

Issue Brief

Assessing China's AI Workforce:

Regional, Military, and Surveillance Geographic Job Clusters

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Executive Summary

The Chinese government's prioritization of artificial intelligence (AI) includes a distinct focus on cultivating talent, a key ingredient for AI development. However, little is known about the quantity or characteristics of technical AI talent that Chinese employers hope to hire. In this report, we highlight regional and local clusters where demand for AI talent is particularly high, as well as assessing the job demand signal from China's defense and surveillance sectors. This paper is a follow on to our November 2022 brief on "[China's AI Workforce: Assessing Demand for AI Talent](#)," which examined employers' demand for AI talent through a dataset of 6.8 million active Chinese job postings collected between April and July 2021. This paper focuses on a subset of 58,229 job postings that are most likely to be part of China's technical AI workforce.

We first examine the distribution of technical AI job postings by region and city. Then we identify AI job postings in national security-relevant sectors by looking at AI job postings advertised by defense-affiliated entities and those related to surveillance.

Analyzing our dataset of 58,229 technical AI job postings in China between April and July 2021, we find:

- 78 percent of job postings are geographically concentrated in three economically and technologically developed hubs with large population centers: the Yangtze River Delta region, the Pearl River Delta, and the Beijing-Tianjin-Hebei area. Other provinces with relatively high demand for AI talent also include Hubei, Shandong and Hunan.
- 10 cities accounted for 71 percent of job postings. The top three were Shanghai, Shenzhen, and Beijing.
- 9 defense-affiliated universities advertised 79 AI job openings across 10 provinces. Additionally, the People's Liberation Army (PLA) directly advertised two positions. Fujian had the highest concentration of defense-affiliated AI job postings, with 24 jobs posted.
- 2,877 job postings were related to surveillance, which were concentrated in Guangdong, Shanghai, Jiangsu, Beijing, and Zhejiang. These postings included keywords such as *facial recognition*, *feature extraction*, *speech recognition*, *sentiment analysis*, and *safe cities*.

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Introduction

Attracting and retaining talent is vital to a country's AI development. China prioritizes talent development in its strategic drive to become a world leader in AI, as evidenced in its 2017 Next Generation AI Development Plan.¹ In June 2022, Xi Jinping reiterated this goal, emphasizing that “technological innovation depends first on investment and second on talent.”² At the 20th Party Congress, Xi also stated, “we must give priority to education, become self-reliant in science and technology, and be guided by talent.”³

Talent is at the core of the technological competition between the United States and China. Therefore, U.S. policymakers need to understand the scale of China's potential talent pool and Chinese efforts to educate and train its talent supply. In addition, it is also important to understand where the demand signal for these professionals is coming from. We [previously](#) addressed demand across China's broader AI workforce. In this follow-on paper, we examine where demand for *technical* AI talent exists in two ways by analyzing:

- the geographic distribution of 58,228 AI-related job postings at the regional and city level; and,
- AI job postings in sectors most pertinent to U.S. national security interests, namely, defense and surveillance.

While job postings are only one indicator of the vitality of a country's labor market, mapping where AI talent is in high demand can help identify both current and emerging regional and city level AI talent hubs.⁴ This analysis can also help assess the relative concentrations of job postings and top AI education programs to see whether the local supply of qualified candidates is able to meet demand.

Alongside the geographic dimension, the focus on AI-related job postings in China's defense and surveillance sectors should also be of interest to U.S. national security and technology policy analysts. The U.S. government has endeavored to prevent American technologies from being used to accelerate China's military modernization or enabling human rights abuses and civil liberties violations.⁵ But stemming the flow of U.S. technology to China's defense and surveillance industries could have a limited effect on China's AI ambitions if the country is able to develop a high quality AI education training pipeline and retain the technical talent that builds and operates indigenously developed AI systems for military or surveillance purposes. Although not without limitations, an analysis of AI-related job postings by China's defense-affiliated institutions and those related to China's surveillance ecosystem can illuminate a

variety of vital policy-relevant dimensions like the demand for specific skill-sets within these sectors, what AI subfields may be prioritized for development, and the geographic locations where companies and other organizations are actively hiring AI professionals.

Data and Methodology

This brief relies on a novel dataset of 6.8 million unique job postings in China that were collected in Spring 2021, between April 2021 and July 2021.⁶ Our data collection methodology was designed to capture a representative sample of four major job boards in China during this timeframe. Due to the strong representation of one predominant job board for technical talent, 51Job, we believe our sample allows for some broader generalization of our findings regarding technical talent.⁷ This dataset was built in partnership with AMPLYFI, a U.K.-based machine learning company. For more information on the data collection process, see Appendix B in our prior report, “China’s AI Workforce: Assessing Demand for AI Talent.”⁸

In constructing this dataset, AMPLYFI and CSET built a classifier to determine whether each job posting relates to the AI workforce. Previous CSET research defined the AI workforce as “the set of occupations that include people who are qualified to work in AI or on an AI development team, or have the requisite knowledge, skills, and abilities (KSAs) such that they could work on an AI product or application with minor training.”⁹ This definition purposefully includes technical and non-technical occupations that may not currently be working on AI applications—but have the KSAs to be—in order to capture the entire pool of AI talent. The 54 selected occupations, taken from the 2018 Standard Occupational Classification (SOC) System, were binned into four categories: Technical Team 1, Technical Team 2, Product Team, and Commercial Team (Table 1)

Table 1. CSET’s AI Workforce Categories

Workforce Categories	Description
Technical Team 1	Occupations that are or could be actively working in AI, are needed to provide technical inputs into AI applications, or could laterally move into an AI development role. (Examples: computer scientist, software developer, network and database administrator.)
Technical Team 2	Occupations that have the related knowledge, skills, and abilities to perform technical roles on an AI team, either as is or with minimal additional training. (Examples: electrical engineer, web developer, IT support.)
Product Team	Occupations that complement AI technical occupations in product development. (Examples: product managers, legal compliance officers.)
Commercial Team	Occupations that provide support for the scaling, marketing, or acquisition of AI. (Examples: sales engineers, purchasing agents.)

In this paper, we focus on job postings in Technical Teams 1 and 2, which have the knowledge, skills, and abilities to most directly contribute to China’s technical AI workforce. These two groups contain 955,000 job postings, or 14 percent of the total job postings in our dataset. To identify jobs that are likely part of China’s *active* technical AI workforce, we further filter these postings by a list of AI keywords (see Appendix A); we conduct our analysis on the remaining 58,229 postings as AI-related technical job postings (or simply “AI job postings”). These AI job postings are the main focus of this paper because these occupations and skill sets represent the workforce that will most directly contribute to China’s technological progress in AI as well as the broad set of sectors, industries, and fields that will be impacted by AI.

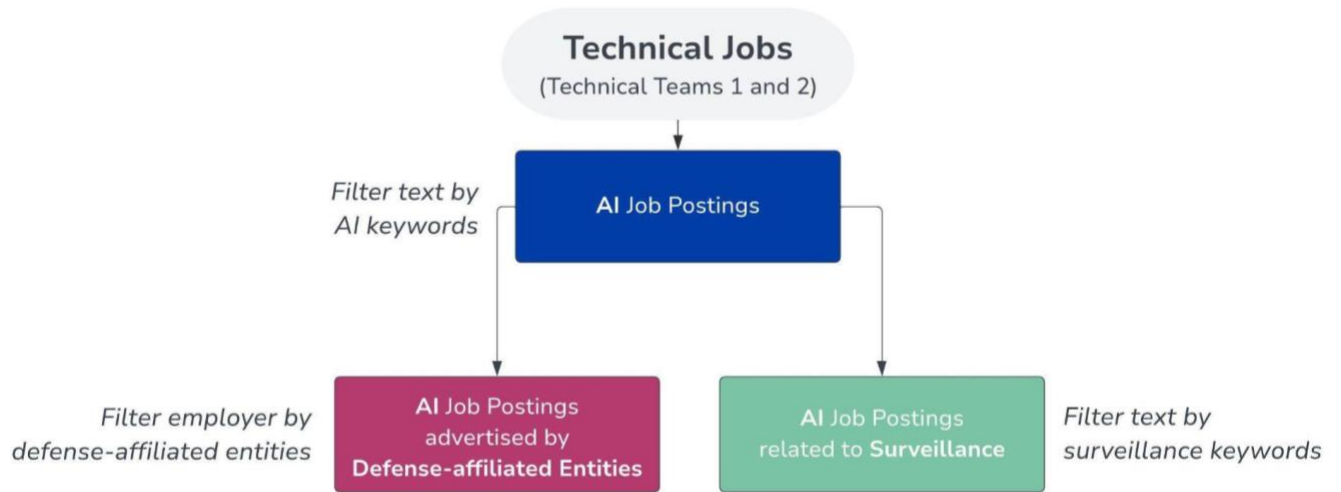
Table 2. Chinese Job Postings by Category in Spring 2021

Category		Number of Job Postings	Share of Total (%)	
Possible AI Postings	Technical Teams	Technical Team 1	364,358	5.4
		Technical Team 2	591,074	8.7
	Product Team		453,230	6.6
	Commercial Team		692,420	10.2
	Total Possible AI Postings		2,101,082	30.9
	Not AI Postings		4,707,216	69.1
Total Job Postings		6,808,298	100	

Note: The bolded technical team categories are included in this brief’s analysis. Within these, we analyze 58,229 job postings that mention at least one AI keyword from our list (see Appendix A). Source: CSET and AMPLYFI Chinese job postings dataset for the period April-July 2021.

Throughout the paper, we analyze and discuss three subsets of the technical job postings (visually depicted in Figure 1 below): **AI job postings**, AI job postings advertised by **defense-affiliated entities**; and AI job postings related to **surveillance**.

Figure 1. Flowchart Describing the Filters Applied to Each of the Three Data Subsets



The three subsets are defined as follows with job posting counts listed in Table 3:

AI job postings: In our [analysis](#), we filter technical job postings by a list of AI keywords (see

1. Appendix A: Methodology, Table A1); any job posting with at least one AI keyword in the job description field or title field qualify. Job postings in this category are referred to as “technical AI job postings,” “AI-related job postings” or simply “AI job postings” throughout this report.
2. **AI job postings advertised by defense-affiliated entities:** In our [analysis below](#), we further filter AI jobs postings to only include postings where the employer is China’s People's Liberation Army (PLA) or a defense-affiliated university. Job postings are included in this subset when both of the following are true:
 - a. The job description field or title field contains at least one AI keyword, and;
 - b. The employer field matches a PLA service branch or unit, or a defense-affiliated university.¹⁰
3. **AI job postings related to surveillance:** In our [analysis of the last sub-category](#), we filter AI job postings by a list of surveillance keywords. Job postings are included in this subset when the job description field or title field contains at least one AI keyword and at least one surveillance keyword. The list of surveillance keywords includes surveillance techniques and national surveillance programs co-run by agencies such as the Ministry of Public Security (MPS) that employ AI-enabled surveillance methods.¹¹ Four job postings are both in this subset and in defense-affiliated entities subset.

Table 3. Chinese AI Job Postings by Subset

Subset of AMPLYFI Dataset	Number of Job Postings in Spring 2021		
	Technical Team 1	Technical Team 2	Total
AI job postings	36,198	22,031	58,229
AI job postings advertised by defense-affiliated entities	59	22	81
AI job postings related to surveillance	2,451	426	2,877

Source: Subset of CSET and AMPLYFI Chinese job postings dataset for the period April-July 2021.

For each subset in Table 3, we analyze the geographic distribution of job postings using the job location—at the provincial level—listed in the job posting. When a job’s structured location field was empty, we attempted to extract the location from the full

text of the job posting.¹² When the full text did not contain any additional information, the job posting's location was marked "null."

For the first subset (AI job postings), we also include a geographic analysis at the prefecture or city level. As the four municipalities—Beijing, Chongqing, Shanghai, and Tianjin—are simultaneously cities and subject to direct control of the central government like provinces, we categorize them as both cities and provinces.¹³ Since there are far fewer AI job postings in the defense-affiliated entities subset and the surveillance subset, we choose not to conduct a city-level analysis of these jobs.

Limitations

The generalizability of our findings is limited in several ways. The data collection mechanism is designed to capture a representative sample of four Chinese job boards at the time of data collection (Spring 2021), but does not cover all publicly available Chinese job boards. Our dataset may also contain a disproportionately large share of early career job postings, possibly because mid- and senior-level positions are more likely to be filled through internal referrals, recruiting firms, or professional networks.¹⁴

To ensure the quality of the results, we conducted validation checks on our list of surveillance keywords and our list of defense-affiliated entities.¹⁵ Still, our keyword lists likely don't capture every facet of AI activity in China; the AI job postings in our dataset may also not reflect what is most prioritized in China's national AI development. It is also likely that the PLA and defense-affiliated universities use other means to advertise for AI and surveillance-related jobs, and that the job boards we scanned do not capture this demand signal well.

Despite these limitations, this data brief provides new and useful information about the geographic distribution of Chinese employers' demand for AI talent, including in the surveillance and defense sectors, that can help U.S. policymakers better understand the Chinese AI labor market and more specifically, the geographic dimensions of China's AI talent development efforts.

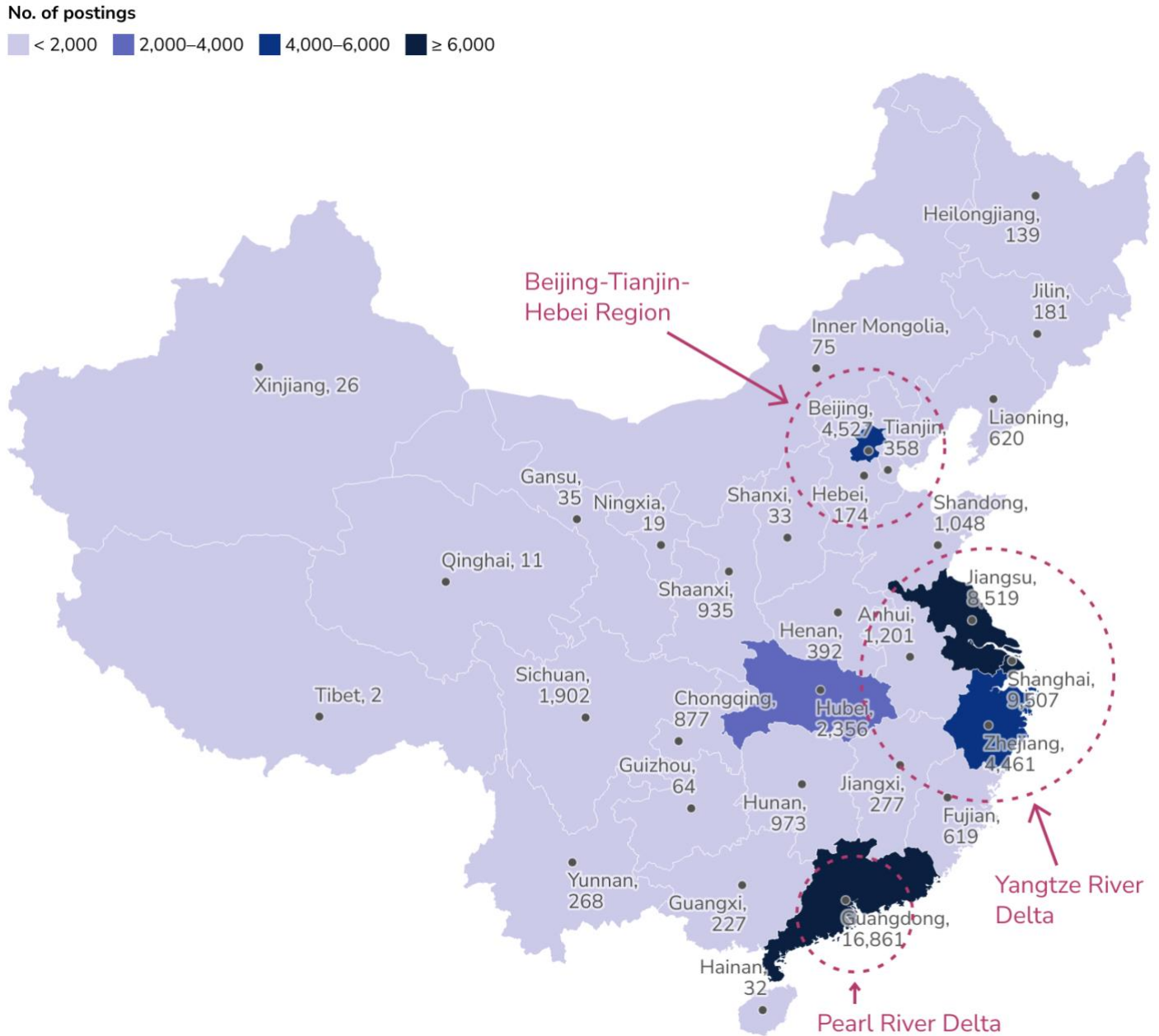
AI Job Postings

Regional Hubs

To better understand the variability of AI job demand across China, in this section we examine AI job postings by region. The geographic location of talent demand helps shed light on the current status and future trajectory of a region's economic and technological development. Following the launch of the national AI plan in 2017, China's local governments published a range of AI development plans to benefit their local economies and meet the overarching goals outlined by the central government. These local plans generally include cultivating AI talent and companies, establishing target values for the AI industry, and encouraging collaboration between government, industry, and academia, among others.¹⁶ In each of these policies, local governments often offer incentives to attract AI talent and investment to their respective locales, with the broader intention of growing the high-tech industry in their jurisdictions.¹⁷

We identified 58,229 AI job postings, which account for about 6 percent of the total number of Technical Team 1 and 2 jobs postings and less than 1 percent of the overall job postings in our larger dataset. 78 percent of AI job postings are concentrated in China's three major metropolitan regions. As seen in Figure 2, these regions are the Yangtze River Delta region (which includes Shanghai, Zhejiang, Jiangsu, and Anhui), the Pearl River Delta (which includes Guangdong, Hong Kong, and Macau), and the Beijing-Tianjin-Hebei area.¹⁸ The Chinese government noted that it selected these major metropolitan areas as strategic locations for prioritized economic development.¹⁹

Figure 2. Number of AI Job Postings by Region in Spring 2021



Note: 1,509 AI job postings did not have a geographic region and are not included in the map.

Source: CSET and AMPLYFI Chinese job postings dataset for the period April-July 2021.

The high concentration of AI job postings in these regions is expected given that these provinces and municipalities are located in key economic and technological development areas with large populations, which are also backed financially and politically by the Chinese government.²⁰ A 2020 report published by China’s Ministry

of Industry and Information Technology (MIIT) conveys similar results, finding that talent demand in the aforementioned three metropolitan areas combined accounts for 89 percent of the total national demand for AI talent.²¹

Moreover, AI job postings are more concentrated in China's coastal areas than in its inland regions. The Yangtze River Delta region alone accounts for 41 percent of all AI job postings in our Spring 2021 dataset, while an additional 29 percent and 9 percent of the job postings advertising AI positions were located in the Pearl River Delta and Beijing-Tianjin-Hebei area, respectively. In contrast, the Sichuan-Chongqing twin cities, which is considered the fastest-growing inland metropolitan region, only accounts for 5 percent of the AI job postings in our dataset.²²

Outside of the aforementioned coastal metropolitan areas, other provinces with a notable number of AI job postings include Hubei, Shandong, and Hunan. Hubei had 2,356 AI job postings or about 4 percent of the total AI job postings in our dataset. Shandong had 1,048 AI job postings, while Hunan had 973, each accounting for less than 2 percent of the total (Figure 2). It is worth noting that in Hubei and Hunan, the capital cities of Wuhan and Changsha respectively account for the majority of job postings. In Shandong, on the other hand, AI job postings are not concentrated in just the capital city Jinan, but also in Qingdao. In a later section, we assess the geographic distribution of AI job postings at the city and municipality level.

Supply and Demand Indicators for China's AI Talent Ecosystem: AI Education Programs and AI Job Postings

Tracking and mapping the demand signal for AI jobs across China based on AI job postings is one part of the talent equation; the other part speaks to the supply of qualified professionals who, at least in theory, can fill these jobs. One way to approximate the supply side of AI talent is through measures such as AI education programs. Prior CSET research has found that between 2019 and 2021, the Ministry of Education approved 345 Chinese universities to offer a newly standardized undergraduate AI major.²³ This tally stands at 440 universities as of 2022.²⁴ The number of AI major university programs does not fully represent China's AI talent supply in a given province nor does it speak to the quality of these professionals. While we cannot know the number of graduates from each of these programs, or whether university graduates from AI major programs filled the AI job postings in our dataset, these graduates presumably have the knowledge, skills, and abilities to perform the tasks outlined in some of the AI job postings. These graduates could meet talent demand either in the provincial workforce—if they choose to stay in the area

after graduation—or work in one of the three metropolitan regions with relatively high AI talent demand. Indeed, 78 percent of AI professionals surveyed by MIIT intend to work in one of those three areas.²⁵

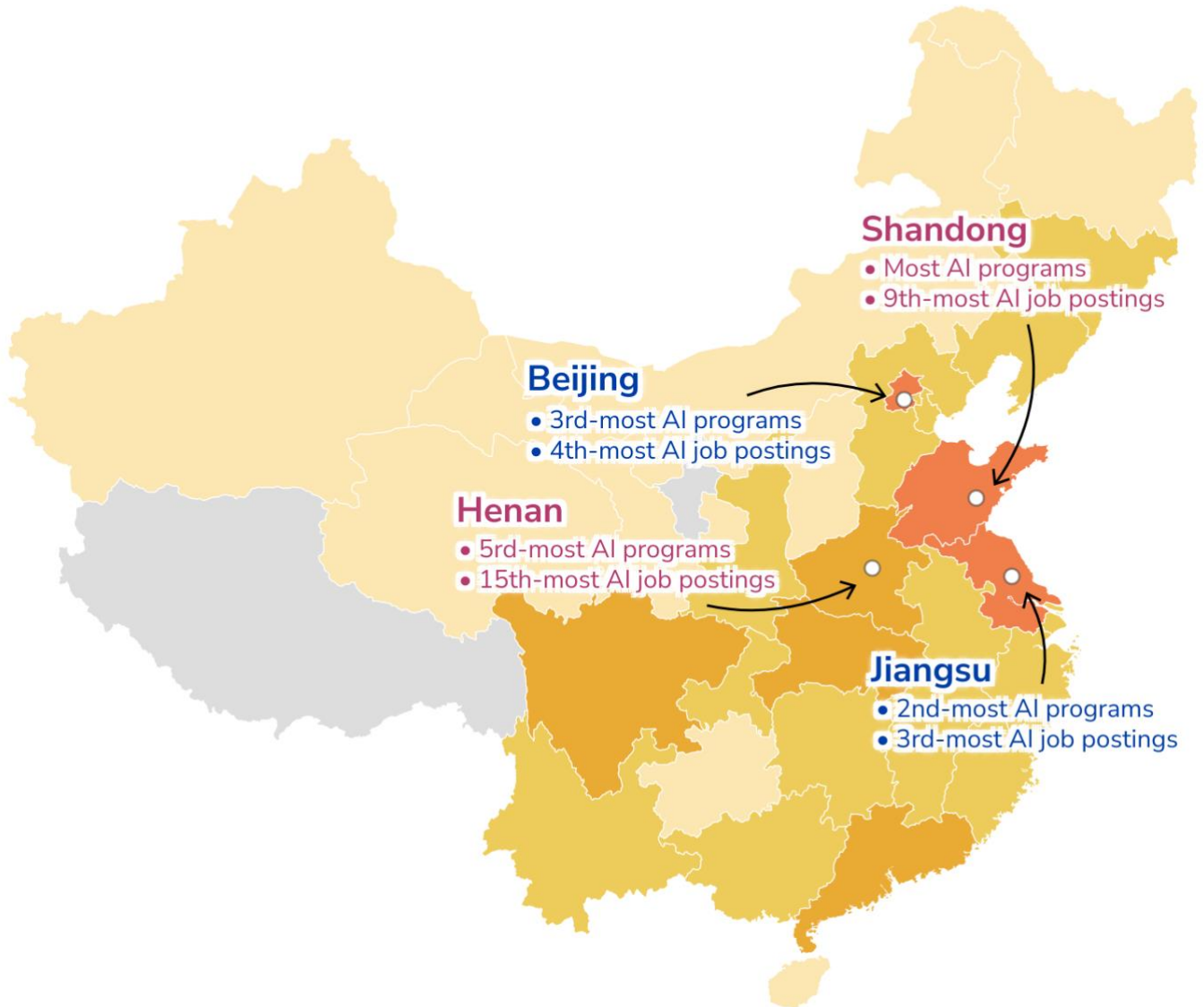
We assess whether the supply of AI talent, as proxied by the count of university AI major programs per province, is aligned with the demand for such talent, as measured by the AI job postings in that same province. Beijing and Jiangsu are ranked high on both AI major programs and AI job postings, meaning our indicators of supply and demand match up. Henan and Shandong, however, are ranked high in AI major programs, but low in AI job postings, signaling that supply may be outpacing demand, at least by our measures (Figure 3).

Jiangsu and Beijing are ranked high both in terms of the number of university AI major programs and the number of AI job postings. Jiangsu and Beijing respectively have the 2nd-most (32) and 3rd-most (30) AI major programs. The two provinces are located in the Yangtze River Delta and the Beijing-Tianjin-Hebei area shown in Figure 2, and as such, have high numbers of AI job postings in our dataset; Jiangsu has the 3rd-most (8,519) and Beijing the 4th-most postings (4,527).

A closer look at the AI education programs and AI job postings in Shandong and Henan—both of which are located outside of the three aforementioned metropolitan regions—tells a different story. Figure 3 shows that while Shandong has the highest number of AI major programs (33), the province has the 9th-most (1,048) AI job postings. The ranking gap is even wider in Henan. The province has the fifth-most (24) AI major programs nationally but is ranked 15th in AI job postings in our dataset, with only 392 postings. Although the number of AI university majors in a given province is only one indicator of AI talent supply, the misalignment between the number of AI education programs and AI job postings in these provinces suggests that graduates from AI university majors might struggle to find employment fitting their education and skills in these regions. It is therefore possible that some of these newly-minted AI professionals are leaving the area after graduation to pursue career opportunities in the three aforementioned AI hubs.

Figure 3. Alignment and Misalignment between AI Major University Programs and AI Job Postings in Select Provinces

No. of AI Major programs



Note: Selected provinces are labeled with rank by the number of university AI major programs as well as rank by the number of AI job postings for the period April-July 2021.

Source: CSET collection of Chinese AI major programs and AMPLYFI Chinese job postings dataset.

City-level Hubs

While the 58,229 AI job postings in our dataset are spread out across 248 Chinese cities, 71 percent of these postings are concentrated in only 10 cities (Table 4).²⁶ There are many reasons that certain cities attract more technical talent than others, such as the historical evolution of the science and technology ecosystem, major companies that offer competitive salaries and connections, or having leading research institutions. The Chinese Institute of New Generation Artificial Intelligence Development Strategies (CINGAI), a state-affiliated research center, has put together an index to judge the “AI competitiveness” of key cities in China, focusing on factors such as enterprise innovation capacity, academic ecosystem, capital environment, international openness, networking capabilities, and government responsiveness.²⁷ Interestingly, while the index does account for the strength of a city’s academic ecosystem as a proxy for the supply of AI talent, it does not consider the *demand* for AI talent in its assessment of AI competitiveness.

As Table 4 shows, the demand for AI talent, as proxied by our data on AI job postings, is concentrated in cities with vibrant innovation ecosystems which ranked high on CINGAI’s “AI competitiveness” index. However, there are two exceptions: Suzhou in Jiangsu province and Dongguan in Guangdong province, which are in the top 10 cities based on the number of AI job postings in our dataset, but fall outside of the top 10 regions in the CINGAI AI competitiveness ranking. The CINGAI report ranks Suzhou in 18th place, with a score of 8 out of 100, indicating a relatively underdeveloped AI innovation ecosystem based on the aforementioned factors considered in the index. Based on our data, however, Suzhou had the 6th-most AI job postings, with 3,793 job postings or 6.5 percent of the total AI job postings in our dataset. It is possible that Suzhou city's growing robotics industry may be driving some of this demand for AI talent.²⁸ For instance, 51 percent of the AI job postings in Suzhou include the keyword “robotics,” compared to 34 percent of all AI job postings in our dataset. The CINGAI report also finds the AI ecosystem in Dongguan to be relatively underdeveloped. The city, however, makes our top 10 based on its demand for AI talent. While we cannot measure trends over time with our data, it is worth watching whether the AI-related job market in Dongguan is expanding, and whether additional investment and other resources are being channeled into the city to establish it as an emerging AI hub.

Table 4. Ranking of Top 10 Municipalities and Prefecture-level Cities by the Most AI Job Postings in Spring 2021 and CINGAI Ranking of AI Competitiveness

City/Municipality	AI job postings	Ranking by most AI job postings	Ranking by CINGAI	Similarity and difference in ranking
Shanghai	9,507	1	3	Similar
Shenzhen	8,916	2	2	Similar
Beijing	4,527	3	1	Similar
Guangzhou, Guangdong	4,396	4	5	Similar
Suzhou, Jiangsu	3,793	5	18	Different
Hangzhou, Zhejiang	2,836	6	4	Similar
Nanjing, Jiangsu	2,418	7	9	Similar
Wuhan, Hubei	2,179	8	10	Similar
Chengdu, Sichuan	1,763	9	7	Similar
Dongguan, Guangdong	1,244	10	20+*	Different

Note: *Dongguan is not on the top 20 ranking by CINGAI.

Source: Analysis of CSET and AMPLYFI Chinese job postings dataset for the period April-July 2021 and CINGAI.

The data on trends in AI talent hubs at the regional and city level highlights a complex reality of AI workforce clusters across China. While the three economically-developed coastal regions and some top-tier cities in China are seeing high demand for AI talent, a few other provinces such as Hubei, Shandong and Hunan, as well as cities such as Suzhou and Dongguan also seem to be competing for AI talent. The myriad of economic, political, and social factors underlying and driving these trends are beyond the scope of this report, but our analysis nonetheless helps identify emerging AI hubs in China that warrant closer attention.

AI Job Postings Advertised by Defense-Affiliated Entities

China's People's Liberation Army (PLA) and defense-affiliated universities are actively seeking technical AI talent to help Beijing achieve its military modernization goals. The U.S. government is particularly concerned about the risks posed by the PLA's development and procurement of AI-enabled military technology, which China intends to use to gain asymmetric advantages (非对称优势) in a potential conflict with the United States.²⁹ Recent assessments from the U.S. Department of Defense indicate that:

The PLA...is pursuing greater autonomy for unmanned aerial, surface, and underwater vehicles to enable manned and unmanned hybrid formations, swarm attacks, optimized logistic support, and disaggregated ISR [intelligence, surveillance, and reconnaissance], among other capabilities.³⁰

With this in mind, we searched our dataset for AI job postings advertised by the PLA and 13 defense-affiliated universities that were on the U.S. Commerce Department's Entity List as of the end of 2022 to better understand the Chinese military's demand for AI talent.³¹ Among the 13 defense-affiliated universities included in the analysis are the Seven Sons of National Defense, which are directly supervised by the MIIT via its subordinate agency State Administration for Science, Technology and Industry for National Defense (SASTIND). These universities' core mission is to support China's defense research, its industrial base, and military-civil fusion to merge civilian research into military applications.* The other six universities on the Commerce Department's Entity List that we include in our analysis are the University of Electronic Science and Technology of China, Sichuan University, the Chinese Academy of Engineering Physics, the National University of Defense Technology (NUDT), Tianjin University, and Beijing University of Posts and Telecommunications.

All together, we identified 81 AI job postings advertised by defense-affiliated entities in our dataset: two roles posted by the 60th Research Institute of the Joint (formerly

* The Seven Sons are the Beijing Institute of Technology, Beijing University of Aeronautics and Astronautics, the Harbin Institute of Technology, Harbin Engineering University, Northwestern Polytechnical University, Nanjing University of Aeronautics and Astronautics and Nanjing University of Science and Technology. See Ryan Fedasiuk and Emily Weinstein, "Universities and the Chinese Defense Technology Workforce" (Center for Security and Emerging Technology, December 2020). <https://doi.org/10.51593/20200043>.

General) Staff Department of the PLA (中国人民解放军总参谋部第六十研究所), and 79 roles advertised by nine of the 13 defense-affiliated universities.³²

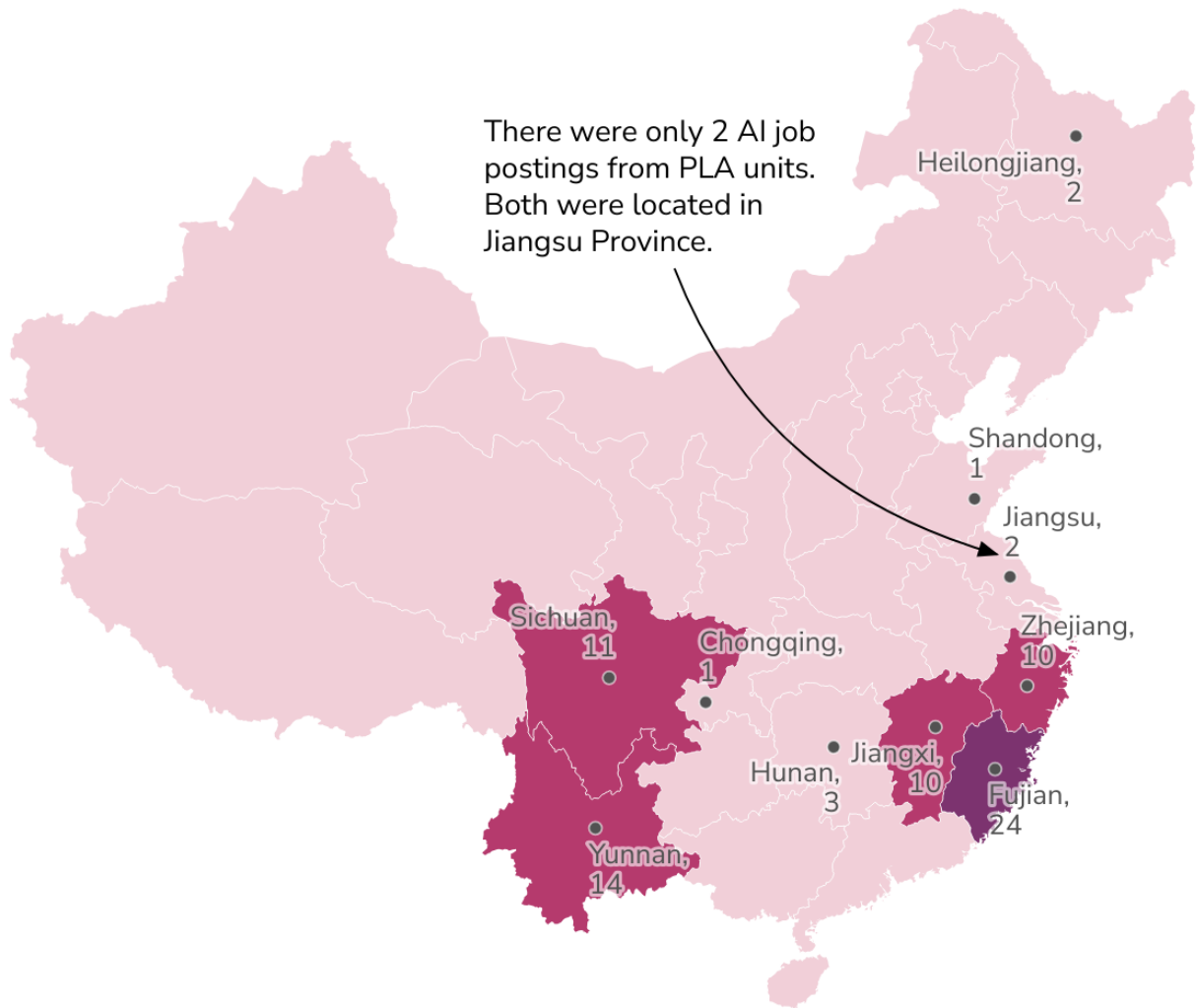
At the provincial level, Figure 4 shows that defense-affiliated job postings are spread across 10 provinces, and are concentrated in Fujian (24), Yunnan (14), Sichuan (11), Zhejiang (10), and Jiangxi provinces (10). Notably, in Fujian, Sichuan, and Zhejiang, the most frequent AI keyword contained in identified job postings is *robotics*, while in Yunnan it is *unmanned*, and in Jiangxi it is *deep learning*.

The 24 AI job postings in Fujian came from two research institutes jointly established by two defense-affiliated universities and local governments. Fujian (Quanzhou) Institute of Advanced Manufacturing Technology of the Harbin Institute of Technology (HIT), jointly established by HIT and the Fujian provincial government, advertised for 15 AI-related jobs.³³ The remaining job postings came from the Southeast Academy of Information Technology of Beijing Institute of Technology (BIT) which was established by BIT and the Putian city government to implement MIIT's policy to integrate industry and education.³⁴ Similarly, other defense-affiliated universities covered in this paper also jointly established satellite campus research institutes with local governments. They are discussed in greater detail in the [next section](#) and [Appendix C](#).

Figure 4. AI Job Postings Advertised by the PLA and Nine Defense-Affiliated Universities are Concentrated in Five Provinces

No. of postings

< 10 10–20 ≥ 20



Note: Provinces with zero job postings are not labeled on the map. All postings were from defense-affiliated universities except for 2 job postings advertised by the PLA in Jiangsu Province. Three of the defense-affiliated AI job postings did not have a geographic region and are therefore not included in the map.

Source: CSET and AMPLYFI Chinese job postings dataset for the period April-July 2021.

AI Job Postings Advertised by the PLA

Of the 58,229 AI jobs in our dataset, we found only two AI jobs advertised by the PLA, specifically the Jiangsu-based 60th Research Institute of the Joint Staff Department of the PLA (labeled in Figure 4). One job posting was in Technical Team 1 and the other in Technical Team 2.³⁵ The Technical Team 1 AI job posting is for an image processing algorithm engineer to work on positioning, detection, and tracking algorithms for video and image processing. The Technical Team 2 AI job posting is for an aircraft structural designer for UAV testing, evaluation, and trial production. The Technical Team 1 position more explicitly requires AI skills to develop computer vision software for UAVs, while the Technical Team 2 position is directed more toward designing and testing the aircraft itself. Given our low result count, it is likely that the PLA primarily recruits AI talent through other methods aside from the four job portals we examine, for instance, defense-specific job boards, university job fairs, industry events, internal channels, and others.

Founded in 1952, the 60th Research Institute is located in Nanjing, Jiangsu Province, and according to the job postings we identified, it is the earliest scientific research unit in China to develop military training simulation equipment. This institute has both research and development (R&D) and production elements with over 10 research labs focusing on designing unmanned aerial vehicles (UAV), flight control technology, small turbojet engines, laser communications, and conducting combat simulation training.³⁶ The job postings note that these products are used broadly across China's army, navy, air force, and reserves as well as for Ministry of Public Security and People's Armed Police personnel.

AI Job Postings Advertised by Defense-Affiliated Universities

Of the 13 defense-affiliated universities we examine, nine advertised 79 AI job postings in university research institutes.* Among these nine defense-affiliated universities, the top three are Beijing University of Aeronautics and Astronautics (also known as Beihang) with 30 job postings, Harbin Institute of Technology with 15 job postings, and Beijing Institute of Technology with 13 job postings (see Table 5).

* We did not find any job postings advertised by Beijing University of Posts and Telecommunications, Chinese Academy of Engineering Physics, Nanjing University of Aeronautics and Astronautics, or Nanjing University of Science and Technology.

Table 5. AI Job Postings Advertised by Nine Defense-affiliated Universities

Defense-affiliated Universities	Count of AI Job Postings
Beijing University of Aeronautics and Astronautics	30
Harbin Institute of Technology	15
Beijing Institute of Technology	13
Tianjin University	5
Sichuan University	4
Northwestern Polytechnical University	4
National University of Defense Technology of China	3
University of Electronic Science and Technology of China	3
Harbin Engineering University	2

Source: CSET and AMPLYFI Chinese job postings dataset for the period April-July 2021.

Of the 79 job postings, only six were advertised by the main campus of their respective defense-affiliated universities. The rest of the job postings were advertised by the satellite campuses' research institutes. For instance, none of the AI jobs posted by Beihang were in Beijing where the university is based. Instead, Beihang's AI job postings were distributed across four cities—Kunming, Nanchang, Ningbo, and Hangzhou (see [Appendix C](#) for more details). One satellite campus in Kunming—Yunnan Innovation Research Institute (北京航空航天大学云南创新研究院)— advertised 14 of the 30 positions from Beihang. Within this institute, half of the posts are offered by the Intelligent Unmanned System Research Center (智能无人系统研究中心).

Some of the job titles advertised in these postings included embedded hardware engineers, software engineers, image recognition algorithm engineers, and navigation algorithm engineers. For example, the aforementioned Yunnan Innovation Research Institute offered positions for electronics hardware engineers and embedded software engineers working on flight control, image processing, and ground station applications.

Beyond engineering positions, three universities including Beihang advertised for seven lecturer positions, presumably to train the next generation of AI talent.* Teaching fields for these seven lecturer positions included AI, computer science, electrical and robotics engineering, and UAV applications. Based on the ads we reviewed, these universities appear to be looking for candidates who have experience beyond an academic setting; most of these postings noted that candidates must hold at least a Master's degree in fields such as software engineering, computer science, or AI, and have at least three years of working experience in these fields. Although our dataset cannot answer where students of these courses go on to seek employment, prior research has shown that three quarters of graduates recruited by defense state-owned enterprises are educated at Seven Sons universities.³⁷

* Universities offering lecturer positions were the University of Electronic Science and Technology, Sichuan University, and Beijing University of Aeronautics and Astronautics.

AI Job Postings Related to Surveillance

In addition to identifying and mapping AI job postings advertised by the PLA and defense-affiliated universities, we also examine the demand signal and geographic distribution of AI job postings related to surveillance across China. To identify this subset of job postings, we searched our dataset of AI job postings for keywords reflecting a set of surveillance techniques and national surveillance programs co-run by the Ministry of Public Security.

The AI-enabled surveillance techniques we searched for across our dataset of AI-related job postings that returned results include *emotion recognition*, *facial recognition*, *speech recognition*, *gait recognition*, *iris recognition*, *minority recognition*, *sentiment analysis*, *feature extraction*, *opinion mining*, and the *Safe Cities*, *Sharp Eyes*, and *Skynet* surveillance programs.* These techniques are further defined in [Appendix B](#). China's national surveillance programs include the Golden Shield Project, Safe Cities, Skynet, Sharp Eyes, and Police Cloud. These national surveillance programs are included because they are increasingly enabled by AI analytics, and as such, would presumably require technical talent to design, develop, integrate and operate these systems.³⁸ These programs extend surveillance from urban to rural areas, and between public and private spaces, tracking everyone from ordinary citizens to “focus personnel” (重点人员).³⁹ Focus personnel includes groups the Chinese government has defined as threatening to social stability, such as government petitioners, supposed terrorists (which includes Uyghurs), drug users, and the mentally ill. Companies such as Megvii have “intelligent search” products that automatically bin people into these categories.⁴⁰

We identify 2,877 AI job postings related to surveillance (see Figure 5): 2,451 in the Technical Team 1 category and 426 in Technical Team 2.[†] We do not comment on the roles and responsibilities outlined in these job postings, nor do we claim that the entities who are hiring for these positions and the individuals who take on these jobs are necessarily involved in China's surveillance ecosystem. The following discussion notes the occurrence and distribution of the surveillance-related keywords we have

* Most of the techniques included in the surveillance keywords list are dual-use, meaning they can be used to support commercial or surveillance applications. Selected techniques vary in how directly they support surveillance activities; for example, *sentiment analysis* is widely used in commercial applications, while *minority recognition* has few non-surveillance applications.

[†] We found four surveillance-related jobs from defense-affiliated entities, all located in Fujian, from the Beijing Institute of Technology (3 posts) and Harbin Institute of Technology (1 post).

used to identify this set of AI jobs in our dataset, and draws on previous research that describes how China has employed some of the surveillance techniques for a variety of purposes, some relatively benign and also practiced in democratic nations and other much more nefarious and in violation of human rights laws and norms.

The top five surveillance keywords appearing in these AI job postings are *facial recognition* (1,057 AI job postings related to surveillance, or 37 percent), *feature extraction* (887 posts, or 31 percent), *speech recognition* (708 posts, or 25 percent), *sentiment analysis* (297 posts, or 10 percent), and *safe cities* (44 posts, or 2 percent).^{*} Previous research has found that sentiment analysis is used to aid censorship by Chinese government bodies.⁴¹

Only 58 AI job postings related to surveillance explicitly mentioned China's national surveillance programs. 44 of these job postings mentioned Safe Cities, which is one of China's oldest surveillance programs established in 2003, 12 mentioned Sharp Eyes, and two referenced Skynet.

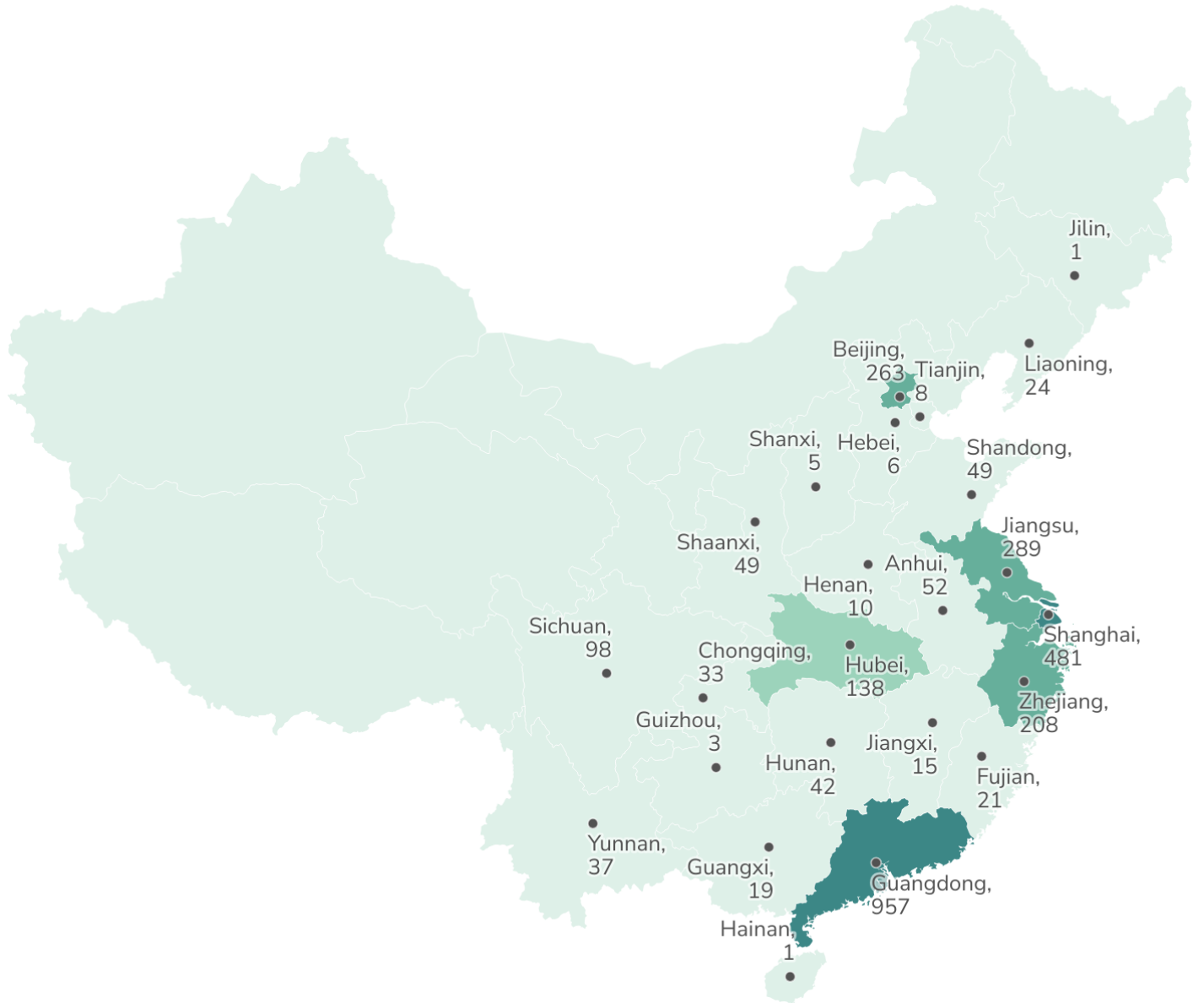
Figure 5 shows that the five provinces and municipalities with the highest number of AI job postings related to surveillance are Guangdong (957 posts), Shanghai (481), Jiangsu (289), Beijing (263), and Zhejiang (208).

^{*} Job postings are double counted when they contain more than one type of surveillance keyword.

Figure 5. Number of AI Job Postings Related to Surveillance by Region

No. of postings

< 100 100–200 200–300 ≥ 300



Note: Provinces with zero job postings are not labeled on the map. 144 surveillance job postings did not have a geographic region and are therefore not included in the map.

Source: CSET and AMPLYFI Chinese job postings dataset for the period April–July 2021.

The AI job postings related to surveillance in our dataset are concentrated in the same three clusters that industry watcher Wanhe Securities identifies as Chinese surveillance industry hubs. Furthermore, these clusters overlap with the three metropolitan regions with relatively high concentrations of AI job postings. These are the Pearl River Delta, the Yangtze River Delta, and the Bohai Economic Rim (which extends beyond the Beijing-Tianjin-Hebei region we discussed earlier to include Liaoning and Shandong provinces).⁴² Previous research has estimated that combined, these three regions constitute about two-thirds of China's total surveillance industry value.⁴³ Within these three regions, Shenzhen (China's Silicon Valley equivalent) stands out with 65 percent of the number of Chinese surveillance companies.⁴⁴ Meanwhile, the Yangtze River Delta is home to China's three largest surveillance companies, Hikvision, Dahua, and Uniview.⁴⁵

Conclusion

Using a novel dataset of 6.8 million job postings from China collected between April and July 2021, this report has narrowed down to 58,229 AI-related job postings, finding 78 percent of these sought-after opportunities are concentrated in economically and technologically developed regions, including the Pearl River Delta, Beijing-Tianjin-Hebei Area, and the Yangtze River Delta. Our analysis also reveals that other provinces outside these three well-established economic and technological regions, especially Hubei, Hunan, and Shandong provinces, are also competing for AI talent. At the city level, while we found postings for AI jobs spread out across 248 Chinese cities, 71 percent of all of the AI job postings in our dataset were concentrated in only 10 cities. The demand for AI talent—at least as proxied by the number of AI-related job postings in our dataset—is highest in China’s major cities like Shanghai, Shenzhen, and Beijing, but other cities such as Suzhou in Jiangsu province and Dongguan in Guangdong province are also showing a notable demand signal for AI professionals who may help buttress and expand the AI ecosystem in these cities.

The paper also focuses on analyzing AI job postings in sectors relevant to U.S. national security interests, specifically identifying AI job postings advertised by defense-affiliated entities and AI job postings related to surveillance. Nearly all of the AI job postings put forth by Chinese defense institutions came from nine defense-affiliated universities, which advertised for 79 posts spread across 10 provinces. However, given this low number, we believe our data may not accurately reflect the entire job posting demand of this sector. With respect to AI job postings related to surveillance, the majority were concentrated in Guangdong, Shanghai, Jiangsu, Beijing, and Zhejiang, while the position descriptions most often mentioned AI-related surveillance techniques such as *facial recognition*, *feature extraction*, *speech recognition*, *sentiment analysis*, and *safe cities*.

This report seeks to understand the baseline of these issues and raise questions for further research and analysis. Future work for analysts in the AI policy field could include analysis of these geographic clusters in a greater ecosystem context, including but not limited to specific employers and their relationships with other relevant stakeholders. Such work could examine the nationwide presence of specific companies, including both those that are known targets of U.S. policy and those that to date have flown under the radar.

Authors

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Appendix A: Methodology

Population Variance

We confirmed that the variance in the size of China's provincial populations was not skewing the results of our analysis after conducting a version of this analysis with population-normalized job postings. Population density is not the only reason high counts of AI job postings exist in these areas. This is likely also due to these areas being economic and technological hubs, which may have higher technology job concentrations.

Defense-Affiliated University List

When filtering by the names of defense-affiliated Chinese universities, we added additional conditions to reduce error. The abbreviated names of some universities overlap with common Chinese phrases, leading searches for these names to return some job postings that were not posted by a defense-affiliated university. To eliminate this source of error, we carefully evaluate each job posting record from a defense-affiliated university and add additional conditions to exclude erroneous results.

AI Keyword List

This is the keyword list used to identify AI job postings. The list is provided in English and Chinese; the job postings were searched for keywords in both languages. The list was developed using CSET staff expertise and a literature review of research, including papers that attempted to identify AI data in documents such as grants and patents.

Table A1. AI Keyword List

English Term	Chinese Term(s)
artificial intelligence	人工智能
\bA\b	
machine learning	机器学习
supervised learning	监督学习
unsupervised learning	无监督学习
reinforcement learning	强化学习
deep learning	深度学习 or 深层学习
neural network	神经网络
computer vision	计算机视觉
natural language processing	自然语言处理
facial recognition	人脸识别 or 面部识别 or 面像识别 or 面容识别 or 面孔识别
biometric	生物识别 or 指纹识别
robotics	机器人
augmented reality	增强现实
autonomous	自主性
human-machine	人机
learning algorithm	学习算法
classification algorithm	分类算法
image recognition	图像识别
data mining	数据挖掘
text mining	文本挖掘
topic model	主题建模 or 主题模型
sentiment analysis	情感分析 or 评论分析 or 评价分析
opinion mining	意见挖掘 or 观点挖掘
pattern recognition	模式识别

speech recognition	语音识别
feature extract	特征提取
unmanned	无人

Source: CSET.

Appendix B: Additional Data and Analysis of AI Job Postings (Surveillance)

Surveillance techniques we searched for include keywords for *emotion recognition*, *facial recognition*, *speech recognition*, *gait recognition*, *iris recognition*, *minority recognition*, *sentiment analysis*, *feature extraction*, *opinion mining*, and the *Safe Cities*, *Sharp Eyes*, and *Skynet* surveillance programs. *Facial*, *gait*, *iris*, and *speech recognition* are biometric recognition techniques that fall under the broader umbrella of pattern recognition. *Sentiment analysis* (also known as opinion mining) is a subfield of Natural Language Processing (NLP) that detects subjective information from input text, and classifies it as across a range of negative, neutral, and positive.⁴⁶ Due to the sensitivity of surveillance applications, we do not provide the exact list of surveillance keywords. Selected keywords were based on their use in Chinese surveillance approaches and are not exhaustive.

Appendix C: Additional Data and Analysis of AI Job Postings Advertised by Defense-Affiliated Entities

Looking at the AI job postings advertised by these nine defense-affiliated universities at the city level, the vast majority are located outside of their main campus city in other provinces (Table C1). Local governments with sufficient funding are likely interested in establishing local research institutes with elite universities, as these partnerships can attract AI talent to their jurisdictions.

Table C1. Locations of AI Job Postings Advertised by Defense-Affiliated Universities

University	Main Campus Location	Location of job posting	Number of job posting
Beijing University of Aeronautics and Astronautics	Beijing	Kunming, Yunnan	14
		Nanchang, Jiangxi	10
		Ningbo, Zhejiang	3
		Hangzhou, Zhejiang	3
Harbin Institute of Technology	Harbin, Heilongjiang	Quanzhou, Fujian	15
Beijing Institute of Technology	Beijing	Putian, Fujian	9
		Unknown*	4
Tianjin University	Tianjin	Chengdu, Sichuan	5
Sichuan University	Chengdu, Sichuan	Meishan, Sichuan	3
		Qingdao, Sichuan	1
Northwestern Polytechnical University	Xi'an, Shaanxi	Ningbo, Zhejiang	4
University of Electronic Science and Technology of China	Chengdu, Sichuan	Chengdu, Sichuan	1
		Unknown*	2
National University of Defense Technology of China	Changsha, Hunan	Changsha, Hunan	3
Harbin Engineering University	Harbin, Heilongjiang	Harbin, Heilongjiang	2

*Note: *Four job postings from the Beijing Institute of Technology and two job postings from the University of Electronic Science and Technology of China have an unknown geographic region or city. Universities without any job postings include Beijing University of Posts and Telecommunications,*

Chinese Academy of Engineering Physics, Nanjing University of Aeronautics and Astronautics, and Nanjing University of Science and Technology.

Source: CSET analysis of AMPLYFI data for the period April-July 2021.

All of Beihang's AI job postings in our dataset were posted by four "innovation research institutes" that are located in Hangzhou and Ningbo, Zhejiang Province, Nanchang, Jiangxi Province, and Kunming, Yunnan Province.⁴⁷ For example, according to information provided in the job postings, in March 2018, Beihang jointly established its Hangzhou institute with local authorities at the Beitanghe Innovation Center (北塘河创新中心). The institute has since launched six research centers focusing on quantum metrology, microelectronic materials, AI, big data and brain-computer interfaces, big data for integrated transportation applications, and cybersecurity.

Beihang's Hangzhou institute works closely with several key laboratories in China. As previously profiled by CSET, State Key Laboratories (SKLs) are strategically significant for China as they have driven advances in defense and commercial sector basic and applied research in a broad array of science and technology fields since the 1980s.⁴⁸

The level of desired experience differs between job positions at Beihang's Intelligent Unmanned System Research Center versus those at its other four satellite institutes. For these seven posts at the unmanned research center, a high level of overall experience is not required: candidates need to have Bachelors in automation or computer science related majors, while two years of embedded programming experience in UAV-related industries is a plus. However, its position for an assistant researcher in UAV design calls for a PhD in aerospace related fields including aerodynamics, flight mechanics, and aircraft design. On the other hand, Beihang's four satellite institutes—which offer positions such as image recognition algorithm engineers, manufacturing engineers for robotics applications, and embedded AI R&D engineers—require Masters degrees.

Another one of the Seven Sons, Beijing Institute of Technology (BIT), has 13 job postings listed across China. Nine of these jobs are offered at the Southeast Academy of Information Technology (北京理工大学东南信息技术研究院), located in Putian, Fujian Province since 2019.⁴⁹ An agreement between BIT, the Putian municipal government, MIIT, and Fujian Province launched the academy in the Haixi Economic Zone (海西经济区), which lies between the Pearl River Delta and Yangtze River Delta economic zones.⁵⁰ These are the same areas where we have identified the majority of AI job postings are located. The academy is meant to train "high-end digital talents with strong engineering capabilities" from undergraduate through postdoctoral levels to

transform Fujian Province into a powerhouse of AI, big data, and industrial internet capabilities.⁵¹ BIT also has three jobs offered at its Chongqing innovation center (北京理工大学重庆创新中心) for jobs such as an unmanned ground system R&D and test engineer, an additive manufacturing R&D engineer with 3D printing experience, and a Linux/C++ engineer with experience using deep learning frameworks, GPUs, and OpenCV. Another job posting is for an engineer developing decision making algorithms for autonomous vehicles at its Shenzhen Automotive Research Institute, which works with China's National Engineering Laboratory for Electric Vehicles.⁵²

Northwestern Polytechnical University (NPU) in Xi'an, Shaanxi Province has a research institute (西北工业大学宁波研究院) located in Ningbo, Zhejiang Province. This Ningbo institute was launched in September 2019 between NPU and the Ningbo municipal government and is located in the "intelligent manufacturing port" of Ningbo's High-tech Zone (宁波高新区智造港).⁵³ Its research focuses on flexible electronics, smart chips, unmanned navigation, civil aerospace, satellites, and big data applications.⁵⁴ From its home base, NPU additionally has a State Key Laboratory for UAV Special Technology (无人机特种技术国家重点实验室), established in 2001 with an initial investment of 420 million RMB, and includes testing functions for "complex electronic warfare environment simulations."⁵⁵

The National University of Defense Technology of China (NUDT), based in Changsha, Hunan Province, has three AI job postings—all located in Changsha—for various algorithm engineer related positions. All three jobs were posted by NUDT's School of Electronic Science (电子科学学院), either in the Department of Intelligent Sensing (智能感知系) or the State Key Laboratory of Complex Electromagnetic Environment Effects on Electronics and Information Systems (电子信息系统复杂电磁环境效应国家重点实验室).

Among the non-Seven Sons defense-affiliated universities, Beijing University of Posts and Telecommunications and CAEP did not have any AI postings during the analyzed timeframe, while Tianjin University had five—all located outside Tianjin in its Sichuan Innovation Research Institute—with positions including AI and autonomous driving development engineers. The University of Electronic Science and Technology of China had one AI posting for a teaching position for students majoring in fields including robotics and electrical engineering at a college located within the university campus in its home location of Chengdu (电子科技大学成都学院).

In contrast to other universities that had job postings located entirely outside the province where the main campus is located, Sichuan University's four AI job postings

were all located within Sichuan, and predominantly focus on education and talent training. Three were at the school's Jinjiang College (四川大学锦江学院) in Meishan, which is located approximately 37 miles away from the main campus in Chengdu.

Endnotes

- ¹ “Notice of the State Council on Issuing the New Generation Artificial Intelligence Development Plan” [国务院关于发布《新一代人工智能发展规划》的通知], PRC State Council, 2017, <https://perma.cc/B9ZR5LQL>. English translation is available at <https://www.newamerica.org/cybersecurityinitiative/digichina/blog/full-translation-chinas-new-generation-artificial-intelligence-development-plan2017>.
- ² “People’s Daily: Have a Firm Grip on the Lifeblood of Technology” [人民网评：把科技的命脉牢牢掌握在自己手中] *People’s Daily*, July 1, 2022, <https://archive.ph/mWT5i>.
- ³ “Xi Jinping: Hold High the Great Banner of Socialism with Chinese Characteristics and Work Together to Comprehensively Build a Modern Socialist Country—Report at the 20th National Congress of the Communist Party of China [习近平：高举中国特色社会主义伟大旗帜 为全面建设社会主义现代化国家而团结奋斗——在中国共产党第二十次全国代表大会上的报告],” *Xinhua*, October 25, 2022, <https://archive.ph/dCWzW>.
- ⁴ “Measuring Job Openings in the U.S. Labor Market,” Congressional Research Service, December 21, 2018, <https://sgp.fas.org/crs/misc/IF11054.pdf>.
- ⁵ Conor Healy and Donald Maye, “Punishing Journalists PRC Province's Latest Mass Surveillance Project, Won by Neusoft Powered By Huawei,” IPVM, November 29, 2021, <https://ipvm.com/reports/henan-neusoft>; Cate Cadell, “China harvests masses of data on Western targets, documents show,” *Washington Post*, December 31, 2021, https://www.washingtonpost.com/national-security/china-harvests-masses-of-data-on-western-targets-documents-show/2021/12/31/3981ce9c-538e-11ec-8927-c396fa861a71_story.html.
- ⁶ All postings in the dataset were active at the time of collection (Spring 2021).
- ⁷ “Job Search Software Ranking 2022 Top 10 Domestic Job Search App Ranking” [找工作软件排行榜 2022 国内十大找工作 app 排行榜], Anfensi [安粉丝], January 13, 2022: <https://perma.cc/CK9K-Z23P>.
- ⁸ Diana Gehlhaus, Joanne Boisson, Sara Abdulla, Jacob Feldgoise, Luke Koslosky, and Dahlia Peterson, “China’s AI Workforce: Assessing Demand for AI Talent” (Center for Security and Emerging Technology, November 2022), <https://doi.org/10.51593/20220003>.
- ⁹ Diana Gehlhaus and Santiago Mutis, “The U.S. AI Workforce: Understanding the Supply of AI Talent” (Center for Security and Emerging Technology, January 2021), <https://doi.org/10.51593/20200068>.
- ¹⁰ In some cases, a job might be posted under a shortened name rather than the full, official name of the organization. For example, 成电 is an alias for 电子科技大学, which is the University of Electronic Science & Technology of China.

¹¹ Due to the sensitivity of surveillance applications, we refrain from providing the exact list of surveillance keywords. Keywords were chosen based on their prevalence in Chinese surveillance approaches and are not exhaustive.

¹² See more in Appendix C in Gehlhaus et al., "China's AI Workforce."

¹³ Cheng Li, "The Leadership of China's Four Major Cities: A Study of Municipal Party Standing Committees," *China Leadership Monitor*, No. 21, June 1, 2007, <https://www.brookings.edu/wp-content/uploads/2016/06/li2007summer.pdf>.

¹⁴ For a detailed explanation, please see the "Desired Experience" section in: Gehlhaus et. al., "China's AI Workforce."

¹⁵ From the job postings containing surveillance keywords, we randomly sampled and manually reviewed 20 postings containing each keyword. Keywords with job posting results unrelated to surveillance were discarded; this process led us to remove pattern recognition, biometric, and data fusion from the surveillance keywords list. For the defense-affiliated job postings, we manually reviewed each entity to ensure that it was truly part of the PLA or the specified defense-affiliated university; this process led us to discard 117 false positives that were posted by private companies, not universities.

¹⁶ Emmie Hine and Luciano Floridi, "Artificial intelligence with American values and Chinese characteristics: a comparative analysis of American and Chinese governmental AI policies" *AI & Soc.* (2022). <https://doi.org/10.1007/s00146-022-01499-8>.

¹⁷ Jinghan Zeng, China's Artificial Intelligence Innovation: A Top-Down National Command Approach? *Global Policy* 12, no.13 (May 2021): 5, <https://onlinelibrary.wiley.com/doi/full/10.1111/1758-5899.12914>; Richard Florida, "The Economic Geography of Talent, *Annals of the Association of American Geographers*," 92, no. 4 (March 2010), <https://www.tandfonline.com/doi/abs/10.1111/1467-8306.00314>.

¹⁸ Of the locations classified as the Pearl River Delta, AI job postings in our dataset are primarily located in Guangdong. The dataset only contains two AI postings in Hong Kong and none in Macau.

¹⁹ The Pearl River Delta became a major industrial base after Deng Xiaoping turned Shenzhen city into a special economic zone, "Optimistic about Pearl River Delta's bright future," *South China Morning Post*, December 18, 2012, <https://www.scmp.com/comment/letters/article/1107234/optimistic-about-pearl-river-deltas-bright-future>; his successor Jiang Zemin pushed for the industrialization of the Yangtze River Delta with Shanghai as a financial hub, Matt Schiavenza, "The Staggering Rebirth of Shanghai," *the Atlantic*, March 15, 2013, <https://www.theatlantic.com/china/archive/2013/03/the-staggering-rebirth-of-shanghai/274061/>; to continue this legacy, Xi Jinping called for an integration of Beijing, Tianjin, and Hebei province into an economic hub in 2014, Cary Huang, "Integration of Beijing, Tianjin and Hebei set to be signature project of Xi Jinping's administration," *South China Morning Post*, June 24, 2014,

<https://www.scmp.com/news/china/article/1539886/integration-beijing-tianjin-and-hebei-set-be-signature-project-xi>.

²⁰ We also conducted a version of this job posting analysis with population normalization and found similar results. We chose to use job posting counts to discuss the results in this section. For more details, see Appendix A.

²¹ “Artificial Intelligence Industry Talent Development Report (2019-2020 Edition)” [人工智能产业人才发展报告（2019-2020年版）] Chinese Ministry of Industry and Information Technology (MIIT) Talent Exchange Center [工业和信息化部人才交流中心], March 29, 2020, translation is available at <https://cset.georgetown.edu/publication/artificial-intelligence-industry-talent-development-report-2019-2020-edition>.

²² Ren Zeping [任泽平], “Ren Zeping: 2022 China Metropolitan Hubs Development Potential Ranking” [任泽平：2022 中国城市群发展潜力排名], *Sina*, October 9, 2022, <https://perma.cc/T2E8-6L7J>.

²³ Dahlia Peterson, Kayla Goode, and Diana Gehlhaus, “AI Education in China and the United States” (Center for Security and Emerging Technology, September 2021). <https://doi.org/10.51593/20210005>.

²⁴ Peterson et. al., “AI Education in China and the United States.” For 2022 analysis, see “95 colleges and universities have added new AI undergraduate majors. The AI major cannot just be a “hot topic,” [95所高校新增 AI 本科专业，AI 专业不能只是“蹭热点”] OFWeek, March 1, 2022, <https://perma.cc/TM6S-VUC9>.

²⁵ “Artificial Intelligence Industry Talent Development Report (2019-2020 Edition).”

²⁶ The top 10 cities are Shanghai, Shenzhen, Beijing, Guangzhou, Suzhou, Hangzhou, Nanjing, Wuhan, Chengdu, and Dongguan.

²⁷ “China’s New Generation AI Technology Industry Region Competitiveness Evaluation Index” [中国新一代人工智能科技产业区域竞争力评价指数（2022）] The Chinese Institute of New Generation Artificial Intelligence Development Strategies [CINGAI; 中国新一代人工智能发展战略研究院], September 8, 2022; see translation at <https://cset.georgetown.edu/publication/chinas-new-generation-ai-technology-industry-region-competitiveness-evaluation-index>.

²⁸ “Top 10 Chinese cities in the robotic industry,” *China Daily*, August 31, 2022, <https://perma.cc/ZNK2-N8BQ>.

²⁹ Ryan Fedasiuk, Jennifer Melot, and Ben Murphy “Harnessing Lightning” (Center for Security and Emerging Technology, October 2021). <https://doi.org/10.51593/20200089>.

³⁰ United States Department of Defense, *Military and Security Developments Involving the People’s Republic of China* (Washington, DC: Department of Defense, 2022), 87, <https://media.defense.gov/2022/Nov/29/2003122279/-1/-1/2022-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF>.

³¹ U.S. Department of Commerce, *Consolidated Entity List* (Washington, DC: Bureau of Industry and Security, 2022), <https://www.bis.doc.gov/index.php/documents/consolidated-entity-list?format=html>.

³² The original language used in the job postings retains the previous title (General Staff Department). In 2016, the General Staff Department of the PLA (中国人民解放军总参谋部) was reorganized into the Joint Staff Department of the Central Military Commission (中央军事委员会联合总参谋部). See *Chairman Xi Remakes the PLA: Assessing Chinese Military Reforms*, eds. Phillip C. Saunders, Arthur S. Ding, Andrew Scobell, Andrew N.D. Yang, and Joel Wuthnow (Washington, DC: National Defense University Press, 2019), 6, <https://ndupress.ndu.edu/Portals/68/Documents/Books/Chairman-Xi/Chairman-Xi.pdf>.

³³ Fujian (Quanzhou) Institute of Advanced Manufacturing Technology [福建(泉州)先进制造技术研究院], <https://perma.cc/YFW8-LLRF>.

³⁴ Beijing Institute of Technology Southeast Academy of Information Technology [北京理工大学东南信息技术研究院], <https://perma.cc/837H-NKC6>; “Several Opinions from the General Office of the State Council on Deepening the Integration of Industry and Education” [国务院办公厅关于深化产教融合的若干意见], PRC State Council, 2017, <https://archive.ph/P1S7S>.

³⁵ Jiangsu is also where Chinese military colleges such as the Nanjing-based Army Engineering University of the PLA and the PLA Naval Command College are located; see Cao Siqi and Liu Xuanzu, “Jiangsu emphasizes people’s defense line in anti-spying regulation,” *Global Times*, April 15, 2020, <https://perma.cc/U35W-MAJD>.

³⁶ The institute is additionally a certified military equipment manufacturer and holds a national certification for military software development. It has a “second-level,” or “secret” equivalent confidentiality qualification for weapons R&D and production. According to the National Administration of State Secrets Protection, this “second-level” qualification is for secret-level scientific research and production tasks, while “first-level” is for top secret. “Announcement of the National Administration of State Secrets Protection” [国家保密局公告], Guidance and Management Department [指导管理司], July 2, 2021, <https://perma.cc/GKQ4-T235>.

³⁷ Ryan Fedasiuk and Emily Weinstein, “Universities and the Chinese Defense Technology Workforce” (Center for Security and Emerging Technology, December 2020), <https://cset.georgetown.edu/publication/universities-and-the-chinese-defense-technology-workforce>.

³⁸ Isabelle Qian, Muyi Xiao, Paul Mozur and Alexander Cardia, “Four Takeaways From a Times Investigation Into China’s Expanding Surveillance State,” *The New York Times*, July 26, 2022, <https://www.nytimes.com/2022/06/21/world/asia/china-surveillance-investigation.html>.

³⁹ Dahlia Peterson, “Designing Alternatives to China’s Repressive Surveillance State” (Center for Security and Emerging Technology, October 2020), <https://doi.org/10.51593/20200016>.

⁴⁰ Paul Mozur, Muyi Xiao and John Liu, “‘An Invisible Cage’: How China Is Policing the Future,” *New York Times*, June 25, 2022, <https://www.nytimes.com/2022/06/25/technology/china-surveillance-police.html>.

⁴¹ Ryan Fedasiuk, "Buying Silence: The Price of Internet Censorship in China," *The Jamestown Foundation*, January 12, 2021, <https://jamestown.org/program/buying-silence-the-price-of-internet-censorship-in-china>.

⁴² "Research on Intelligent Security Industry: Status, Trend and Pattern" [智能安防行业研究：现状、趋势与格局], Vanho Securities [万和证券], February 5, 2020, <https://perma.cc/A6J7-VUHL>.

⁴³ "Research on Intelligent Security Industry."

⁴⁴ "Research on Intelligent Security Industry."

⁴⁵ "Uniview Company Profile," XLR Security, September 26, 2022, <https://www.xlrsecurity.com/uniview-company-profile>.

⁴⁶ While sentiment analysis and opinion mining are synonyms, the vast majority of our results are in sentiment analysis. Technical Team 1 has 209 sentiment analysis job postings versus only two postings in opinion mining. Technical Team 2 has 88 postings in sentiment analysis and 0 in opinion mining.

⁴⁷ The full titles for these innovation research institutes are: 北京航空航天大学杭州创新研究院, 北京航空航天大学宁波创新研究院, 北京航空航天大学江西研究院, and 北京航空航天大学云南创新研究院.

⁴⁸ Collaborators include the Beihang Key Laboratory of Inertial Technology for National Defense in Science and Technology (北航惯性技术国防科技重点实验室), the Ministry of Industry and Information Technology's Key Laboratory of Quantum Sensing Technology (量子传感技术工信部重点实验室), the MOE's Key Laboratory of Advanced Aerospace Materials and Service (空天先进材料与服役教育部重点实验室), the State Key Laboratory of Virtual Reality Technology and Systems (虚拟现实技术与系统国家重点实验室), the State Key Laboratory of Software Development Environment (软件开发环境国家重点实验室), the National Engineering Laboratory for Big Data Applications for Integrated Transportation(综合交通大数据应用技术国家工程实验室), and the National Model Academy of Cyber Security (网络安全国家示范学院). This last aspect is a ten-year strategic initiative promulgated by the Ministry of Education and the Cyberspace Administration of China in August 2017 to build world-class cybersecurity colleges by expanding enrollment for cybersecurity programs, build labs with enterprises, and conduct state-sanctioned research; see "Notice on Publishing and Distributing of the 'Administrative Measures for the Construction Demonstration Project of First-class Network Security College'" [关于印发《一流网络安全学院建设示范项目管理暂行办法》的通知], PRC's Ministry of Education, August 15, 2017, [\[https://perma.cc/X3JM-SFFW\]](https://perma.cc/X3JM-SFFW). Of the labs the Beihang Hangzhou center works with, the Virtual Reality and Software SKLs have been previously profiled in Emily Weinstein, Channing Lee, Ryan Fedasiuk, and Anna Puglisi, "China's State Key Laboratory System: A View into China's Innovation System" (Center for Security and Emerging Technology, June 2022). <https://doi.org/10.51593/20210019>.

⁴⁹ "Beijing Institute of Technology Southeast Academy of Information Technology."

⁵⁰ "Beijing Institute of Technology Southeast Academy of Information Technology."

⁵¹ “Beijing Institute of Technology Southeast Academy of Information Technology.”

⁵² The Mandarin titles for the Beijing Institute of Technology Shenzhen Automotive Research Institute and National Engineering Laboratory for Electric Vehicles are 北京理工大学深圳汽车研究院(电动车辆国家工程实验室深圳研究院).

⁵³ “Northwestern Polytechnical University” [西北工业大学宁波研究院], <https://ningbo.nwpu.edu.cn/>.

⁵⁴ “Northwestern Polytechnical University.”

⁵⁵ “National Defense Science and Technology Key Laboratory of UAV Special Technology” [无人机特种技术国防科技重点实验室], Collaborative Innovation Center of Future Aerospace Vehicle, <https://web.archive.org/web/20191011015420/http://cicav.nwpu.edu.cn/info/1204/2623.htm>.