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Universities and the Chinese Defense Technology Workforce

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Executive Summary

Since the mid-2010s, U.S. lawmakers have voiced a broad range of concerns about academic collaboration with the People’s Republic of China (PRC), but the most prominent have been about China’s strategy of military-civil fusion (MCF). One concern holds that Chinese university students or graduates may come to the United States on exchange programs or for postgraduate education, then return and contribute to China’s military modernization.¹ To address this concern, U.S. policymakers must first understand which forms of collaboration, and with which Chinese universities, pose the greatest risk to U.S. research security.

This report examines 2019 graduate employment data from 45 elite Chinese universities, in addition to Ministry of Education documents, which list collaborative training projects between private companies and Chinese universities. Key findings include the following:

- Chinese defense state-owned enterprises (SOEs) directly hired a combined 6,000 graduates from 29 leading Chinese universities in 2019.
- China’s defense SOEs tend to recruit far more graduates completing advanced degree programs than those finishing baccalaureates.
- Three quarters of graduates recruited by defense SOEs come from China’s “Seven Sons of National Defense,” a group of universities administered directly by the Ministry of Industry and Information Technology.
- From 2018–2019, 13 U.S. technology companies established collaborative training programs with the Seven Sons. These projects primarily involved training faculty and developing course curricula related to machine learning, big data, and integrated circuit design.

China’s “Seven Sons of National Defense” include the following universities:

- Beijing Institute of Technology
- Beijing University of Aeronautics and Astronautics
- Harbin Engineering University
- Harbin Institute of Technology
- Nanjing University of Aeronautics and Astronautics
- Nanjing University of Science and Technology
- Northwestern Polytechnical University

- U.S. tech companies may inadvertently aid China’s military modernization through their subsidiaries’ relationships with defense-affiliated universities.

Our findings confirm that the Seven Sons of National Defense are important feeders for China’s military and defense industry. However, it appears that the vast majority of civilian universities in China maintain at least some connection to the country’s defense industry.

Furthermore, despite the risks of collaborating with universities so closely tied to China’s defense industrial base, we find that several prominent U.S. technology companies have established close working relationships with the Seven Sons and other defense affiliated universities in China. Documents from the Chinese Ministry of Education indicate that the Seven Sons have benefited from training programs and partnerships with the China-based subsidiaries or joint ventures of Autodesk, Dell, Google, Honeywell, IBM, Intel, Merrill Lynch, Microsoft, National Instruments, Rockwell Automation, Synopsys, Tektronix, and Texas Instruments.

Introduction

In recent years, the U.S. government has sought to limit U.S. research institutions' exposure to China's defense industry. Despite mounting concerns around U.S.-China collaboration, however, U.S. policymakers recognize that placing blanket limitations on Chinese universities with *any* connections to the People's Liberation Army (PLA) would incur major costs for the U.S. research enterprise.² The United States needs a targeted approach to research security. Recent policy decisions such as Presidential Proclamation 10043 have placed selective restrictions on Chinese students and researchers with clear ties to China's MCF strategy.³

U.S. policymakers and university administrators are asking which forms of engagement, and with which Chinese universities, may unwittingly aid in China's military modernization. To inform that question, this study highlights relationships between certain leading Chinese universities and the PRC defense industry, based on how many graduates they supply to defense SOEs. We find that a select group of universities, China's Seven Sons of National Defense, contribute the lion's share of new hires at Chinese defense SOEs. Beyond defense SOEs, Appendix I also details how many graduates joined the PLA, as well as the Chinese Academy of Engineering Physics (CAEP), China's leading nuclear weapons lab.

Table 1. Chinese Universities with the Most 2019 Graduates Employed by Major Defense Companies

Name	Name (Chinese)	No. of 2019 Grads Employed by Chinese Defense SOEs	Portion of Employed Graduates Working at Chinese Defense Companies	Member of "Seven Sons of National Defense"
Northwestern Polytechnical University	西北工业大学	963	26%	Yes
Beijing University of Aeronautics and Astronautics (Beihang University)	北京航空航天大学	833	24%	Yes
Beijing Institute of Technology	北京理工大学	767	17%	Yes
Harbin Engineering University	哈尔滨工程大学	753	24%	Yes
Harbin Institute of Technology	哈尔滨工业大学	581	13%	Yes
Nanjing University of Science and Technology	南京理工大学	416	13%	Yes
Xi'an Jiaotong University	西安交通大学	241	6%	No
Tianjin University	天津大学	229	4%	No
Dalian University of Technology	大连理工大学	191	3%	No
Shanghai Jiaotong University	上海交通大学	153	3%	No
<i>Total: Top Ten Universities</i>		<i>5,127 graduates employed by Chinese defense SOEs</i>		

Source: Chinese universities' 2019 employment quality reports.

Methodology and Scope

Universities in China publish yearly graduate employment quality reports (毕业生就业质量报告), which detail how many of their graduates find jobs after graduation, and where. We looked at employment data published by a group of 45 leading universities: all 42 "Double First Class" (双一流) universities, and the remaining three Seven Sons of National Defense (国防七子).*

* We added Harbin Engineering University, Nanjing University of Aeronautics and Astronautics, and Nanjing University of Science and Technology, which are not considered Double First Class universities, but which are three of China's Seven Sons of National Defense.

- **Double First Class Universities** are a group of 42 elite Chinese universities that the Chinese government believes have the potential to become world-class universities with world-class curricula (hence the name Double First Class).⁴ As a result of their status, these universities receive preferential treatment and access to greater resources from the Ministry of Education and Ministry of Finance.⁵
- **The Seven Sons of National Defense** are a group of seven universities with historical ties to China’s defense industry. They are directly administered by the State Administration for Science, Technology, and Industry for National Defense (国家国防科技工业局; SASTIND), and their academic disciplines focus predominantly on science and technology with dual-use applications. Four of the Seven Sons—Northwestern Polytechnical University, Beijing University of Aeronautics and Astronautics, Beijing Institute of Technology, and Harbin Institute of Technology—are also considered Double First Class Universities.

A full list of the 45 universities considered in this report can be found in Appendix I. Of the 45 elite universities we considered for analysis, 29 published data detailing how many of their graduates went to work at specific companies. Collectively, these 29 universities produced 250,000 graduates in 2019, of whom 141,000 had secured post-graduation job contracts. This paper focuses on their career moves—specifically, how many took jobs at China’s state-owned defense companies, outlined in Table 2.

Table 2. China’s State-Owned Defense Companies

<i>Company</i>	<i>Year Established</i>	<i>No. of Employees</i>	<i>Key Areas</i>	<i>Subject to U.S. Export Controls?⁶</i>
Aero Engine Corporation of China (AECC; 中国航空发动机集团)	2016 ⁷	96,000 ⁸	Aircraft engines and materials	No
Aviation Industry Corporation of China (AVIC; 中国航空工业集团公司)	1951; ⁹ reorganized in 2008 ¹⁰	450,000 ¹¹	Aviation weapons and equipment, military transport aircraft, helicopters, airborne systems, general aviation, aviation R&D ¹²	Yes
China Aerospace Science and Industry Corporation (CASIC; 中国航天科工集团有限公司)	2002 ¹³	150,000 ¹⁴	Aerospace defense, commercial aerospace, industrial internet, smart	Yes

			industries ¹⁵	
China Aerospace Science and Technology Corporation (CASC; 中国航天科技集团有限公司)	1999 ¹⁶	180,000 ¹⁷	Aerospace products, missile/weapons systems and products	Yes
China Electronics Technology Group (CETC; 中国电子科技集团)	2002 ¹⁸	190,000 ¹⁹	Electronic equipment, software, hardware components ²⁰	Yes
China National Nuclear Corporation (CNNC; 中国核工业集团公司)	1999	150,000 ²¹	Nuclear technologies, nuclear energy ²²	Yes
China North Industries Corporation (NORINCO; 中国兵器工业集团公司)	1999 ²³	220,000 ²⁴	Military technology, tanks and armored vehicles, air and missile defense ²⁵	Yes
China Shipbuilding Industry Corporation (CSIC; 中国船舶重工股份有限公司) †	1999 ²⁶	165,000 ²⁷	Ship R&D, ship design and manufacturing, marine defense and transportation equipment, deep-sea equipment	No
China South Industries Group Corporation (CSGC; 中国南方工业集团公司)	1999	170,000	Firearms, vehicle parts, and optical-electronic devices	No
China State Shipbuilding Corporation (CSSC; 中国船舶集团有限公司)	1982 ²⁸	310,000 ²⁹	Naval weapons and equipment R&D, production, testing, and support ³⁰	No
Commercial Aircraft Corporation of China (COMAC; 中国商用飞机有限责任公司)	2008 ³¹	11,000 ³²	Large aircraft manufacturing and R&D ³³	No

Note that for some companies, only a subsidiary is subject to U.S. export controls.

†CSIC and CSSC merged in 2019 to form the new China State Shipbuilding Corporation.³⁴

The findings of this study are limited in several ways. First, our findings are restricted to the 29 universities for which data was available. Adding data from the missing 16 elite universities could change our results; any of the excluded universities may disproportionately produce graduates who work in the defense industry. Second, this report only assesses graduate flows from 2019; it is not clear to what extent this 2019 snapshot reflects longer-term employment trends in China. Third, Chinese universities highlight their employment data in different ways; some include every company that employs more than 10 graduates, or only the top 25 or 50 employers. Therefore, we do not know exactly how many students took jobs at each company discussed below. Finally, this analysis does not account for

alternative career paths into China’s defense industry. Students could pursue advanced degrees and be hired as professors at defense-affiliated universities, or enter private companies that contract with the PLA, and our analysis would not capture these inroads to China’s defense industry. Despite these limitations, our findings establish a floor for universities’ graduate flows, and highlight clear relationships between certain Chinese defense companies and the universities that feed them.

Moreover, this study does not tell a complete story. Using our approach, foreign observers of the United States could describe U.S. universities like Carnegie Mellon, the University of Arizona, or Georgia Tech as “defense-affiliated” because their graduates frequently take jobs at Honeywell, Lockheed Martin, or Raytheon.³⁵ To be sure, there are fundamental differences between the U.S. and Chinese higher education systems, and U.S. defense companies are not state-owned. But policymakers should carefully consider the political and scientific costs and benefits of labeling certain universities as “defense-affiliated.”

Part I: China’s Defense Companies Recruit from Civilian Universities

Chinese state-owned defense firms directly hired a combined 6,000 graduates from 29 leading Chinese universities in 2019—a 0.3 percent increase over their estimated 2018 workforce of 2.1 million people. Nearly two-thirds of graduates bound for the defense industry (3,725 people) took jobs at the three largest state-owned electronics and aerospace companies: China Electronics Technology Group (CETC), Aviation Industry Corporation of China (AVIC), and China Aerospace Science and Technology Corporation (CASC).

Table 3. Chinese Defense SOEs’ New Hires (2019) from Leading Chinese Universities

<i>Name</i>	<i>No. of 2019 Elite University Grads Employed</i>
China Electronics Technology Group (CETC)	1,370
Aviation Industry Corporation of China (AVIC)	1,210
China Aerospace Science and Technology Corporation (CASC)	1,145

China Aerospace Science and Industry Corporation (CASIC)	697
China Shipbuilding Industry Corporation (CSIC)	322
China North Industries Corporation (NORINCO)	318
Commercial Aircraft Corporation of China (COMAC)	280
China National Nuclear Corporation (CNNC)	209
China State Shipbuilding Corporation (CSSC)	177
Aero Engine Corporation of China (AECC)	164
China South Industries Group Corporation (CSGC)	87
<i>Total: All Eleven Defense Companies</i>	<i>5,979</i>

Source: Chinese universities' 2019 employment quality reports.

There are several notable trends in the way China's state-owned defense companies recruit recent university graduates.

First, China's defense giants recruit primarily from a small group of elite universities. Nearly every leading Chinese university produces some graduates who take jobs in China's defense industry. However, of the 10 universities that produce the *most* defense industry employees, six are members of China's "Seven Sons of National Defense"—the seventh "Son" being Nanjing University of Aeronautics and Astronautics (南京航空航天大学), for which data was not available. Collectively, these six universities produced just 16 percent of the employed graduates in our dataset, but 72 percent of the graduates who took jobs at major defense companies. By comparison, the next four universities—Xi'an Jiaotong University, Tianjin University, Dalian University of Technology, and Shanghai Jiaotong University—generated 11 percent of the employed graduates in our dataset, and 14 percent of new defense company hires.

Second, China's defense companies tend to recruit far more graduates with advanced degrees than they do undergraduate degree holders. Few universities disaggregate their employment data in a way that would allow us to measure this trend comprehensively, but there are some notable examples. At Beijing University of Aeronautics and Astronautics, just eight percent of graduates hired by defense companies had completed only their undergraduate degrees; the remaining 92 percent had completed graduate

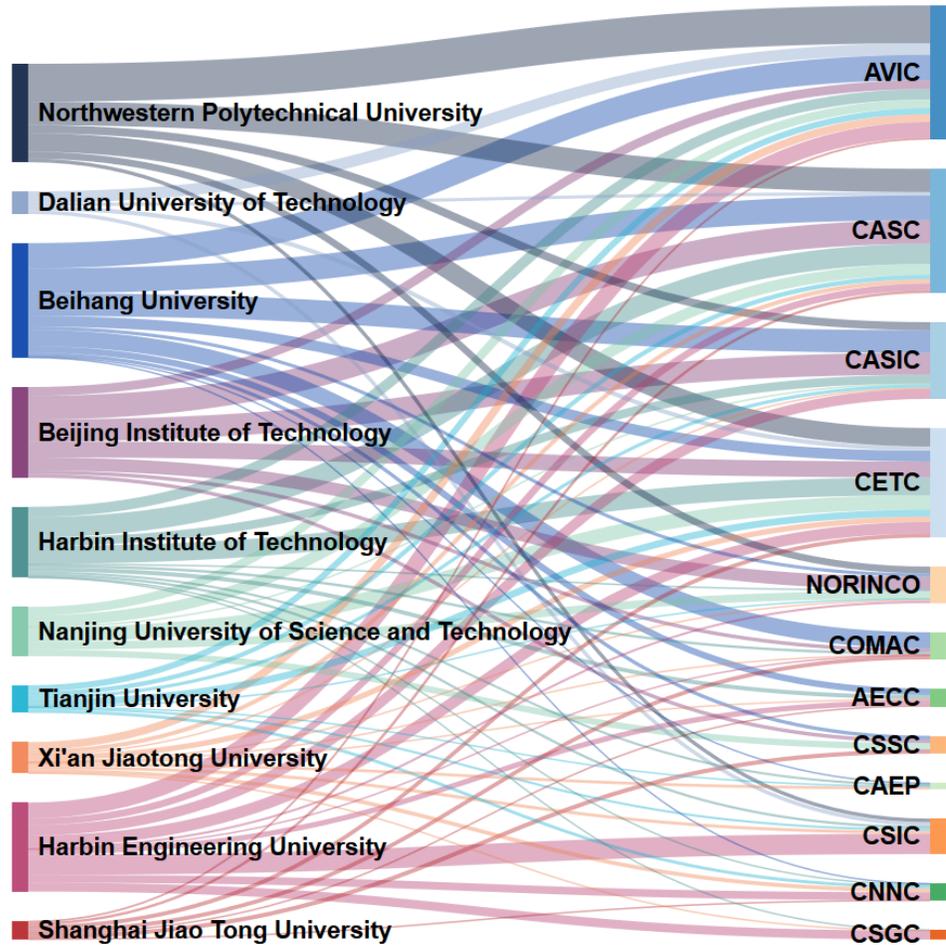
degree programs.³⁶ The same is true at Harbin Engineering University and at Tianjin University, where undergraduates represented more than half of all graduating students, but fewer than a quarter of those who took jobs at defense companies.³⁷

Third, we found several instances where a Chinese university had established an especially close relationship with one or more defense companies. Three universities have especially close relationships with defense SOEs; other relationships are explored in Appendix II:

- **Northwestern Polytechnical University (NWPU) and Aviation Industry Corporation of China (AVIC).** NWPU is the top generator of new employees at China's largest defense company. The university has established a scholarship program specifically for students looking to work at AVIC, and generated more than a quarter of all elite university graduates AVIC recruited in 2019.
- **Harbin Engineering University (HEU) and China Shipbuilding Industry Corporation (CSIC).** HEU was established as a shipbuilding institute in the 1970s, and today maintains strong connections to China's shipbuilding industry. More than half of the elite university graduates CSIC recruited in 2019 came from HEU.
- **Beijing Institute of Technology (BIT) and China North Industries Corporation (NORINCO).** BIT is consistently among the top feeder schools of many large defense companies, but it holds a particularly important place for NORINCO, for whom it is the top source of new employees. BIT and NORINCO have signed several strategic cooperation agreements and hold exclusive job fairs. Although NORINCO has been on the U.S. Department of Commerce's Bureau of Industry and Security Entity List since 2003, BIT is not.³⁸

Figure 1 illustrates relationships between universities in China and the defense companies they feed. The vertical size of each box indicates the number of graduates (for universities to the left) or new hires (for companies to the right) in 2019. The strongest relationships are between NWPU, BUAA (Beihang University), BIT, and HEU; and AVIC, CASC, CASIC, and CSIC, respectively.

Figure 1. 2019 Graduate Flows Between Chinese Universities and Chinese Defense SOEs



Finally, in addition to the Seven Sons of National Defense—which have clear connections to the military—we find that several students from civilian universities like Dalian University of Technology, Xi’an Jiaotong University, Tianjin University, and Shanghai Jiaotong University took jobs at defense SOEs in 2019.* Many, if not all, civilian Chinese universities maintain at least some connection to China’s defense apparatus.³⁹ For example, the Dalian University of Technology in 2004 jointly established the National Defense

* It is difficult to estimate how many graduates at any given Chinese university will enter the defense industry. At half of the universities we examined, more than 3 percent of employed graduates (between 50 and 1,000 people) went to work for state-owned defense companies. At the other half, fewer than 1 percent (fewer than 50 people) did so.

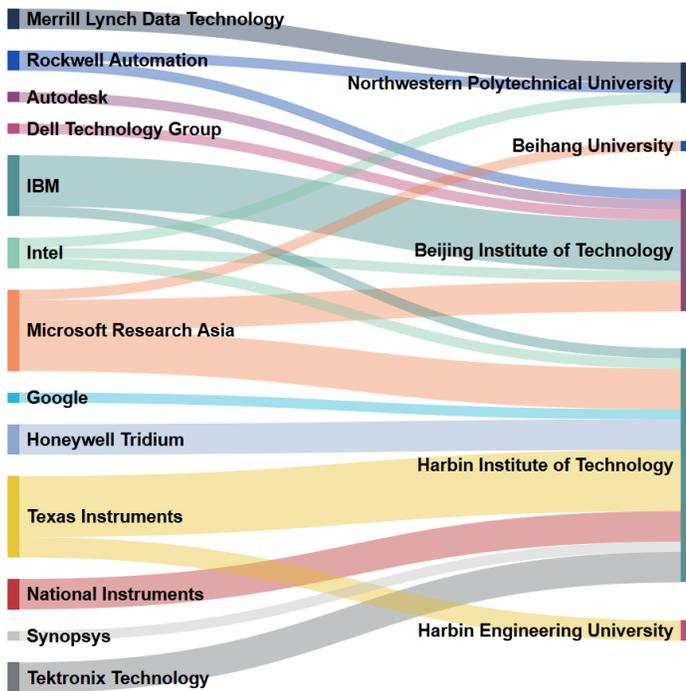
Education College (大连理工大学国防教育学院) with the Shenyang Military Region (now the Northern Theater Command) to “cultivate new military talents for national defense.”⁴⁰ The project included hiring PLA generals as faculty members at the university.⁴¹ Similarly, Tianjin University, which was named an “Advanced Unit of National Defense Education” (国防教育先进单位) by the local PLA branch in Nankai,⁴² maintains a joint research institute on human-computer interaction with the PLA Academy of Military Science.⁴³ These are just two examples, but it is likely that the majority of top universities in China have some observable connection to the defense industry or the PLA. The extent of these relationships requires further analysis beyond the scope of this report.

Part II: Some U.S. Tech Companies Indirectly Support China’s Defense Industry

The findings of this report imply that seven universities—China’s Seven Sons of National Defense—are particularly important feeders for China’s military and defense industry. Collectively, they produce nearly three quarters of the elite university graduates hired by China’s largest defense companies. Despite the risks associated with collaborating with these institutions, we find that several U.S. technology companies have established and maintain close working relationships with the Seven Sons and other defense-affiliated universities in China.⁴⁴

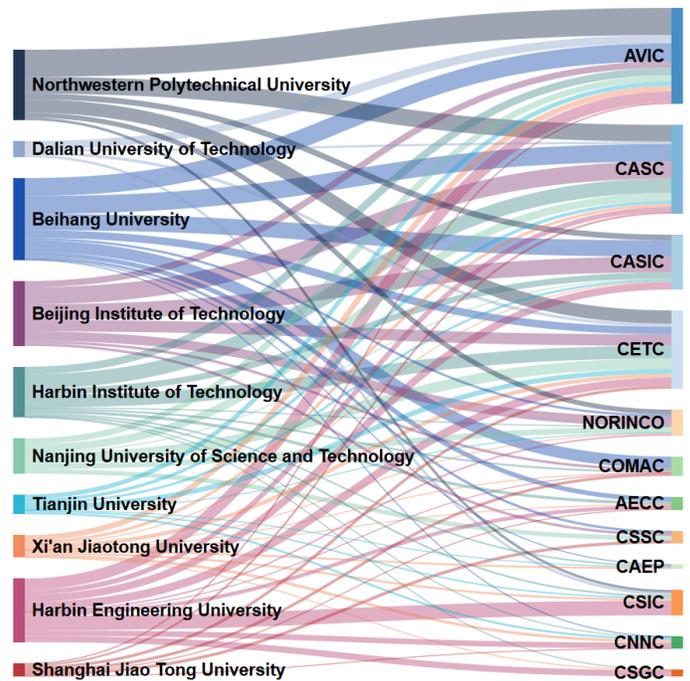
Specifically, we counted 42 cases where U.S. companies and their subsidiaries have trained faculty members at China’s Seven Sons of National Defense;⁴⁵ developed course curricula related to computer science and integrated circuit design,⁴⁶ constructed new laboratory facilities, or furnished them with equipment.⁴⁷ Considering the number of graduates from these universities who take jobs in China’s defense industry, it is likely that U.S. tech companies are inadvertently aiding in China’s military modernization by providing resources and information to the next generation of China’s defense industry engineers.

Figure 2. No. of U.S. Tech Companies' Cooperative Training Projects Established with Chinese Universities (2018-2019)



Source: 42 cooperative training programs published by the Ministry of Education, 2018-2019.

Figure 3. No. of Chinese Universities' Graduates who Took Jobs at Chinese Defense Companies (2019)



Source: 4,769 graduates' career paths published in 2019 graduate employment quality reports.

For private companies, collaboration with local research institutions is often the price of doing business in China. Many U.S. companies fear they will lose market access or face regulatory reprisal unless they comply with PRC government and Communist Party policies, including coerced technology transfer.⁴⁸ One such policy is the Ministry of Education's charge to promote "industry-university cooperation and collaborative education projects" (产学研合作协同育人项目), whereby the MOE calls upon private enterprises, especially foreign companies' China-based subsidiaries and joint ventures,⁴⁹ to aid in Chinese universities' research, curriculum development, and teacher training.⁵⁰ Since 2006, China's National Medium and Long-term Education Reform and Development Plan has sought to "encourage multinational corporations to establish their R&D centers in our country."⁵¹ In 2014, MOE

formalized a “matchmaking” process to recommend collaborative projects between specific multinational companies and Chinese universities, including the Seven Sons.⁵²

We canvassed the lists of “industry-university collaborative education projects” published by the Chinese MOE in 2018 and 2019.⁵³ In those two years, MOE documents indicate that the China-based subsidiaries or joint ventures of 13 U.S. technology companies established training programs with China’s Seven Sons of National Defense. These companies include Autodesk, Dell, Google, Honeywell, IBM, Intel, Merrill Lynch, Microsoft, National Instruments, Rockwell Automation, Synopsys, Tektronix, and Texas Instruments. We have not been able to confirm that every one of these companies actually established the training programs indicated by the Chinese government. However, we have been able to find corroborating information about several projects in news articles and on university and company websites. Below, we present three examples:

- **IBM China and Beijing Institute of Technology** signed a contract to build the IBM-BIT Mainframe Excellence Center (北理工—IBM 主机卓越中心) in 2014.⁵⁴ According to BIT, under the agreement, IBM would jointly build the facility and “provide our school with the world-class mainframe IBM System z10 enterprise server (z10 EC) for free.”⁵⁵ MOE documents indicate that in 2018, IBM launched a follow-up training program at BIT titled “Artificial intelligence for mainframe operation and management” (大型机操作和管理的人工智能). A Sohu post from IBM China that year insisted that “As an advocate of the Ministry of Education’s ‘new engineering’ construction, IBM has actively participated in it from the beginning,” and said the company would launch 84 online technical courses for students at a coalition of universities that included BIT.⁵⁶ The courses are related to quantum computing, artificial intelligence, and cognitive computing, among other topics.⁵⁷ In 2019, BIT was one of just eight universities partnering with IBM.⁵⁸ A statement on the company’s website reads, “We cherish the long-term love and support given to IBM by the Ministry of Education and partner universities, and will continue to support the reform and development of China’s education industry.”⁵⁹
- **Microsoft Research Asia and Harbin Institute of Technology** jointly launched the MSRA-HIT Artificial Intelligence and Machine Translation Joint Laboratory (哈工大—微软机器翻译技术联合实验室) in 2000.⁶⁰ By 2006, the Chinese Ministry of Education classified

it as one of the country's Key Laboratories.⁶¹ HIT's website indicates the lab is jointly financed by MOE and Microsoft Research Asia, and carries out research projects on behalf of the National Natural Science Foundation of China.⁶² In the course of its operations, the lab employs 120 HIT graduate students.⁶³ It is unclear which HIT students may have trained in the lab during their studies, but university-wide data indicates that at least 14 percent of HIT graduate students entered the Chinese defense industry upon graduation in 2019.⁶⁴ MOE documents also indicate that MSRA aided in developing computer science curricula and provided teacher training sessions related to artificial intelligence and natural language processing for HIT faculty in 2018 and 2019.⁶⁵ On its website, Microsoft Research Asia confirms it launched cooperative training programs with at least four of the Seven Sons.⁶⁶

- **Texas Instruments and Harbin Engineering University** established the TI-HEU "Pocket Laboratory" Innovation Base (哈尔滨工程大学与美国德州仪器口袋实验室) in 2015.⁶⁷ The project constructed an equipment sharing system, whereby HEU students could borrow advanced TI processors to run computationally demanding programs from the comfort of their classrooms or dormitories.⁶⁸ More recent MOE data indicates that in 2018 and 2019, TI aided HEU staff in developing curricula for courses on integrated circuit design.⁶⁹

Figure 4. Texas Instruments and Harbin Engineering University Launch the "Pocket Laboratory" Innovation Base



Source: Harbin Engineering University.⁷⁰

Conclusion

The evidence presented in this report suggests a significant and meaningful relationship between the Seven Sons of National Defense and China's largest state-owned defense companies. Despite the risks posed by research collaboration, however, U.S. technology companies' China-based subsidiaries and joint ventures have established collaborative training projects with most of these universities. As a result, U.S. tech companies may inadvertently aid in China's military modernization. Beyond training students who end up working in the PRC defense industry after graduation, U.S. tech companies' participation in MOE-sponsored collaborative training projects may indirectly enhance or accelerate the Seven Sons' research into technologies with dual-use applications. Because the technical knowledge U.S. companies provide in these exchanges is not easily controllable, there is little way of ensuring it does not proliferate across China's wider defense industry after students graduate.

To protect its edge in innovation while incurring the least cost for its research enterprise, the United States should continue to focus on managing U.S. institutions' exposure to the Seven Sons and, by extension, China's defense industry. Several U.S. policies have addressed threats to U.S. research security, including Presidential Proclamation 10043, the publication of Chinese military-linked companies operating in the United States,⁷¹ and legislation aimed at addressing PRC government influence in higher education.⁷²

Beyond the Seven Sons, the departments of several leading, ostensibly civilian Chinese universities require their researchers to hold advanced security credentials, receive funding from China's Ministry of State Security, or contribute directly to PLA-led research projects.⁷³ The difficulty for the United States is that many of those universities are also some of the most advanced and well-funded in the world, and contribute countless person-years of expertise to the U.S. science and technology enterprise through their partnerships with U.S. companies and universities.⁷⁴ Moving forward, it will be crucial for policymakers to find a way to balance the risks to research security and the benefits that come from engagement with China's civilian universities.

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Appendix I: Chinese Universities Included in This Report

This appendix includes all 45 “elite” Chinese universities considered in this report, and details which 29 published disaggregated employment information. We considered all 42 “Double First Class” universities, plus three universities that are not considered Double First Class, but which are members of China’s Seven Sons of National Defense. “Class A” universities are institutions the Ministry of Education considers to be well on their way to becoming world-class universities; “Class B” institutions at least have the potential to do so.⁷⁵

<i>Name (English)</i>	<i>Name (Chinese)</i>	<i>Type of University</i>	<i>Disaggregated Employer Data Available?</i>
Beijing Institute of Technology	北京理工大学	Class A	Yes
Beijing Normal University	北京师范大学	Class A	No
Beijing University of Aeronautics and Astronautics (Beihang University)	北京航空航天大学	Class A	Yes
Central South University	中南大学	Class A	Yes
China Agricultural University	中国农业大学	Class A	No
Chongqing University	重庆大学	Class A	Yes
Dalian University of Technology	大连理工大学	Class A	Yes
East China Normal University	华东师范大学	Class A	Yes
Fudan University	复旦大学	Class A	Yes
Harbin Engineering University	哈尔滨工程大学	Not DFC	Yes
Harbin Institute of Technology	哈尔滨工业大学	Class A	Yes
Huazhong University of Science & Technology	华中科技大学	Class A	Yes
Hunan University	湖南大学	Class B	Yes
Jilin University	吉林大学	Class A	Yes
Lanzhou University	兰州大学	Class A	Yes
Minzu University of China	中央民族大学	Class A	No
Nanjing University	南京大学	Class A	Yes
Nanjing University of Aeronautics and Astronautics	南京航空航天大学	Not DFC	No
Nanjing University of Science and Technology	南京理工大学	Not DFC	Yes
Nankai University	南开大学	Class A	Yes
National University of Defense Technology	国防科技大学	Class A	No

Northeastern University	东北大学	Class B	No
Northwest Agriculture & Forestry Technology University	西北农林科技大学	Class B	No
Northwestern Polytechnical University	西北工业大学	Class A	Yes
Ocean University of China	中国海洋大学	Class A	No
Peking University	北京大学	Class A	Yes
Renmin University	中国人民大学	Class A	No
Shandong University	山东大学	Class A	Yes
Shanghai Jiaotong University	上海交通大学	Class A	Yes
Sichuan University	四川大学	Class A	No
South China University of Technology	华南理工大学	Class A	No
Southeast University	东南大学	Class A	Yes
Sun Yat-sen University	中山大学	Class A	No
Tianjin University	天津大学	Class A	Yes
Tongji University	同济大学	Class A	Yes
Tsinghua University	清华大学	Class A	Yes
University of Electronic Science & Technology of China	电子科技大学	Class A	No
University of Science and Technology of China	中国科学技术大学	Class A	Yes
Wuhan University	武汉大学	Class A	Yes
Xi'an Jiaotong University	西安交通大学	Class A	Yes
Xiamen University	厦门大学	Class A	Yes
Xinjiang University	新疆大学	Class B	No
Yunnan University	云南大学	Class B	No
Zhejiang University	浙江大学	Class A	Yes
Zhengzhou University	郑州大学	Class B	No

Appendix II: Breakdown by Employer

This appendix includes disaggregated recruitment data for Chinese defense SOEs mentioned in this report. Although beyond the scope of our analysis, we also include information about how many university graduates joined the PLA directly or went to work for the China Academy of Engineering Physics, China's leading nuclear weapons lab.



Aero Engine Corporation of China
中国航空发动机集团

At least 164 graduates from leading Chinese universities took jobs at AECC in 2019. Among our sample, 154 employees (93 percent) came from six universities, the largest being Beihang University, which makes up 34 percent of total graduates employed by AECC in 2019.

Beihang University and AECC appear to maintain a close working relationship. Two Beihang alumni, Cao Jianguo and Li Fangyong, were named, respectively, as the first chairman and general manager of AECC when it was founded in 2016.⁷⁶ Beihang’s Research Institute for Aero Engine (航空发动机研究院) houses two institutes—the Beihang Aviation Engine Research Institute (北航航空发动机研究院) and the Aero Engine International Academy (航空发动机国际学院), which were co-founded by Beihang University and AECC in 2018.⁷⁷

<i>University</i>	<i>No. of 2019 Graduates Recruited by AECC</i>	<i>Portion of All Employed Graduates Working at AECC</i>
Beihang University	55	1%
Harbin Engineering University	45	1%
Harbin Institute of Technology	35	<1%
Shanghai Jiaotong University	11	<1%
Huazhong University of Science and Technology	8	<1%



Aviation Industry Corporation of China (AVIC)
中国航空工业集团公司

At least 1,210 graduates from leading Chinese universities took jobs at AVIC in 2019. Among our sample, 853 employees (71 percent) came from five primary feeder universities, the largest being Northwestern Polytechnical University (NWPU).

NWPU and AVIC appear to maintain a close relationship through visits and cooperative research initiatives. For instance, NWPU in September 2016 launched the “AVIC Scholarship” (中行工业奖学金) for its students using funding from AVIC.⁷⁸ The two organizations also held a symposium in Beijing in June 2020 focused on talent training and cooperation opportunities.⁷⁹

<i>University</i>	<i>No. of 2019 Graduates Recruited by AVIC</i>	<i>Portion of All Employed Graduates Working at AVIC</i>
Northwestern Polytechnical University	321	9%
Beihang University	214	6%
Harbin Engineering University	133	4%
Dalian University of Technology	97	2%
Harbin Institute of Technology	88	2%



China Aerospace Science and Industry Corporation (CASIC)
中国航天科工集团有限公司

At least 697 graduates from leading Chinese universities took jobs at CASIC in 2019. Available data indicates that 604 employees (87 percent) came from five primary feeder universities, the largest being Beihang University.

Beihang's School of Aeronautic Science and Engineering in 2012 signed and inaugurated the "Missile Aeroelastic Technology Joint Laboratory" with CASIC's Second Research Institute. A report from the inauguration ceremony states that the CASIC's Second Institute is "a national key military enterprise" (国家重点军工企业), and that Beihang has unique advantages in aeroelastic research and has made significant contributions to CASIC's weapons and equipment construction.⁸⁰

<i>University</i>	<i>No. of 2019 Graduates Recruited by CASIC</i>	<i>Portion of All Employed Graduates Working at CASIC</i>
Beihang University	192	6%
Beijing Institute of Technology	185	4%
Harbin Engineering University	86	3%
Harbin Institute of Technology	73	2%
Northwestern Polytechnical University	68	2%



China Aerospace Science and Technology Corporation (CASC)
中国航天科技集团有限公司

At least 1,145 graduates from leading Chinese universities took jobs at CASC in 2019. Available data indicates that 870 employees (76 percent) came from five primary feeder universities, the largest being Beihang University.

CASC and Beihang signed a strategic cooperation agreement in December 2018, in which Beihang's party secretary thanked CASC for its longstanding support for the university.⁸¹ CASC has historically organized visits for Beihang students at various CASC laboratories and sent high-profile experts to teach courses on campus.⁸²

<i>University</i>	<i>No. of 2019 Graduates Recruited by CASC</i>	<i>Portion of All Employed Graduates Working at CASC</i>
Beihang University	210	6%
Beijing Institute of Technology	200	4%
Northwestern Polytechnical University	198	6%
Harbin Institute of Technology	170	4%
Nanjing University of Science and Technology	92	3%



China Electronics Technology Group (CETC)
中国电子科技集团

At least 1,370 graduates from leading Chinese universities took jobs at CETC in 2019. Available data indicates that 669 employees (49 percent) came from five primary feeder universities, the largest being Northwestern Polytechnical University.

NWPU and CETC maintain extensive connections. Since 2005, affiliates from both entities have published over 100 research products together, according to data from the China National Knowledge Infrastructure. CETC also conducts seminars and various talent training and recruitment programs at NWPU,⁸³ including one in 2016 that focused on the evolution of warfare and the effectiveness of mechanized and informatized warfare.⁸⁴

<i>University</i>	<i>No. of 2019 Graduates Recruited by CETC</i>	<i>Portion of All Employed Graduates Working at CETC</i>
Northwestern Polytechnical University	157	5%
Harbin Institute of Technology	151	3%
Beijing Institute of Technology	135	3%
Nanjing University of Science and Technology	122	4%
University of Science and Technology of China	104	4%



China National Nuclear Corporation (CNNC)
中国核工业集团公司

At least 209 graduates from leading Chinese universities took jobs at CNNC in 2019. Among our sample, 174 employees (83 percent) came from six primary feeder universities, the largest being Harbin Engineering University.

Aside from shipbuilding, HEU is a leader in Chinese nuclear research. CNNC and HEU in September 2018 signed a strategic cooperation agreement as a means to more quickly and effectively transform HEU's theoretical research into applied research and products.⁸⁵ In addition, HEU and CNNC in January 2019 jointly established the China Nuclear Industry Safety and Simulation Technology Research Institute.⁸⁶

<i>University</i>	<i>No. of 2019 Graduates Recruited by CNNC</i>	<i>Portion of All Employed Graduates Working at CNNC</i>
Harbin Engineering University	66	2%
Xi'an Jiaotong University	33	1%
Tsinghua University	29	1%
Tianjin University	26	<1%
Southeast University	10	<1%
Harbin Institute of Technology	10	<1%



China North Industries Corporation (NORINCO)
中国兵器工业集团

At least 318 graduates from leading Chinese universities took jobs at NORINCO in 2019. Available data indicates that 282 employees (89 percent) came from five primary feeder universities, the largest being Beijing Institute of Technology.

Over the past decade, NORINCO has held several special job fairs exclusively for BIT students.⁸⁷ The two entities also maintain strategic cooperation agreements, such as one signed in 2012 that emphasized BIT's position as the "most important university in China's weapons industry" and ensured that BIT and NORINCO would work together to further R&D.⁸⁸

<i>University</i>	<i>No. of 2019 Graduates Recruited by NORINCO</i>	<i>Portion of All Employed Graduates Working at NORINCO</i>
Beijing Institute of Technology	110	2%
Nanjing University of Science and Technology	67	2%
Northwestern Polytechnical University	58	2%
Beihang University	28	1%
Harbin Engineering University	19	1%



China Shipbuilding Industry Corporation (CSIC)

中国船舶重工股份有限公司

At least 322 graduates from leading Chinese universities took jobs at CSIC in 2019 prior to its merger with CSSC. Available data indicates that 281 employees (87 percent) came from five primary feeder universities. Harbin Engineering University was the single largest supplier of university graduates to CSIC, accounting for over half of all recruited employees in our sample.

Harbin Engineering University has maintained long-standing connections to China's shipbuilding industry. HEU in 1970 was known as the Harbin Shipbuilding Engineering Institute and was previously under the administration of China State Shipbuilding Corporation (CSSC),⁸⁹ which CSIC spun off from in 1999.⁹⁰ With respect to autonomy and undersea systems specifically, Nanjing University of Science and Technology has collaborated closely with CSIC's 724 Institute. The institute focuses on intelligent manufacturing and equipment,⁹¹ and claims to "adhere to military-oriented technological innovation."⁹²

<i>University</i>	<i>No. of 2019 Graduates Recruited by CSIC</i>	<i>Portion of All Employed Graduates Working at CSIC</i>
Harbin Engineering University	172	5%
Dalian University of Technology	31	1%
Northwestern Polytechnical University	31	1%
Xi'an Jiaotong University	26	1%
Harbin Institute of Technology	21	<1%



China South Industries Group Corporation (CSGC)

中国兵器装备集团公司

At least 87 graduates from leading Chinese universities took jobs at CSGC in 2019. Among our sample, Harbin Engineering University is overwhelmingly the largest feeder school, with HEU graduates representing 75 (86 percent) of the employees recruited that year.

The authors could not find any information to indicate deliberate overtures between HEU and CSGC. However, some of CSGC's subsidiaries are headquartered in nearby cities in Heilongjiang province, and their local job postings may appeal to HEU graduates.⁹³

<i>University</i>	<i>No. of 2019 Graduates Recruited by CSGC</i>	<i>Portion of All Employed Graduates Working at CSGC</i>
Harbin Engineering University	75	2%
All Other Universities	12	N/A



China State Shipbuilding Corporation (CSSC)

中国船舶集团有限公司

At least 177 graduates from leading Chinese universities took jobs at CSSC in 2019. However, data on graduates bound for CSSC was only available for five of the 45 universities selected for this study. All five feeder universities are shown to the right, Nanjing University of Science and Technology being the largest.

In 2017, 30 individuals from NJUST were permitted to visit CSSC's 724 Institute for tours and seminars.⁹⁴ NJUST and the 724 Institute have also published research together, including a 2017 piece entitled "Research on the legal guarantee mechanism of military-civil fusion in military research institutes" (军工科研院所军民融合法律保障机制研究).⁹⁵

<i>University</i>	<i>No. of 2019 Graduates Recruited by CSSC</i>	<i>Portion of All Employed Graduates Working at CSSC</i>
Nanjing University of Science and Technology	54	2%
Shanghai Jiaotong University	36	1%
Beijing Institute of Technology	31	1%
Beihang University	30	1%
Huazhong University of Science & Technology	26	1%



Commercial Aircraft Corporation of China (COMAC)

中国商用飞机有限公司

At least 280 graduates from leading Chinese universities took jobs at COMAC in 2019. Among our sample, 261 employees (93 percent) came from six universities, the largest being Beihang University.

Beihang University and COMAC have operated under a strategic cooperation agreement for talent training since 2009.⁹⁶ In 2019, the two organizations inaugurated two separate labs, including the Large Aircraft Flight Control/Hydraulic/Landing Gear Joint Laboratory (大飞机飞控/液压/起落架联合实验室) and the Large Aircraft Innovation Valley Joint Laboratory (大飞机创新谷联合实验室).⁹⁷

<i>University</i>	<i>No. of 2019 Graduates Recruited by COMAC</i>	<i>Portion of All Employed Graduates Working at COMAC</i>
Beihang University	137	4%
Tongji University	37	1%
Shanghai Jiaotong University	34	<1%
Beijing Institute of Technology	31	<1%
Harbin Institute of Technology	22	<1%



**People's Liberation Army
(PLA) Forces**
解放军部队

At least 1,487 students at leading Chinese universities joined the PLA directly upon graduating in 2019.

28 of the 29 universities for which data was available reported one or more graduates joining the PLA. Among our sample, the top five source universities produced 512 PLA officers (26 percent), the largest being Lanzhou University.

Since 2019, Lanzhou University has been party to a cooperation agreement with the PLA Army Frontier and Coastal Defense College.⁹⁸ It is located in a strategically important region in northwestern China, and tends to produce graduates who join the military. In 2016, Lanzhou University launched a Rocket Force Silk Road Scholarship (火箭军丝路奖助学金) program, which fully funds 100 students at the university.⁹⁹ The PLA also holds frequent recruitment drives at the university.¹⁰⁰

<i>University</i>	<i>No. of 2019 Graduates Who Joined the PLA</i>	<i>Portion of All Employed Graduates Working for the PLA</i>
Lanzhou University	128	3%
Jilin University	109	2%
Harbin Engineering University	105	3%
Harbin Institute of Technology	88	2%
Northwestern Polytechnical University	82	2%



**China Academy of Engineering Physics
(CAEP)**
中国工程物理研究院

Founded in 1958,¹⁰¹ the China Academy of Engineering Physics is China's leading nuclear weapons lab.¹⁰² It is headquartered in Mianyang, China,¹⁰³ and employs 24,000 people.¹⁰⁴

At least 92 graduates from leading Chinese universities took positions at CAEP in 2019. Only six universities published data about how many of their graduates worked for CAEP; all of them are featured to the right.

CAEP has been on the U.S. Department of Commerce's Bureau of Industry and Security Entity List since 2012, and several of its affiliates have been added since.¹⁰⁵ In July 2016, CAEP signed a strategic cooperation agreement with Xi'an Jiaotong University to "jointly carry out scientific research and innovation and share advantageous resources."¹⁰⁶ In 2020, staff at XJTU launched three new research projects with the China International Nuclear Fusion Energy Program.¹⁰⁷

<i>University</i>	<i>No. of 2019 Graduates Employed</i>	<i>Portion of All Employed Graduates Working at CAEP</i>
Xi'an Jiaotong University	24	1%
University of Science and Technology of China	20	1%
Harbin Institute of Technology	19	<1%
Zhejiang University	16	<1%
Beihang University	8	<1%
Tianjin University	5	<1%

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⁶⁴ MSRA continues to carry out cooperative training programs for a wide range of Chinese universities. In 2018, more than a quarter of MSRA’s cooperative training projects were with Seven Sons universities. See “2018 Microsoft Research Asia-Ministry of Education Industry-University Cooperation Collaborative Education Project (first batch)” [2018 年微软亚洲研究院-教育部产学研合作协同育人项目（第一批）], Microsoft Research Asia, accessed October 2020, <https://web.archive.org/web/20201015180833/https://www.msra.cn/zh-cn/connections/academic-programs/academia-industry-cooperation-2018-1>.

⁶⁵ In 2018 and 2019, Microsoft Research Asia hosted a teacher training session at HIT entitled “New Artificial Intelligence in Engineering Education Teacher Workshop Practice (Phase I)” [新工科人工智能教育实践师资研讨会（第一期）] and a curriculum development workshop entitled “‘Natural Language Processing’ Course Construction” [“自然语言处理”课程建设]. See “Brief Introduction of Industry-University Cooperation Collaborative Education Projects,” Ministry of Education of the People’s Republic of China.

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⁷⁰ “Pocket Lab is fully open.”

⁷¹ Bethany Allen-Ebrahimian and Zach Dorfman, “Defense Department produces list of Chinese military-linked companies,” *Axios*, June 24, 2020, <https://www.axios.com/defense-department-chinese-military-linked-companies-856b9315-48d2-4aec-b932-97b8f29a4d40.html>.

⁷² Concerns Over Nations Funding University Campus Institutes in the United States (CONFUCIUS) Act, S 939, 116th Cong. (2019), <https://www.congress.gov/bill/116th-congress/senate-bill/939>.

⁷³ “Tsinghua University,” “Peking University,” and “Zhejiang University,” Australian Strategic Policy Institute, November 2019, <https://unitracker.aspi.org.au/universities/tsinghua-university/>; <https://unitracker.aspi.org.au/universities/peking-university/>; and <https://unitracker.aspi.org.au/universities/zhejiang-university/>.

⁷⁴ Researchers at China's elite universities frequently collaborate with U.S. co-authors. Respectively, 44 percent, 35 percent, and 42 percent of publications by authors at Tsinghua, Peking, and Zhejiang University are written with international coauthors, most of whom are in the United States. See "Tsinghua University," "Peking University," and "Zhejiang University," Nature Index, May 2020, <https://www.natureindex.com/institution-outputs/china/tsinghua-university/513906ba34d6b65e6a000049>; <https://www.natureindex.com/institution-outputs/china/peking-university-pku/5139072d34d6b65e6a002146>; and <https://www.natureindex.com/institution-outputs/china/zhejiang-university-zju/5139072d34d6b65e6a002144>.

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