologies

While the top suppliers of AI-related technology in the dataset are SOEs and research institutions that have long been affiliated with China's defense sector, our analysis reveals that a wide range of organizations are nonetheless active in the PLA's procurement of AI-enabled goods and services. Figure 2 presents how many entities in each of our three categories—SOEs, research institutions, and NTVs—won at least two AI-related defense contracts, along with the total contracts awarded to each group.

Figure 2. Number of Entities by Classification



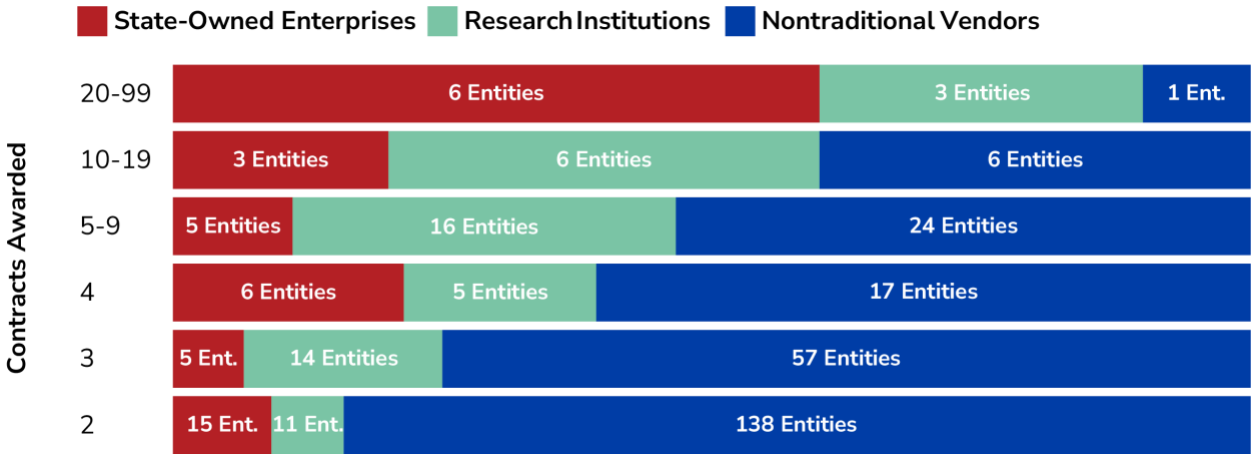
Source: CSET dataset of AI-related Chinese military award notices.

Figure 2 shows that defense SOEs and military-linked research institutions are not the only suppliers of AI-enabled technologies. As a reminder, we identified 3,789 unique entities that submitted at least one bid in 2023 or 2024, and 1,560 entities that won at least one contract during this same period of time. The remainder of this report, however, focuses on the 338 entities that were awarded at least two AI-related contracts. When looking at this subset, over 70 percent are NTVs. These 243 firms do not self-report state ownership ties on their websites.

Furthermore, Figure 3 shows the number of SOEs, research institutions, and NTVs by contracts awarded. While SOEs and a few defense-affiliated research institutions are the top suppliers in our dataset—iFlytek Digital (合肥讯飞数码科技有限公司) was the

only NTV awarded 20 or more AI-related contracts—Figure 3 reveals that a broader set of entities comprise the PLA's suppliers of AI-related goods and services. Of the entities awarded fewer than 10 contracts, three-quarters are NTVs.* Altogether, NTVs won 764 contracts. Excluding CAS and the Seven Sons, research institutions won 224.

Figure 3. Contracts Awarded by Entity Classification



Source: CSET dataset of AI-related Chinese military award notices.

The above figure illustrates two seemingly contrasting dynamics in the PLA's AI defense industrial base. On one hand, China's leading defense SOEs and defense-affiliated research institutions are still the top-awarded entities in the dataset, even in a nascent technology sector like AI; on the other hand, an emerging class of NTVs and civilian universities are bidding on and winning a substantial portion of AI-related defense contracts.†

As further evidence of the apparent competitiveness of NTVs and research institutions for AI-related contracts, Figure 4 presents the total bids submitted and contracts awarded by each type of entity. Importantly, because each procurement document only

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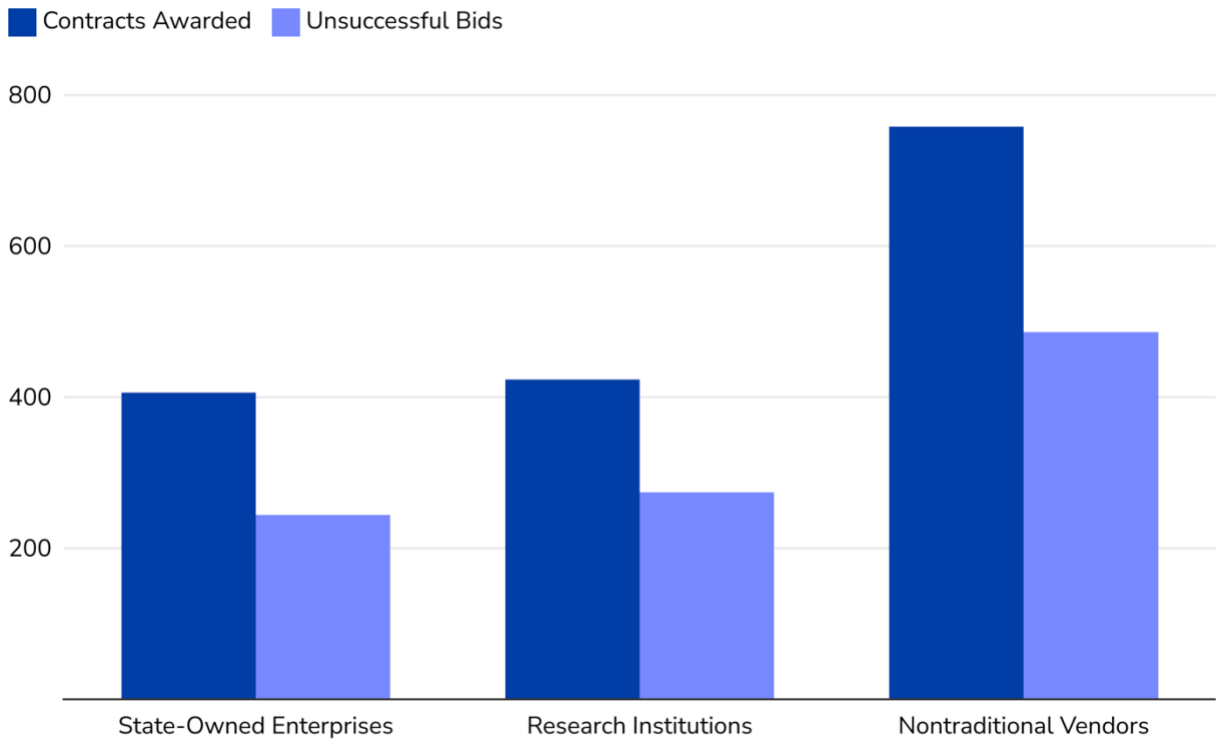
* This analysis only includes entities that were awarded fewer than 10 and at least two AI-related contracts, since we did not categorize entities awarded fewer than two AI-related contracts.

† We use civilian universities to describe institutions supervised by the Ministry of Education (MOE), provincial or local governments, and other non-security governmental agencies. The Seven Sons of National Defense, as well as institutions overseen by the PLA, the Ministry of State Security, the Ministry of Public Security, or the General Office of the Chinese Communist Party, are excluded. This definition follows that used in the Australian Strategic Policy Institute's China Defence Universities Tracker. See: Joske, The China Defence Universities Tracker.

includes information about the entities that submitted the three most competitive bids, the unsuccessful bid data in Figure 4 is incomplete. As a result of the partial bid data, we cannot assert that this data completely captures the relationship between the awarded contracts and unsuccessful bids. That said, of the 1,254 contracts on which NTVs submitted bids, they won 764 (61 percent). Notably, this proportion was similar to that of both research institutions and SOEs (61 percent and 63 percent, respectively).

Figure 4. Contracts Awarded and Unsuccessful Bids by Entity Type



Source: CSET dataset of AI-related Chinese military award notices.

While acknowledging the limitations of this incomplete data, that the proportion of successful to unsuccessful bids is similar across the three types of entities challenges the notion that SOEs face little competition in China's military procurement processes, at least within the subset of contracts featured in the dataset. This is particularly significant given that SOEs have historically accounted for the overwhelming majority of military procurement contracts in China and that non-SOEs faced steep, often insurmountable barriers to winning such contracts.[43]

In sum, this data suggests that NTVs and research institutions are important contributors to China's AI-related defense industrial base. NTVs won more AI-related

contracts than did research institutions or SOEs, even as SOEs were awarded the highest-value contracts. Tracking how this balance shifts over time will be critical to understanding the PLA's procurement of AI-enabled capabilities.

Below, we further expand on the role of NTVs and civilian universities in AI-related military procurement.

Emerging Suppliers: Nontraditional Vendors

The NTVs in the dataset specialize in a wide range of AI-enabled applications. For example, iFlytek Digital, the top-awarded NTV, is a company with close ties to iFlytek, an AI company that has developed AI-enabled techniques for natural language processing, translation, data mining, and speech recognition.[44] * iFlytek helped develop China's first "mass automated voice recognition and monitoring system" and played a key role in the Chinese government's surveillance programs in Xinjiang and Tibet, among other provinces and autonomous regions.[45] Given its prominent role in Beijing's security apparatus, iFlytek has been on the U.S. government's radar for years; it was placed on the Bureau of Industry and Security's Entity List in late 2019.[46] The dataset underscores that iFlytek Digital has emerged as an important military supplier, winning 20 contracts in 2023 and 2024, including one for the development of an "Intelligent Speech Processing and Translation System" (某智能语音处理与翻译系统), and another for an "Auxiliary Decision-Support System" (某辅助决策系统), among other data processing and analysis-related projects.

After iFlytek Digital, PIESAT and Chengdu JOUAV Automation were among the top-awarded NTVs in our dataset. PIESAT (航天宏图信息技术股份有限公司), a company listed on the Shanghai Stock Exchange Science and Technology Innovation Board (STAR Market), specializes in aerospace systems, including remote sensing satellite constellations.[47] The company also markets a range of AI-related technologies, including data fusion software to process and integrate remote sensing and radar data,

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* iFlytek Digital was a subsidiary of iFlytek until 2021, after which reports indicate that iFlytek divested its shares from the company. However, the ultimate beneficiaries of the new ownership group of iFlytek Digital consisted of iFlytek executives, indicating continued linkages to the original parent. See: "The Disappearance" of iFlytek Digital, May 19, 2021. https://perma.cc/HLA4-SUWB. Although iFlytek has links to the Chinese Academy of Sciences and other state sector entities, we classify iFlytek Digital as an NTV because it does not self-report that it is owned or affiliated with research institutions or SOEs. For more on iFlytek's relationship with CAS, see: Cole McFaul, Hanna Dohmen, Sam Bresnick, and Emily S. Weinstein, "Fueling China's Innovation: The Chinese Academy of Sciences and Its Role in the PRC's S&T Ecosystem," Washington, DC, Center for Security and Emerging Technology, October 2024.

as well as automatic target recognition capabilities and drones.[48] It also provides virtual combat simulation platforms, combat planning technology, and equipment testing capabilities.[49] PIESAT is deeply integrated into China's AI defense-industrial ecosystem, and has partnered with the Chinese government and a range of SOEs, including CETC, CASC, and the Chinese Aerospace Science and Industry Corporation (CASIC).[50] Notable contracts awarded to PIESAT include $572,622 for a "Big Data Analysis and Artificial Intelligence Application System" (大数据分析与人工智能运用系统), a project to develop an "Unmanned Aerial Vehicle Virtual Simulation Training System" (无人机虚拟仿真练习系统) worth $222,111, and a contract for a "Multidimensional Visualization Application System for Marine Environmental Big Data Analysis and Mining" (海洋环境大数据分析挖掘产品多维可视化应用系统).

Chengdu JOUAV Automation (成都纵横大鹏无人机科技有限公司) is a Sichuan-based company that specializes in unmanned aerial vehicles (UAVs), including those that can perform vertical takeoffs and landings (VTOL).[51] JOUAV, which is also listed on the Shanghai Stock Exchange's STAR Market, claims to be the first Chinese drone company to go public.[52] According to its website, JOUAV has sold products to clients in 40 countries and holds over 400 drone-related patents.[53] While the company's main product is UAVs, it also sells LiDAR systems, cameras, and thermal sensors, as well as software for data collection, processing, and analysis.[54] The majority of the 12 contracts awarded to JOUAV were related to the procurement of UAVs and related technologies.

Sichuan Tengden Sci-Tech Innovation Co., Ltd. (四川腾盾科创股份有限公司), which won six AI-related contracts in 2023 and 2024, is an NTV that exemplifies Beijing's vision for the implementation of its MCF strategy.* Established in 2016, Sichuan Tengden was founded by a former deputy director and deputy chief engineer at the AVIC Chengdu Aircraft Design Research Institute, where he helped design the J-10 and FC-1, both fourth-generation multirole combat aircraft.[55] Tengden, a "Little Giant" enterprise, soon received large investments from both the Fujian Provincial and Guangxi Zhuang Autonomous Regional governments and has since signed cooperation agreements with various defense sector organizations.[56] While the PLA historically sources weapons systems exclusively from SOEs, Sichuan Tengden sold the TB-001—a medium-sized combat UAV—to the PLA Rocket Force, which has used the drone to conduct intelligence, surveillance, and reconnaissance (ISR) missions around Japan and

* "Sichuan Tengden Sci-Tech Innovation Co., Ltd." is the company's official English-language name, per its website. A more literal translation of the company name would be "Sichuan Tengdun Science and Technology Innovation Co., Ltd."

Taiwan.[57] The TB-001 is notable in that it represents one of the first known cases in which a non-SOE supplied the PLA with a complete military end-use system.[58] *

Figure 5. Sichuan Tengden's TB-001 UAV

Source: Sohu—China Equipment Chronicle.[59]

Other NTVs specialize in data analysis, autonomy, and training. Beijing SOUVI Information Technology Co. Ltd. (北京华路时代信息技术股份有限公司) which won four contracts, advertises drone control systems, intelligent image processing platforms, and data mining capabilities, among other products and services.[60] Xi'an Lyncon Electronic Technology Co., Ltd. (西安羚控电子科技有限公司), which won three contracts, claims to produce military drones with swarming and autonomous landing, cruising, and take-off capabilities.[61] Other companies, such as Beijing Magicode Science and Technology Co., Ltd. (北京神舟智汇科技有限公司), which won three contracts, is based in Beijing's Zhongguancun Military-Civil Fusion Industrial Park (中关村军民融合产业园). The

* Historically, only China's defense SOEs were permitted to compete for most major weapons systems contracts, which were usually awarded through single-sourcing mechanisms. For more, see Tai Ming Cheung, "Keeping Up with the Jundui: Reforming the Chinese Defense Acquisition, Technology, and Industrial System," in *Chairman Xi Remakes the PLA*, ed. Philip C. Saunders et al., National Defense University Press, 2019, https://ndupress.ndu.edu/Media/News/News-Article-View/Article/1748736/keeping-up-with-the-jundui-reforming-the-chinese-defense-acquisition-technology/.

company advertises that its AI-enabled virtual combat simulation platforms are used by various branches of the PLA for both training and war-gaming.[62]

Emerging Suppliers: Civilian Universities

There are 55 research institutions in the dataset that won at least two AI-related contracts, the majority of which are civilian universities. For example, outside of the Seven Sons, Shanghai Jiao Tong University (上海交通大学) and Tsinghua University (清华大学) are among the top-awarded universities in our dataset, winning 15 and seven AI-related contracts, respectively. These universities are internationally recognized hubs of AI research.[63] Though not directly affiliated with the military, they have collaborated on S&T research with China's defense sector. Shanghai Jiao Tong University, for example, has signed several cooperation and R&D agreements with Chinese military-linked entities, including AVIC and CSSC.[64] In a 2022 speech, the president of the university touted its work to promote MCF.[65] For its part, Tsinghua University has signed strategic cooperation agreements with CASC and CASIC.[66] Shanghai Jiao Tong won a contract published in November 2023 for "Research on Bidirectional Control Method for Neural Network Decision-Making Module" (神经网络决策模块双向控制方法研究). Contracts awarded to Tsinghua University include a "Prototype System of Behavior Modeling and Optimization Based on Multi-Agent Collaboration" (基于多智能体协同的行为建模与优化原型系统) and "a Certain Type of AI Adversarial Virtual Target Generation Software for UAVs" (无人机 XXAI 对抗虚拟目标生成软件), projects that may help improve multi-agent systems and stress test UAV targeting systems.[67]

While the defense sector ties of some universities have been previously documented, other civilian universities without prominent military links also won contracts. The Australian Strategic Policy Institute's China Defence Universities Tracker includes risk evaluations for over 150 Chinese research institutions.* Of the 51 universities that won at least two AI-related contracts in the dataset, 29 received "high" or "very high" risk evaluation scores.† Fourteen universities received a risk evaluation of "medium" or

* In August 2025, the Australian Strategic Policy Institute announced that it would publish an update to the China Defence Universities Tracker.

† Universities that received "very high" risk evaluations include all of the Seven Sons of National Defense, Xidian University, Wuhan University, and Tsinghua University, among others. Twenty-one of the 29 universities with "high" or "very high" risk evaluations in our dataset were classified by ASPI as civilian universities.

“low,” and eight were missing from ASPI’s tracker. For example, Beijing Jiao Tong University (北京交通大学), China University of Geosciences (Wuhan) (中国地质大学(武汉)), and Dalian Maritime University (大连海事大学), are listed as “medium risk” institutions for their involvement in defense R&D projects, according to the Australian Strategic Policy Institute’s China Defence Universities Tracker.[68] East China Normal University and Nankai University, both listed as “low risk” in the tracker, won five and three contracts, respectively.[69] Many of these civilian universities have established research facilities in other countries and partnered with U.S. and European universities.[70]

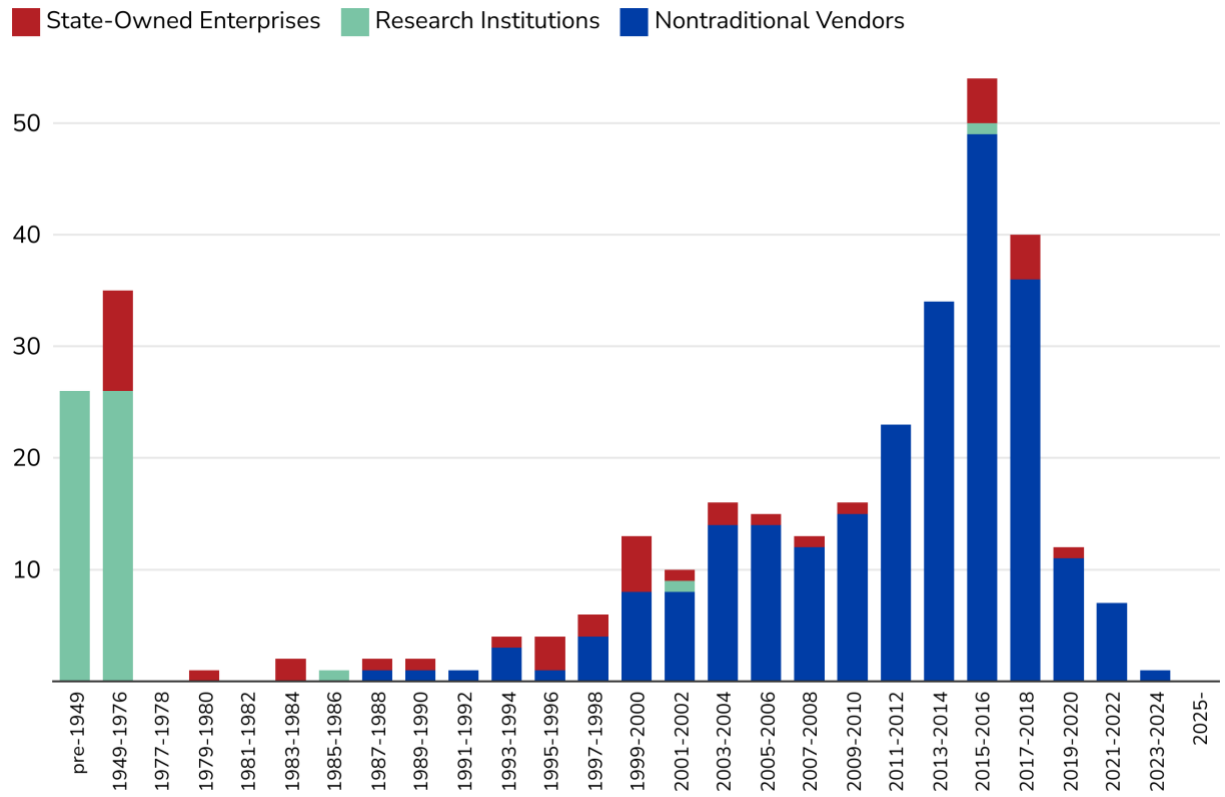
Contracts awarded to these medium- and low-risk universities include AI-related contracts for the development of military-relevant capabilities. For example, Beijing Jiao Tong University was awarded seven AI-related contracts, including one for the “Development of Deep Reinforcement Learning Uncertainty Analysis Module and Verification Environment” (深度强化学习不确定性分析模块与验证环境开发), likely to support efforts to assess the robustness of certain systems. Contracts awarded to East China Normal University, listed as a “low risk” entity, include a project for “Semantic Modeling Software for Navigation Environment of Unmanned Platforms and Platform Modification Materials” (无人平台导航环境语义建模软件与平台改造材料). Semantic modeling for navigation may refer to semantic mapping, used for advanced robotic navigation and cited as a key enabler of embodied AI.[71] Beijing University of Technology, which does not appear on the ASPI China Defence Universities Tracker, won three contracts, including one for a “Swarm Cooperative Navigation Hardware Proof-of-Concept Prototype” (无人集群协同导航原理样机硬件).

For the United States, the ties between the civilian and defense sectors in China pose significant challenges. Policymakers in Washington are increasingly encouraging U.S. universities and companies to reexamine their connections to Chinese civilian universities and companies. In September 2024, the House Select Committee on the Chinese Communist Party published a report examining the extent to which U.S. federally funded research benefits China’s military modernization.[72] The report found that U.S. federal research funds had been allocated to researchers and institutions with close ties to China’s defense sector, partially as a result of opaque ties to the defense sector. The report further cited both Shanghai Jiao Tong and Tsinghua University for their ties to the defense industry.[73] Following the report’s publication, the University of Michigan and the University of California Berkeley terminated their partnerships with Shanghai Jiao Tong University and Tsinghua University, respectively.[74]

Characterizing the PLA's AI Suppliers: Firm Maturity

Historically, the PLA largely relied on a small group of defense-focused SOEs for its procurement needs. However, as discussed, our analysis suggests that a new group of emerging companies is active in AI-related military procurement. As shown in Figure 6, the vast majority of these NTVs were founded after the turn of the century, with two-thirds established after 2010.

Figure 6. Analyzed Entities by Entity Classification and Founding Year



Source: CSET dataset of AI-related Chinese military award notices.*

Of the 338 entities with a publicly available founding date, over 70 percent were established after 2000. From 2000 to 2012, about ten entities—mostly NTVs—were founded each year. There was a notable uptick between 2015 and 2017, with 73 NTVs

* Most SOEs with more recent founding dates are restructured versions of precursors that were originally established during the Mao era.

founded during that period. Notably, many of the NTVs founded prior to the recent surge in AI development now actively market AI-enabled capabilities on their websites, indicating that they have identified the technology as a potential growth area.[75]

To add further detail about the 338 analyzed entities, we gathered publicly available information on each entity's registered capital.* In China, every commercial actor must report the total capital that shareholders have committed to invest in a company.[76] Of the 214 firms with less than $10 million in registered capital, all but six are NTVs. See Appendix A5 for registered capital data. While an imperfect proxy, the registered capital data underscores an unsurprising finding: the vast majority of NTVs in the dataset are at a less mature stage of their development than the majority of SOEs.

Figure 6 demonstrates that, at least among publicly available AI-related award notices, the PLA procures AI-related goods and services from a set of more recently founded, smaller firms, especially relative to their state-owned counterparts. Further research is needed to assess the extent to which these findings reflect broader trends in China's defense innovation ecosystem.

This data does not provide significant insight into the factors behind the founding of these recently incorporated NTVs. The last two decades have seen tremendous economic and technological growth in China's civilian sector, and many of China's top technology firms that produce dual-use products have become globally competitive. That said, this period also coincides with changing policy signals from Beijing regarding the leveraging of China's civilian sector to promote military modernization.[77] Under former President Hu Jintao, Chinese policymakers studied the best practices of other countries—including the United States—to improve China's "overall coordination" (统筹规划) to more effectively combine China's military and civilian capabilities to strengthen defense innovation.[78] Xi has since accelerated these efforts. In November 2012, the communique of the Third Plenum of the 18th Party Congress called the Party to "[guide] superior private enterprises to enter into areas of military research, development, production, and maintenance."[79] Since 2013, China has introduced major reforms that promote the involvement of civilian enterprises in China's defense sector.[80] Reflecting this, the data suggests that a new and emerging class of defense suppliers are active in China's AI-related military procurement.

* Registered capital can serve as one, imperfect indicator of the maturity of a company.

Characterizing the PLA's AI Suppliers: Headquarters Location

We were able to determine headquarters information for 331 of the 338 entities, the majority of which are located in areas with strong ties to the defense industry.

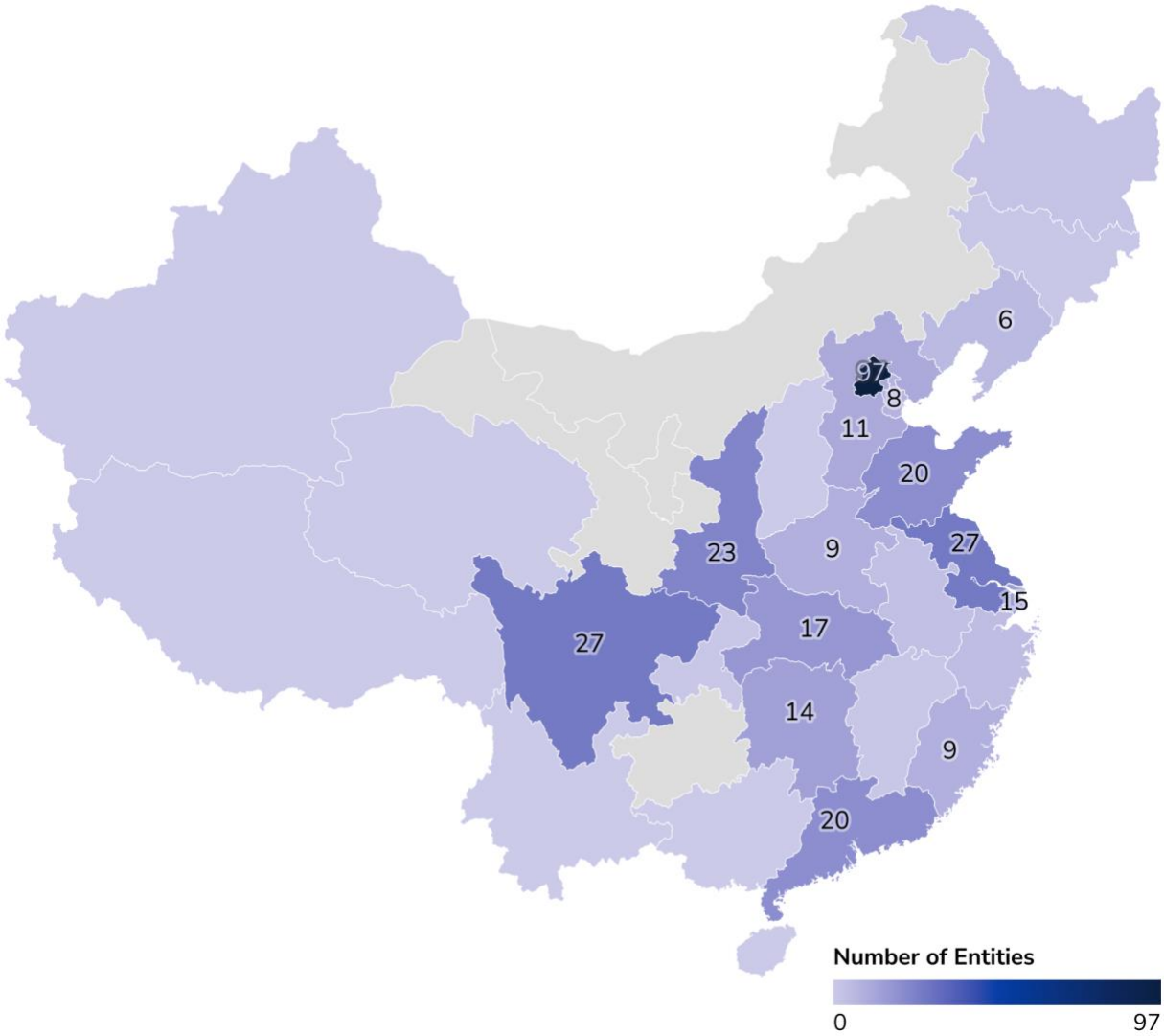
Over a quarter of the entities are headquartered in Beijing. Many of China's largest defense SOEs, including China Aerospace Science and Technology Corporation (CASC), China Aerospace Science and Industry Corporation (CASIC), China North Industries Group Corporation (NORINCO), and Aviation Industry Corporation of China (AVIC) are based in the capital. Beijing is also a critical hub of AI research and is where the headquarters of several prominent Chinese technology companies are located.

Another 97 are located in other technological and defense-industrial strongholds, which are home to important military-linked universities, defense SOEs, and/or technology companies. Jiangsu (27), Sichuan (27), Shaanxi (23), and Guangdong (20) host the largest numbers of entities in the dataset, the majority of which are NTVs. This distribution suggests that China's emerging suppliers of AI-related goods and services to the PLA are located in both AI research hubs like Jiangsu and Guangdong, as well as in traditional defense hot spots, such as Sichuan and Shaanxi.*

For example, according to CSET research, Jiangsu and Guangdong are leading AI R&D hubs, as proxied by job postings.[81] Moreover, Sichuan is home to several important players in China's defense industrial complex, including those involved in nuclear weapons development, air defense networks, and combat aircraft manufacturing.[82] Shaanxi, for its part, is host to one of the Seven Sons, Northwestern Polytechnical University, and a range of aerospace and military technology companies.[83] However, though Zhejiang has emerged as an AI hot spot in recent years, there are only five entities in the dataset headquartered there.[84]

* Jiangsu has long been a key province for China's defense industrial base, as outlined below.

Figure 7. Geographic Distribution of Entities by Headquarters Location



Source: CSET dataset of AI-related Chinese military award notices.

While Beijing has long anchored China's defense industry, it is also a technological hub. Many of China's top technology companies are based in Beijing's Zhongguancun neighborhood.[85] In addition, many of China's top universities are based in Beijing, including two of the Seven Sons of National Defense (国防七子), Beihang University and Beijing Institute of Technology. Beijing's importance across political, defense, and technological domains likely helps explain the concentration of NTVs based in the municipality. Of the 97 Beijing-based entities, 73 are NTVs.

Twenty-seven entities are headquartered in Jiangsu. The provincial capital, Nanjing, is home to the PLA's Eastern Theater Command and is a defense technology research

hub.[86] Two of the Seven Sons, Nanjing University of Science and Technology (南京理工大学) and Nanjing University of Aeronautics and Astronautics (南京航空航天大学), are based in the city, as are several SOEs focused on radars, UAVs, and electronic warfare, including the Nanjing Research Institute of Electronics Technology (南京电子技术研究所; NRIET), a CETC subsidiary.[87] Moreover, the province is an electronics and manufacturing powerhouse.[88] Of the 27 entities based in Jiangsu, 19 are NTVs, six are research institutions, and the other two are SOEs.

Importantly, although they may be headquartered in Beijing, many of China's defense SOEs have operations and subsidiaries across China. For instance, CETC subsidiaries that were awarded contracts are based in Beijing, Jiangsu, Hebei, Henan, Sichuan, Zhejiang, Shanxi, Hunan, Shaanxi, and Anhui. The subsidiaries of other leading defense SOEs are similarly geographically distributed.

Despite the fact that Guangdong has not traditionally been considered an important node in China's military-industrial complex, it is home to many NTVs that are winning contracts to supply the Chinese military with AI-related technologies; 16 of the 20 Guangdong-based entities are NTVs. Given that Shenzhen has emerged as a central locus of China's technology R&D, it is unsurprising that the city, and Guangdong as a whole, might emerge as a nexus of companies producing military-relevant technologies. The large number of NTVs in the province indicates that tech innovation centers around China may be becoming more important actors in China's military-industrial complex, especially for technology products.

Main Takeaways

Leveraging a novel dataset of open-source contract award notices, this report examines the top suppliers of AI-related goods and services to China's defense sector. Our findings suggest two major takeaways:

China's legacy defense sector players lead AI-related military procurement.

Established defense players that have long served as the backbone of China's defense industrial base, including state-owned defense conglomerates and research institutions with longstanding ties to China's defense sector, were the top-awarded organizations in the dataset. Many of these entities, including CETC, CASC, CAS, and the Seven Sons, have deep, longstanding ties to China's defense sector. Even in AI, an emerging technology, China's legacy defense sector actors are still the top defense suppliers.

Geographically, a large number of leading AI suppliers are concentrated in areas that have historically served as hubs of China's defense industrial base. Most of these entities are large and well-resourced and were founded before the turn of the century.

An emerging set of NTVs and civilian universities play a consequential role in China's AI-related military procurement.

While acknowledging the limitations of the dataset, our findings suggest that the PLA sources AI-related technologies from a wide array of suppliers, including NTVs and civilian research institutions.

NTVs won 764 contracts, more than both SOEs and research institutions. Most of these firms were founded after 2010, coinciding with China's technological rise and Beijing's greater emphasis on encouraging civilian firms' participation in defense procurement. These factors likely have augmented the competitiveness of NTVs, many of which are now contributing to China's military modernization. Most of the NTVs in the dataset have fewer assets and are much smaller than the state-owned defense conglomerates with which they compete. NTVs also tend to develop a more narrow catalog of technology products for specific use cases.

Furthermore, the dataset reveals that several civilian universities are also developing AI-related technologies for the PLA. Some of these research institutions are not known for their ties to China's defense sector but nevertheless feature in the dataset. The contracts awarded to these institutions are not for basic research; they have clear military applications.

Conclusion

Our findings provide evidence that Beijing's efforts to expand AI-related military procurement beyond the PLA's traditional network of suppliers may be yielding results. However, due to the limitations discussed in the methodology section above, the dataset does not allow us to make broader statements about China's AI defense-industrial base. NTVs continue to face high barriers to entry, and China's defense SOEs are still shielded from competition, especially in the procurement of major weapons systems.[89] That said, NTVs and research institutions are playing a larger role in China's AI-related defense industrial base.

This report also underscores the growing complexity of sustained military, economic, and technological competition with China. The suppliers featured in this dataset include not only defense SOEs but also civilian research institutions and NTVs. Moreover, as technology is increasingly dual-use, drawing clear distinctions between the civilian and defense sectors will become more difficult.

These challenges highlight the difficulty the United States and its allies face in simultaneously advancing their technological progress while hampering the PLA's ability to develop, acquire, and adopt advanced technologies. Many of the entities in our dataset have established research facilities or commercial operations abroad. Most are not subject to U.S. sanctions or trade restrictions. Without a clear understanding of the pathways through which the PLA acquires and deploys defense and dual-use technologies, the United States and its allies risk unintentionally supporting China's military modernization.

Looking ahead, these blurring boundaries will pose significant challenges to U.S. policymakers, companies, and universities, particularly as the United States navigates difficult trade-offs between preserving openness, which is key to promoting innovation, and safeguarding national security. Blanket restrictions on the ability of U.S. researchers to work with their counterparts at Chinese universities, for example, could disrupt productive research partnerships and inadvertently undermine U.S. scientific leadership. Without close coordination with allies and partners, the unilateral implementation of economic or research security measures could undermine the global competitiveness of U.S. technology companies or isolate U.S. researchers from international scientific networks.

These realities underscore the need for a rigorous and evidence-based approach to managing sustained competition with China in emerging technologies that strengthens U.S. technological leadership and impairs the PLA's ability to exploit advanced

technologies. Success will require sustained investment in developing the tools and capabilities needed for granular, empirically grounded risk assessments that enables policymakers, universities, and companies to make decisions that promote long-term U.S. technological leadership while safeguarding national security. Until then, the United States will be ill-positioned to navigate the challenge of a China equipped with improving technological capabilities and a seemingly more agile defense industrial base.

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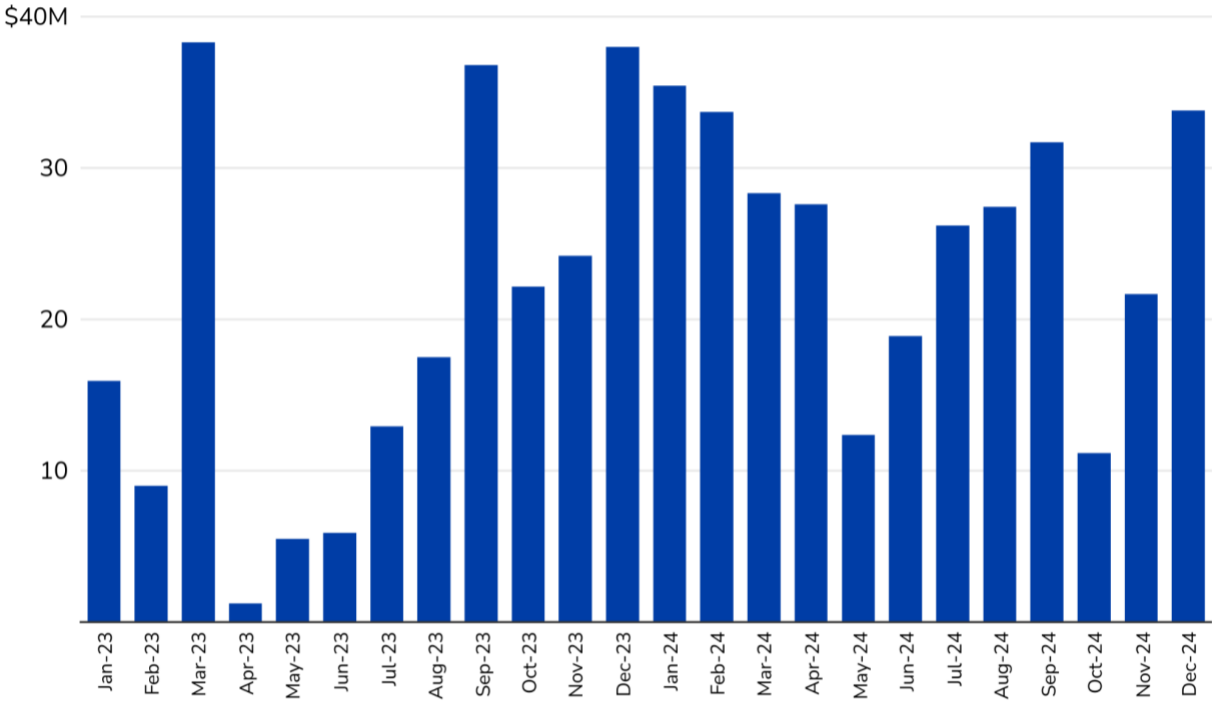
Appendix A: Additional Tables and Figures

Appendix A1. Monthly Contract Value, USD (Millions)



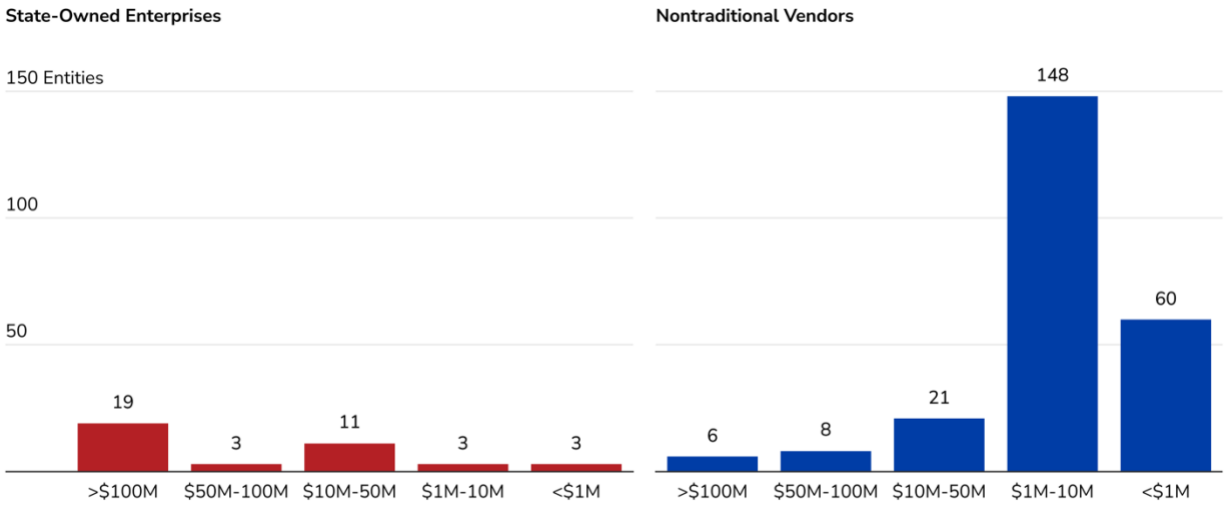
Source: CSET dataset of AI-related Chinese military award notices.

Appendix A2. Top Entities by Number of Contracts Awarded

	Name	Entity Category	Contracts Awarded	Bids Submitted
1	Chinese Academy of Sciences (CAS)	Research Institution	92	163
2	China Electronics Technology Group Corporation (CETC)	State-Owned Enterprise	90	155
3	China Aerospace Science and Technology Corporation (CASC)	State-Owned Enterprise	47	72
4	China North Industries Group Corporation (NORINCO)	State-Owned Enterprise	46	75
5	China State Shipbuilding Corporation (CSSC)	State-Owned Enterprise	44	68
6	Northwestern Polytechnical University	Research Institution	33	52
7	Aviation Industry Corporation of China (AVIC)	State-Owned Enterprise	26	32
8	Beihang University	Research Institution	23	33
9	Hefei iFlytek Digital Technology (iFlytek Digital)	Nontraditional Vendor	20	25
10	CASIC	State-Owned Enterprise	20	34
11	PIESAT Information Technology (PIESAT)	Nontraditional Vendor	18	36
12	Beijing Institute of Technology	Research Institution	18	30
13	China RongTong Asset Management Group Corporation (CRTC)	State-Owned Enterprise	16	21
14	NovaSky Technology (NovaSky)	Nontraditional Vendor	15	26
15	Shanghai Jiao Tong University	Research Institution	15	18

Source: CSET dataset of AI-related Chinese military award notices.

Appendix A3. State-owned Enterprises and Nontraditional Vendors by Registered Capital, Millions USD



Source: CSET dataset of AI-related Chinese military award notices.

Appendix A4. Entities by Category and Headquarters Location

Headquarters Location	State-Owned Enterprises	Research Institutions	Nontraditional Vendors	Total
Beijing	14	10	73	97
Jiangsu	2	6	19	27
Sichuan	4	3	20	27
Shaanxi	1	5	17	23
Guangdong	2	2	16	20
Shandong	2	2	15	19
Hubei	3	5	9	17
Shanghai	1	3	11	15
Hunan	2	3	9	14
Hebei	0	0	11	11
Fujian	0	1	8	9
Henan	0	2	7	9
Tianjin	2	3	3	8
Liaoning	1	2	3	6
Zhejiang	0	2	3	5
Other	1	5	17	23

Source: CSET dataset of AI-related Chinese military award notices.

Appendix B: Methodology

Appendix B1. Methodology to Identify AI-related Award Notices

This report draws from a dataset of 2,857 AI-related award notices published by the PLA between January 2023 and December 2024.

All of the award notices in the dataset analyzed for this report are either Winning Bid Announcements (中标公示) or Sole-Source Procurement Announcements (单一来源采购公告). Each document includes information about the product or service being procured, identifies the contract winner, and, for about three-quarters of the documents, discloses the award value. Most of the documents in the dataset are Winning Bid Announcements, which also include information on up to three entities that submitted bids for the project. In most cases, the PLA served as the soliciting party for goods and services in our dataset. Chinese defense SOEs did so less frequently.

We used a human-curated list of AI-related Chinese-language keywords to identify potential AI-relevant award notices. See Appendix B3 for the full list of keywords. For each potentially AI-relevant document, we first applied another, more extensive set of human-curated AI-related and non-AI related keywords over project titles to classify AI-related award notices. See Appendices B4 and B5 for the AI- and non-AI-related keywords. Then, using a standardized prompt designed to assess whether a product or service is AI-related based on the definition used in this report, we used OpenAI's gpt-4.1-mini model to evaluate each award notice. If the results of the keyword-based classification and LLM-based classification aligned, it was accepted. In cases where the two disagreed with one another, a human annotator manually reviewed the document and made a final determination as to whether the document was AI-related.

We use the following definition for an AI-related award notice:

Excluding medical systems, any award notice that may involve the development or deployment of AI-enabled systems (such as machine learning or decision-making software), hardware that may incorporate or enable AI-enabled systems (such as autonomous vehicles or specialized AI chips), or data collection, processing, or labeling.*

For each AI-related award notice, we used the gpt-4.1-mini model to extract the following data: project title, award value, the entity awarded the contract, entities that

* For this report, we exclude projects intended for medical use, including medical equipment.

submitted bids, and the value of each bid. We manually validated the accuracy of the LLM-enabled data extraction for a subset of the documents.

Appendix B2. Methodology for Entity Classification and Contract Attribution

Across the documents, we identified 1,747 unique entities that won at least one AI-related contract, and nearly 2,000 that submitted bids but failed to win any contracts. To more thoroughly analyze the top suppliers of AI-related technology in the dataset, we gathered additional open-source information on each of the 439 entities that were awarded at least two contracts. For each entity, we collected self-reported information from each entity's website, supplemented by corporate registration data to ascertain parent-child relationships or relevant affiliations. We recorded instances when an entity self-reported that it was affiliated with or originated from a parent organization. For this study, we attribute the contracts won by the subsidiary entity to its parent. As a result of this attribution process, we arrive at 338 entities that were awarded at least two AI-related contracts. To further strengthen our analysis, we also collected information for entities that were awarded only one AI-related contract if they shared a common four-character prefix with one of the 338 entities that were awarded two AI-related contracts.

Our classification rules are as follows:

- State-owned enterprise: any entity that self-reports that it is, or is overseen by, a state-owned enterprise.
- Research institution: any university or research laboratory that is not overseen by a state-owned enterprise.
- Nontraditional vendor: any firm that does not self-report that it is overseen or affiliated with an SOE or research institution.

Appendix B3. Keywords for Potential AI-relevant Contract Awards

The following keywords were used to identify potential AI-relevant contract awards. We include the English-language translations in parentheses:

专家系统 (expert system)
专用模型 (dedicated model)
专用芯片 (dedicated chip)
主动学习 (active learning)
主题模型 (topic model)
交叉验证 (cross-validation)
人像识别 (human appearance recognition)
人在回路 (human in the loop)
人在回路上 (human in the loop)
人在回路中 (human in the loop)
人工智能 (artificial intelligence)
人工智能推理 (artificial intelligence inference)
人工神经网络 (artificial neural network)
人机 (human-machine)
人机互动 (human-machine interaction)
人机交互 (human-machine interaction)
人机协作 (human-machine collaboration)
人机协同 (human-machine collaboration)
人机对话 (human-computer dialogue)
人机接口 (human-machine interface)
人机混合智能 (human-machine hybrid intelligence)
人机物 (human-machine-object)
人机界面 (human-machine interface)
人机系统 (human-machine system)
人机结合 (human-machine integration)
人机融合 (human-machine fusion)
人机融合智能 (human-machine fusion intelligence)
人脸图像 (face image)
人脸检测 (face detection)
人脸识别 (face recognition)
人脸跟踪 (face tracking)
仿脑 (brain-inspired)
优化算法 (optimization algorithm)
位置跟踪 (position tracking)
信息抽取 (information extraction)
信息检索 (information retrieval)
先进控制 (advanced control)
全连接网络 (fully connected network)
六足机器人 (hexapod robot)
共指 (coreference)
关系网络 (relationship network)
关联分析 (association analysis)
关联性分析 (correlation analysis)
决策支持系统 (decision support system)
决策树 (decision tree)
决策系统 (decision system)
分布式协同 (distributed collaboration)
分布式探测 (distributed detection)
分布式控制 (distributed control)
分布式训练 (distributed training)
分类器 (classifier)
分类标签 (classification label)
分类模型 (classification model)
分类算法 (classification algorithm)
分解算法 (decomposition algorithm)
刷脸支付 (face-scan payment)
前馈神经网络 (feedforward neural network)
动作单元 (action unit)
动作捕捉 (motion capture)
动作检测 (action detection)
动作识别 (action recognition)
动态神经网络 (dynamic neural network)
动态自适应 (dynamic adaptation)
动态视觉 (dynamic vision)
协作机器人 (collaborative robot)
协同控制 (collaborative control)
协同攻 (collaborative approach)
卷积神经网络 (convolutional neural network)
参数优化 (parameter optimization)
可解释 (explainable)
可解释性 (explainability)
可追溯性 (traceability)
因果推断 (causal inference)
图像传感 (image sensing)
图像修复 (image restoration)
图像分割 (image segmentation)
图像分类 (image classification)
图像匹配 (image matching)
图像检索 (image retrieval)
图像注释 (image annotation)
图像理解 (image understanding)
图像识别 (image recognition)
图像配准 (image registration)
图分析 (graph analysis)
图匹配 (graph matching)
图形处理单元 (Graphics Processing Unit)
图形处理器 (graphics processor)
图模型 (graph model)
图神经网络 (graph neural network)
在线分析处理 (online analytical processing)
场景感知 (scene awareness)
基座大模型 (foundation large model)
基础模型 (base model)
增强学习 (enhancement learning)
增强智能 (augmented intelligence)
增强现实 (augmented reality)
增量学习 (incremental learning)
声学模型 (acoustic model)
外骨骼 (exoskeleton)
多智能体 (multi-agent)
多模态交互 (multimodal interaction)
大型语言模型 (large language model)
大模型 (large model)
头戴式显示器 (head-mounted display)
字符识别 (character recognition)
学习算法 (learning algorithm)
对抗模型 (adversarial model)
对抗网络 (adversarial network)
对抗训练 (adversarial training)
对话系统 (dialogue system)
层次模型 (hierarchical model)
层次聚类 (hierarchical clustering)
工业机器人 (industrial robot)
建模语言 (modeling language)
异常检测 (anomaly detection)
强人工智能 (strong AI)
强化学习 (reinforcement learning)
徘徊检测 (loitering detection)
循环神经网络 (recurrent neural network)
恶意样本 (malicious sample)
情感分析 (sentiment analysis)
情感计算 (affective computing)
情感识别 (emotion recognition)
情绪识别 (emotion recognition)
意图识别 (intent recognition)
感知神经网络 (perception neural network)
手势识别 (gesture recognition)
扩展现实 (extended reality)
指静脉识别 (finger vein recognition)
推理 (reasoning)
推理引擎 (reasoning engine)
推荐引擎 (recommendation engine)
推荐算法 (recommendation algorithm)
推荐系统 (recommendation system)
提示词工程 (prompt engineering)
支持向量机 (support vector machine)
数字人 (digital human)
数据并行 (data parallelism)
数据手套 (data glove)
数据挖掘 (data mining)
数据标注 (data labeling)
文字识别 (text recognition)
文本分类 (text classification)
文本挖掘 (text mining)
文本数据挖掘 (text data mining)
文本生成 (text generation)
方言识别 (dialect recognition)
无人 (unmanned)
无人驾驶 (autonomous driving)
智慧决策 (smart decision-making)
智能决策 (intelligent decision-making)
智能决策控制 (intelligent decision control)
智能化 (intelligentization)
智能平台管理接口 (Intelligent Platform Management Interface)
智能性 (intelligence)
智能感知 (intelligent perception)
智能感知算法 (intelligent perception algorithm)
智能控制 (intelligent control)
智能推理 (intelligent reasoning)
智能机器人 (intelligent robot)
智能硬件 (intelligent hardware)
智能认知 (intelligent cognition)
智能语音 (intelligent voice)
智能语音交互 (intelligent voice interaction)
智能调度 (intelligent scheduling)
智能辅诊 (intelligent auxiliary diagnosis)
有向图 (directed graph)
机器人 (robot)
机器人学 (robotics)
机器人技术 (robotics)
机器人控制系统 (robot control system)
机器人操作系统 (Robot Operating System)
机器人本体 (robot body)
机器人自主导航 (robot autonomous navigation)
机器学习 (machine learning)
机器翻译 (machine translation)
机器翻译引擎 (machine translation engine)
机器视觉 (machine vision)
模型并行 (model parallelism)
模型推理 (model inference)
模型的训练 (model training)
模型自适应 (model adaptation)
模型训练 (model training)
模型轻量化 (model lightweighting)
模型部署 (model deployment)
模式分类 (pattern classification)
模式匹配 (pattern matching)
模式识别 (pattern recognition)
模拟现实 (simulated reality)
模糊逻辑 (fuzzy logic)
正则化 (regularization)
步态分析 (gait analysis)
沉浸式虚拟现实环境 (immersive virtual reality environment)
深层模型 (deep model)
深度学习 (deep learning)
深度强化学习 (deep reinforcement learning)
深度神经网络 (deep neural network)
深度网络 (deep network)
混合并行 (hybrid parallelism)
混合现实 (mixed reality)
源语言 (source language)
激活函数 (activation function)
灾难性遗忘 (catastrophic forgetting)
父节点 (parent node)
物体检测 (object detection)
物体识别 (object recognition)
物联网 (Internet of Things)
特征匹配 (feature matching)
特征学习 (feature learning)
特征工程 (feature engineering)
特征提取 (feature extraction)
特征识别 (feature recognition)
特征选择 (feature selection)
特性识别 (feature identification)
生成模型 (generative model)
生物反馈传感器 (biofeedback sensor)
盘古 (PanGu)
目标分类 (object classification)

目标检测 (object detection)
目标特征 (target feature)
目标识别 (target recognition)
目标跟踪 (target tracking)
眼动跟踪 (eye tracking)
知识库系统 (knowledge base system)
知识建模 (knowledge modeling)
知识挖掘 (knowledge mining)
知识推理 (knowledge reasoning)
知识获取 (knowledge acquisition)
知识表示 (knowledge representation)
神经网络 (neural network)
端智能 (edge intelligence)
算法 (algorithm)
类脑 (brain-like)
类脑智能 (brain-like intelligence)
类脑计算 (brain-inspired computing)
红外图像 (infrared image)
翻译系统 (translation system)
翻译记忆 (translation memory)
联邦学习 (federated learning)
聚类 (clustering)
聚类分析 (cluster analysis)
聚类算法 (clustering algorithm)
脉冲神经网络 (spiking neural network)
脑机交互 (brain-computer interaction)
脑机接口 (brain-computer interface)
自主 (autonomous)
自主学习 (self-learning)
自主导航 (autonomous navigation)
自主智能 (autonomous intelligence)
自主系统 (autonomous system)
自动光学检测 (automatic optical inspection)
自动摘要 (automatic summarization)
自动编码 (auto-encoding)
自动车牌识别 (automatic license plate recognition)
自动驾驶 (autonomous driving)
自学习 (self-learning)
自然语言处理 (Natural Language Processing)
自然语言理解 (natural language understanding)
自组织 (self-organization)
自诊断 (self-diagnosis)
自适应学习 (adaptive learning)
虚拟形象 (virtual avatar)
虚拟环境 (virtual environment)
虚拟现实 (virtual reality)
虚拟现实场景 (virtual reality scene)
虹膜识别 (iris recognition)
蜂群 (swarm)
融合智能 (integrated intelligence)
行人检测 (pedestrian detection)
行人重识别 (person re-identification)
表情识别 (facial expression recognition)
表示学习 (representation learning)
规则模型 (rule-based model)
视觉认知 (visual cognition)
视觉里程计 (visual odometry)
视频跟踪 (video tracking)
解析系统 (parsing system)
解释性 (interpretability)
计算图 (computational graph)
计算机视觉 (computer vision)
计算机辅助翻译 (computer-assisted translation)
认知 (cognition)
认知智能 (cognitive intelligence)
训练数据 (training data)
训练模型 (trained model)
评价分析 (evaluation analysis)
词性标注 (part-of-speech tagging)
语义分割 (semantic segmentation)
语义处理 (semantic processing)
语义检索 (semantic search)
语义理解 (semantic understanding)
语义相似度 (semantic similarity)
语义识别 (semantic recognition)
语种识别 (language identification)
语言代码 (language code)
语言模型 (language model)
语言识别 (language recognition)
语音交互 (speech interaction)
语音合成 (speech synthesis)
语音增强 (speech enhancement)
语音处理 (speech processing)
语音技术 (voice technology)
语音接口 (voice interface)
语音翻译 (speech translation)
语音识别 (speech recognition)
语音识别引擎 (speech recognition engine)
语音转写 (speech transcription)
语音转录 (speech transcription)
语音采集 (speech acquisition)
说话人识别 (speaker recognition)
调参 (parameter tuning)
贝叶斯网络 (Bayesian network)
超分辨 (super-resolution)
超参数 (hyperparameter)
超参数优化 (hyperparameter optimization)
路径规划 (path planning)
软件代理 (software agent)
辅助决策 (decision support)
辅助技术 (assistive technology)
输入层 (input layer)
输出层 (output layer)
迁移学习 (transfer learning)
过参数化 (over-parameterization)
运动跟踪 (motion tracking)
进化算法 (evolutionary algorithm)
通用智能 (general intelligence)
遗传算法 (genetic algorithm)
鉴伪 (authentication)
长短期记忆 (long short-term memory)
集群 (cluster)
集群智能 (swarm intelligence)
面部识别 (facial recognition)
音频信号处理 (audio signal processing)
音频分类 (audio classification)
预测分析 (predictive analytics)
预测模型 (prediction model)
预训练模型 (pre-trained model)
驾驶辅助 (driving assistance)
验证集 (validation set)
AI (AI)
NLP (NLP)

Appendix B4. Keywords for AI-related Contract Awards

Award notices were classified as AI-related if their project titles contained any of the following keywords. We include the English-language translations in parentheses:

专家系统 (expert system)
专用模型 (dedicated model)
专用芯片 (dedicated chip)
主动学习 (active learning)
主题模型 (topic model)
云平台 (cloud platform)
云架构 (cloud architecture)
交叉验证 (cross-validation)
人像识别 (human appearance recognition)
人在回路 (human in the loop)
人在回路上 (human in the loop)
人在回路中 (human in the loop)
人工智能 (artificial intelligence)
人工智能推理 (artificial intelligence inference)
人工神经网络 (artificial neural network)
人机互动 (human-machine interaction)
人机交互 (human-machine interaction)
人机协作 (human-machine collaboration)
人机协同 (human-machine collaboration)
人机对话 (human-computer dialogue)
人机接口 (human-machine interface)
人机混合智能 (human-machine hybrid intelligence)
人机界面 (human-machine interface)
人机系统 (human-machine system)
人机结合 (human-machine integration)
人机融合 (human-machine fusion)
人机融合智能 (human-machine fusion intelligence)
人脸图像 (face image)
人脸检测 (face detection)
人脸识别 (face recognition)
人脸跟踪 (face tracking)
仿真 (simulation)
仿脑 (brain-inspired)
优化 (optimization)
优化算法 (optimization algorithm)
位置跟踪 (position tracking)
信息抽取 (information extraction)
信息检索 (information retrieval)
先进控制 (advanced control)
全连接网络 (fully connected network)
六足机器人 (hexapod robot)
共指 (coreference)
关系网络 (relationship network)
关联分析 (association analysis)
关联性分析 (correlation analysis)
决策支持系统 (decision support system)
决策树 (decision tree)
决策系统 (decision system)
分布式协同 (distributed collaboration)
分布式探测 (distributed detection)
分布式控制 (distributed control)
分布式训练 (distributed training)
分析 (analysis)
分类器 (classifier)
分类标签 (classification label)
分类模型 (classification model)
分类算法 (classification algorithm)
分解算法 (decomposition algorithm)
刷脸支付 (face-scan payment)
前馈神经网络 (feedforward neural network)
动作单元 (action unit)
动作捕捉 (motion capture)
动作检测 (action detection)
动作识别 (action recognition)
动态神经网络 (dynamic neural network)
动态自适应 (dynamic adaptation)
动态视觉（dynamic vision)
北斗 (Beidou (satellite navigation))
协作机器人 (collaborative robot)
协同控制 (collaborative control)
协同攻 (collaborative approach)
卷积神经网络 (convolutional neural network)
参数优化 (parameter optimization)
可解释 (explainable)
可解释性 (explainability)
可追溯性 (traceability)
因果推断 (causal inference)
图像传感 (image sensing)
图像修复 (image restoration)
图像分割 (image segmentation)
图像分类 (image classification)
图像匹配 (image matching)
图像检索 (image retrieval)
图像注释 (image annotation)
图像理解 (image understanding)
图像识别 (image recognition)
图像配准 (image registration)
图分析 (graph analysis)
图匹配 (graph matching)
图形处理单元 (Graphics Processing Unit)
图形处理器 (graphics processor)
图形工作站 (graphics workstation)
图模型 (graph model)
图神经网络 (graph neural network)
在线分析处理 (online analytical processing)
场景感知 (scene awareness)
基座大模型 (foundation large model)
基础模型 (base model)
增强学习 (enhancement learning)
增强智能 (augmented intelligence)
增强现实 (augmented reality)
增量学习 (incremental learning)
声学模型 (acoustic model)
外骨骼 (exoskeleton)
多智能体 (multi-agent)
多模态交互 (multimodal interaction)
大型语言模型 (large language model)
大数据 (big data)
大模型 (large model)
头戴式显示器 (head-mounted display)
字符识别 (character recognition)
学习算法 (learning algorithm)
实验（experiment)
对抗模型 (adversarial model)
对抗网络 (adversarial network)
对抗训练 (adversarial training)
对话系统 (dialogue system)
导调（operation coordination)
层次模型 (hierarchical model)
层次聚类 (hierarchical clustering)
工业机器人 (industrial robot)
建模语言 (modeling language)
异常检测 (anomaly detection)
强人工智能 (strong AI)
强化学习 (reinforcement learning)
徘徊检测 (loitering detection)
循环神经网络 (recurrent neural network)
恶意样本 (malicious sample)
情感分析 (sentiment analysis)
情感计算 (affective computing)
情感识别 (emotion recognition)
情绪识别 (emotion recognition)
意图识别 (intent recognition)
感知神经网络 (perception neural network)
手势识别 (gesture recognition)
扩展现实 (extended reality)
指静脉识别 (finger vein recognition)
推理 (reasoning)
推理引擎 (reasoning engine)
推荐引擎 (recommendation engine)
推荐算法 (recommendation algorithm)
推荐系统 (recommendation system)
提示词工程 (prompt engineering)
摄像跟随 (camera following)
支持向量机 (support vector machine)
数字人 (digital human)
数据 (data)
数据并行 (data parallelism)
数据手套 (data glove)
数据挖掘 (data mining)
数据标注 (data labeling)
文字识别 (text recognition)
文本分类 (text classification)
文本挖掘 (text mining)
文本数据挖掘 (text data mining)
文本生成 (text generation)
方言识别 (dialect recognition)
无人机 (drone)
无人飞行 (unmanned flight)
无人驾驶 (autonomous driving)
智慧决策 (smart decision-making)
智能决策 (intelligent decision-making)
智能决策控制 (intelligent decision control)
智能平台管理接口 (Intelligent Platform Management Interface)
智能性 (intelligence)
智能感知 (intelligent perception)
智能感知算法 (intelligent perception algorithm)
智能控制 (intelligent control)
智能推理 (intelligent reasoning)
智能机器人 (intelligent robot)
智能硬件 (intelligent hardware)
智能认知 (intelligent cognition)
智能语音 (intelligent voice)
智能语音交互 (intelligent voice interaction)
智能调度 (intelligent scheduling)
智能辅诊 (intelligent auxiliary diagnosis)
有向图 (directed graph)
服务器 (server)
机器人学 (robotics)
机器人技术 (robotics)
机器人控制系统 (robot control system)
机器人操作系统 (robot operating system)
机器人本体 (robot body)
机器人自主导航 (robot autonomous navigation)
机器学习 (machine learning)
机器翻译 (machine translation)
机器翻译引擎 (machine translation engine)
机器视觉 (machine vision)
模 (module)
模型 (model)
模型并行 (model parallelism)
模型推理 (model inference)
模型的训练 (model training)
模型自适应 (model adaptation)
模型训练 (model training)
模型轻量化 (model lightweighting)
模型部署 (model deployment)
模式分类 (pattern classification)
模式匹配 (pattern matching)
模式识别 (pattern recognition)
模拟 (emulation)
模拟现实 (simulated reality)

模糊逻辑 (fuzzy logic)
正则化 (regularization)
步态分析 (gait analysis)
沉浸式虚拟现实环境 (immersive virtual reality environment)
深层模型 (deep model)
深度学习 (deep learning)
深度强化学习 (deep reinforcement learning)
深度神经网络 (deep neural network)
深度网络 (deep network)
混合并行 (hybrid parallelism)
混合现实 (mixed reality)
源语言 (source language)
激活函数 (activation function)
灾难性遗忘 (catastrophic forgetting)
父节点 (parent node)
物体检测 (object detection)
物体识别 (object recognition)
特征匹配 (feature matching)
特征学习 (feature learning)
特征工程 (feature engineering)
特征提取 (feature extraction)
特征识别 (feature recognition)
特征选择 (feature selection)
特性识别 (feature identification)
生成模型 (generative model)
生物反馈传感器 (biofeedback sensor)
盘古 (PanGu)
目标分类 (object classification)
目标检测 (object detection)
目标特征 (target feature)
目标识别 (target recognition)
目标跟踪 (target tracking)
眼动跟踪 (eye tracking)
知识库 (knowledge base)
知识库系统 (knowledge base system)
知识建模 (knowledge modeling)
知识挖掘 (knowledge mining)
知识推理 (knowledge reasoning)
知识获取 (knowledge acquisition)
知识表示 (knowledge representation)
神经网络 (neural network)
端智能 (edge intelligence)
算法 (algorithm)
类脑 (brain-like)
类脑智能 (brain-like intelligence)
类脑计算 (brain-inspired computing)
红外图像 (infrared image)
翻译系统 (translation system)
翻译记忆 (translation memory)
联网工程 (network engineering)
联邦学习 (federated learning)
聚类 (clustering)
聚类分析 (cluster analysis)
聚类算法 (clustering algorithm)
脉冲神经网络 (spiking neural network)
脑机交互 (brain-computer interaction)
脑机接口 (brain-computer interface)
自主 (autonomous)
自主学习 (self-learning)
自主导航 (autonomous navigation)
自主智能 (autonomous intelligence)
自主系统 (autonomous system)
自动光学检测 (automatic optical inspection)
自动摘要 (automatic summarization)
自动编码 (auto-encoding)
自动车牌识别 (automatic license plate recognition)
自动驾驶 (autonomous driving)
自学习 (self-learning)
自然语言处理 (natural language processing)
自然语言理解 (natural language understanding)
自组织 (self-organization)
自诊断 (self-diagnosis)
自适应学习 (adaptive learning)
节点 (node)
节点边 (nodes and edges)
虚拟形象 (virtual avatar)
虚拟环境 (virtual environment)
虚拟现实 (virtual reality)
虚拟现实场景 (virtual reality scene)
虹膜识别 (iris recognition)
蜂群 (swarm)
融合智能 (integrated intelligence)
行人检测 (pedestrian detection)
行人重识别 (person re-identification)
表情识别 (facial expression recognition)
表示学习 (representation learning)
规则模型 (rule-based model)
视觉认知 (visual cognition)
视觉里程计 (visual odometry)
视频跟踪 (video tracking)
解析系统 (parsing system)
解释性 (interpretability)
计算 (computing)
计算图 (computational graph)
计算机视觉 (computer vision)
计算机辅助翻译 (computer-assisted translation)
认知 (cognition)
认知智能 (cognitive intelligence)
训练数据 (training data)
训练模型 (trained model)
评价分析 (evaluation analysis)
识别 (recognition)
词性标注 (part-of-speech tagging)
语义分割 (semantic segmentation)
语义处理 (semantic processing)
语义检索 (semantic search)
语义理解 (semantic understanding)
语义相似度 (semantic similarity)
语义识别 (semantic recognition)
语种识别 (language identification)
语言代码 (language code)
语言模型 (language model)
语言识别 (language recognition)
语音交互 (speech interaction)
语音合成 (speech synthesis)
语音增强 (speech enhancement)
语音处理 (speech processing)
语音技术 (voice technology)
语音接口 (voice interface)
语音翻译 (speech translation)
语音识别 (speech recognition)
语音识别引擎 (speech recognition engine)
语音转写 (speech transcription)
语音转录 (speech transcription)
语音采集 (speech acquisition)
说话人识别 (speaker recognition)
调参 (parameter tuning)
贝叶斯网络 (Bayesian network)
超分辨 (super-resolution)
超参数 (hyperparameter)
超参数优化 (hyperparameter optimization)
路径规划 (path planning)
软件 (software)
软件代理 (software agent)
辅助决策 (decision support)
辅助技术 (assistive technology)
输入层 (input layer)
输出层 (output layer)
迁移学习 (transfer learning)
过参数化 (over-parameterization)
运动跟踪 (motion tracking)
进化算法 (evolutionary algorithm)
通用智能 (general intelligence)
遗传算法 (genetic algorithm)
鉴伪 (authentication)
长短期记忆 (long short-term memory)
集群智能 (swarm intelligence)
面部识别 (facial recognition)
靶机 (target machine)
音频信号处理 (audio signal processing)
音频分类 (audio classification)
预处理 (preprocessing)
预测分析 (predictive analytics)
预测模型 (prediction model)
预训练模型 (pre-trained model)
驾驶辅助 (driving assistance)
验证集 (validation set)
AIS (Automatic Identification System)
ARM (Advanced RISC Machine)
GPU (Graphics Processing Unit)
NLP (Natural Language Processing)

Appendix B5. Keywords for non-AI-related Award Notices

Award notices were classified as non-AI-related if their project titles contained any of the following keywords. We include the English-language translations in parentheses:

万方 (Wanfang [Chinese database])
临床 (clinical)
仓库 (warehouse)
代谢 (metabolism)
体能 (physical fitness)
体训中心 (physical training center)
体适能测试 (physical fitness test)
健康体检 (health check-up)
健身器材 (fitness equipment)
元件 (component)
光缆 (optical cable)
养老 (elderly care)
内镜 (endoscope)
医 (medicine)
医保 (medical insurance)
医疗 (healthcare)
医疗设备 (medical equipment)
医院 (hospital)
医院感染 (hospital infection)
医院系统 (hospital system)
发药系统 (drug dispensing system)
变换器 (converter)
咨询服务 (consulting services)
售货机 (vending machine)
图书室 (reading room)
场建设 (venue construction)
大厅 (hall)
媒体设备 (media equipment)
安全系统 (safety system)
安防，建设 (security construction)
安防设施 (security facilities)
室 (room)
库室 (storage room)
库房 (storeroom)
建工 (construction engineering)
建筑智能化系统 (building automation system)
建设 (construction)
建设，油库（construction of oil depot)
建设，车场（construction of parking lot)
房屋 (house)
手册 (manual)
手术（surgery)
护理 (nursing)
报警装 (alarm device)
揭阳 (Jieyang [city in Guangdong, China])
操场 (playground)
改造 (renovation)
教学 (teaching)
教学管理 (teaching management)
教学资源 (teaching resources)
教室 (classroom)
教材，智能管理 (teaching materials, intelligent management)
教育 (education)
文体中心 (cultural and sports center)
无人机，备件 (drone, spare parts)
无人机，备品 (drone, spares)
无人机，属件 (drone, attachments)
无人机，物资 (drone, supplies)
无人机，电池 (drone, battery)
无人机，部件 (drone, components)
无人机，配件 (drone, accessories)
无人机，配套设备（drone, supporting equipment)
无人机库建设（drone depot construction)
无人车底盘平台 (unmanned vehicle chassis platform)
智慧，图书馆 (smart library)
智慧，教学场地 (smart teaching venue)
智慧，教室 (smart classroom)
智慧园区 (smart campus)
智能会议 (smart conferencing)
智能化，图书馆（intelligent library)
智能化体育考评系统设计 (intelligent sports evaluation system design)
智能化系统，维保 (intelligent system maintenance)
智能化设备 (intelligent equipment)
校园 (campus)
测试纸（test paper)
物资 (supplies)
物资设备 (supplies and equipment)
生信 (bioinformatics)
电（electricity)
病 (disease)
病房 (ward)
病理信息系统 (pathology information system)
症 (symptom/condition)
监控 (monitoring)
空调（air conditioner)
管理智慧化建设（smart management construction)
维护 (maintenance)
胃 (stomach)
药柜 (medicine cabinet)
血 (blood)
血液透析 (hemodialysis)
设备（equipment)
诊断 (diagnosis)
诊疗 (diagnosis and treatment)
课堂 (classroom)
课室 (classroom)
超市 (supermarket)
运动场 (sports field)
通信 (communication)
配件 (accessories)
门诊 (outpatient service)
附属品 (accessory)
集群通信 (cluster communication)
靶场 (target range)
颐养 (nursing care)
食堂 (canteen)
饭堂 (canteen)
CNKI (CNKI – China National Knowledge Infrastructure [Chinese database])
DC 变换器 (DC converter)
ICU (ICU – Intensive Care Unit)
MailService (MailService)
PET-MR (PET-MR – Positron Emission Tomography & Magnetic Resonance)

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