

The China Defence Universities Tracker

Exploring the military and security links of China's universities

Alex Joske



About the author

Alex Joske is an Analyst working with the International Cyber Policy Centre.

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Contents

What's the problem?	03
What's the solution?	03
Introduction	04
China's civilian defence universities	06
The Seven Sons of National Defence	06
Universities with national defence characteristics	08
Defence laboratories	09
Designated defence research areas	10
Security credentials	10
Case study: The University of Electronic Science and Technology of China	11
Espionage	12
Public and state security links	14
The overseas expansion of China's nuclear weapons program and defence industry	15
Defence industry	16
Missile technology	17
Aviation technology	18
Military electronics	19
Nuclear weapons program	19
Areas for further research	21
Engaging with research partners in China	21
Recommendations for universities	22
Recommendations for the Australian Government	23
Appendix: Universities supervised by SASTIND	25
Notes	27
Acronyms and abbreviations	32

This report accompanies the ASPI International Cyber Policy Centre's China Defence Universities Tracker website.

What's the problem?

The Chinese Communist Party (CCP) is building links between China's civilian universities, military and security agencies. Those efforts, carried out under a policy of leveraging the civilian sector to maximise military power (known as 'military-civil fusion'), have accelerated in the past decade.

Research for the China Defence Universities Tracker has determined that greater numbers of Chinese universities are engaged in defence research, training defence scientists, collaborating with the military and cooperating with defence industry conglomerates and are involved in classified research.¹ At least 15 civilian universities have been implicated in cyberattacks, illegal exports or espionage. China's defence industry conglomerates are supervising agencies of nine universities and have sent thousands of their employees to train abroad.

This raises questions for governments, universities and companies that collaborate with partners in the People's Republic of China (PRC). There's a growing risk that collaboration with PRC universities can be leveraged by the People's Liberation Army (PLA) or security agencies for surveillance, human rights abuses or military purposes.

Universities and governments remain unable to effectively manage risks that come with growing collaboration with PRC entities. There's little accessible information on the military and security links of PRC universities. This knowledge gap limits the effectiveness of risk-management efforts.

What's the solution?

Efforts to manage the risks of engaging with PRC universities should involve close collaboration between governments and universities. Both share a concern for protecting national interests, ensuring the integrity of research, preventing engagement from being exploited by rival militaries or for human rights abuses, and increasing the transparency of research collaboration.

The Australian Government should establish a national research integrity office and refine and enforce foreign interference and export controls legislation. It should use the China Defence Universities Tracker to improve the screening of visa applicants and inform decisions to award research funding.

Universities should be proactive in their efforts to concretely improve how research collaboration is managed. The China Defence Universities Tracker is a tool to help universities and researchers understand institutions in China and avoid harmful collaborations. Universities can use the recently published *Guidelines to counter foreign interference in the Australian university sector* to help review their management of collaboration.² They should introduce clauses into agreements with PRC entities to terminate those agreements in the case of specific ethical concerns or indications of research going towards a military end use. Universities could demonstrate their commitment to these initiatives by establishing independent research integrity offices that promote transparency and evaluate compliance with ethics, values and security interests, serving as administratively distinct bodies that avoid influence from internal university politics.

Introduction

Military–civil fusion is the CCP’s policy of maximising linkages between the military and the civilian sector to build China’s economic and military strength.³ The policy was promoted by President Hu Jintao in 2007 but has been elevated to a national strategy by President Xi Jinping, who personally oversees the Central Commission for the Development of Military–Civil Fusion (中央军民融合发展委员会).⁴ It has its roots in efforts dating back to the PRC’s founding, including policies such as military–civil integration and ‘nestling the military in the civil’.⁵

Many countries seek to leverage private industry and universities to advance their militaries. However, as scholar Lorand Laskai writes, ‘civil–military fusion is more far-reaching and ambitious in scale than the US equivalent, reflecting a large push to fuse the defense and commercial economies’.⁶

Military–civil fusion in China’s university sector has spurred efforts to increase academe’s integration with defence and security. In 2017, the Party Secretary of Beijing Institute of Technology, a leading university for defence research, wrote that universities should ‘stand at the front line of military–civil fusion’.⁷

‘National defence technology research requires the participation of universities’, according to the Chinese government agency overseeing efforts to safeguard classified information at universities. The agency describes universities as one of three parts of the national defence science and technology innovation system. Alongside defence conglomerates, which are responsible for large-scale projects and the commercialisation of defence equipment, and defence research organisations, which are institutes run by defence conglomerates or the military that are responsible for breaking through research bottlenecks and developing key components, universities undertake research at the frontier of defence technology.⁸

Military–civil fusion is tied to the government’s Double First-Class University Plan (世界一流大学和一流学科建设 or 双一流) to build 98 of China’s best universities into world-class institutions by 2050.⁹ A 2018 policy document about the plan states that universities should integrate into ‘the military–civil fusion system’ and ‘advance the two-way transfer and transformation of military and civilian technological achievements’.¹⁰ The importance of international collaboration and foreign talent to the Double First-Class University Plan means that military–civil fusion, the improvement of China’s universities and research collaboration are becoming inextricable.¹¹

While military–civil fusion doesn’t mean that barriers between the military and other parts of PRC society have vanished, it’s breaking down those barriers in many universities. At least 68 universities are officially described as parts of the defence system or are supervised by China’s defence industry agency, the State Administration of Science, Technology and Industry for National Defense (SASTIND, 国家国防科技工业局).

At the same time, universities around the world are expanding their collaboration with PRC partners. Much of that collaboration is mutually beneficial, but it’s clear that many institutions have not effectively managed risks to human rights, security and research integrity. While universities already have systems in place to manage these issues, they should be revisited and strengthened.

Recent cases have demonstrated gaps in universities' management of research collaboration. For example, the ASPI International Cyber Policy Centre's 2018 report *Picking flowers, making honey: the Chinese military's collaboration with foreign universities* highlighted concerns about the high level of international research collaboration involving the PLA.¹² Between 2007 and 2017, the PLA sent more than 2,500 of its scientists to train and work in overseas universities. Some of those scientists used civilian cover or other forms of deception to travel abroad. All of them were sent out to gain skills and knowledge of value to the Chinese military; all of them are believed to be party members who returned to China when instructed.

This report uses the ASPI International Cyber Policy Centre's China Defence Universities Tracker to explain how many of the concerns raised by collaboration with the PLA increasingly apply to defence-linked Chinese universities, security organisations and industry conglomerates. The wedding of the military and the civilian in China's universities has important consequences for policymakers and overseas universities engaged with partners in China.

To help universities, companies and policymakers navigate engagement with research institutions in China, the China Defence Universities Tracker is a database that sorts institutions into categories of very high, high, medium or low risk:

- 92 institutions in the database have been placed in the 'very high risk' category
 - 52 People's Liberation Army institutions
 - 8 security or intelligence-agency institutions
 - 20 civilian universities
 - China's 12 leading defence industry conglomerates.
- 23 institutions—all civilian universities—have been placed in the 'high risk' category.
- 44 institutions—all civilian universities—have been placed in the 'medium' or 'low' risk categories.

The database is designed to capture the risk that relationships with these entities could be leveraged for military or security purposes, including in ways that contribute to human rights abuses and are against Australia's interests. It provides overviews of their defence and security links and records any known involvement in espionage or cyberattacks, inclusion on end-user lists that restrict exports to them, and several measures of their involvement in defence research. While this project has uncovered large amounts of previously inaccessible information on PRC universities and research institutions, continued due diligence and research are required.

Research for the tracker was undertaken over the course of 2019. It focused on identifying key indicators of defence and security links at each university and developing reliable methods for evaluating those links. Institutions were included in the project for their military links, security links or known connection to human rights abuses or espionage. This research primarily used online Chinese-language resources from universities or Chinese Government agencies. We have attempted to archive all online sources using the Wayback Machine or archive.today.

China's civilian defence universities

Many of China's universities originated as military institutions but have since been developed into civilian universities that are increasingly competitive in global research rankings. However, developments over the past decade highlight the military and security links of more than 60 universities in particular.

The Seven Sons of National Defence and their specialisations

Beijing Institute of Technology

Armaments and aeronautics

Beihang University

Aeronautics and astronautics

Harbin Engineering University

Maritime technology, nuclear, aeronautics, astronautics and armaments

Harbin Institute of Technology

Aeronautics and astronautics

Nanjing University of Aeronautics and Astronautics

Aeronautics and astronautics

Nanjing University of Science and Technology

Armaments

Northwestern Polytechnical University

Aeronautics, astronautics, maritime technology and armaments

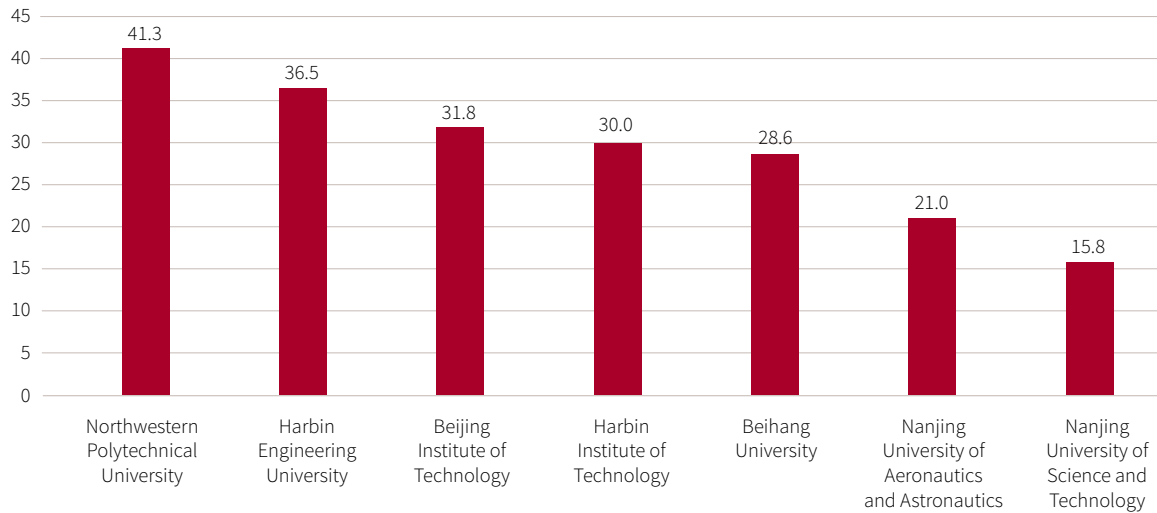
The Seven Sons of National Defence

The 'Seven Sons of National Defence' (国防七子) are a group of leading universities with deep roots in the military and defence industry. They're all subordinate to the Ministry of Industry and Information Technology (工业和信息化部), which oversees China's defence industry through its subordinate agency, SASTIND.

The depth of the Seven Sons' integration with the military suggests that it would be more accurate to describe them as defence universities than as civilian universities. In fact, they call themselves 'defence science, technology and industry work units' or parts of the 'defence system'.¹³

Each year, more than 10,000 graduates from the Seven Sons join the defence research sector—just under 30% of their employed graduates. PhD graduates from these universities are particularly sought after, and as many as half of them go into the defence sector (Figure 1).¹⁴ State-owned defence conglomerates specialising in aircraft, missiles, warships, armaments and military electronics are among their top employers, alongside high-tech companies such as Huawei and ZTE.¹⁵

Figure 1: The percentage of employed 2017 or 2018 graduates of the Seven Sons working in the defence system



Note: Figures for Northwestern Polytechnical University and Harbin Engineering University are for 2017. The remaining figures are for 2018. Source: university graduate employment quality reports (毕业生就业质量年度报告).

The Seven Sons stand at the forefront of defence research in China. Hundreds of their scientists sit on PLA expert advisory committees and assist or even serve in major military projects, such as fighter jet or aircraft carrier programs.¹⁶ They dominate the ranks of defence research prize and defence technology patent recipients.¹⁷ One Chinese study of military–civil fusion in the university sector estimated that more than half the academics at the Seven Sons have been involved in defence projects.¹⁸ All seven have been accredited at the institutional level to participate in research into and the production of top-secret weapons and defence equipment.

They're also among China's best-funded universities. In 2016, the Seven Sons spent a total of ¥13.79 billion (A\$2.88 billion) on research. In 2018, four of them ranked among China's top five universities for funding per research staff member.¹⁹

Approximately half of their research spending goes towards defence research. Harbin Institute of Technology spent ¥1.973 billion (A\$400 million), or 52% of its total research budget, on defence research in 2018.²⁰ Beihang University spends roughly 60% of its research budget on defence research.²¹

Harbin Institute of Technology's defence research spending alone is comparable to the Australian Department of Defence's. The Australian Government's most recent defence science and technology budget was just under A\$469 million. Under current plans, that figure is estimated to decrease to A\$418 million by 2023.²²

Like the Seven Sons of National Defence, the 'Seven Sons of the Arms Industry' (兵工七子) are a group of Chinese universities previously subordinate to the Ministry of Ordnance Industry (兵器工业部), which was dissolved in 1986.²³ Two of them—Beijing Institute of Technology and Nanjing University of Science and Technology—are also among the Seven Sons of National Defence (see box). All of them are still involved in researching and developing weapons.

The Seven Sons of the arms industry

Beijing Institute of Technology

Changchun University of Science and Technology

Chongqing University of Technology

Nanjing University of Science and Technology

North University of China

Shenyang Ligong University

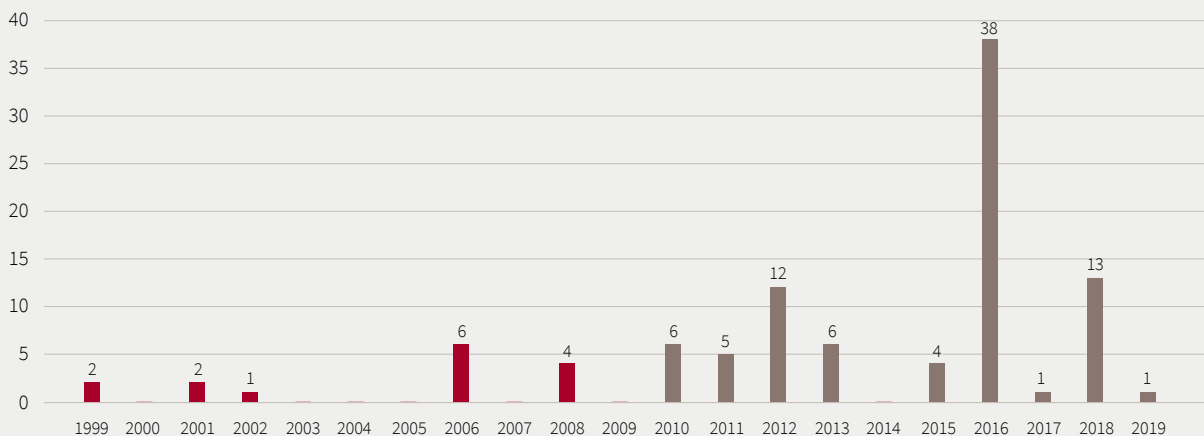
Xi'an Technological University

Universities with national defence characteristics

Recent developments have pushed military–civil fusion far beyond the Seven Sons.²⁴ Research for the China Defence Universities Tracker has identified 101 agreements signed between defence industry agency SASTIND (or its predecessor, COSTIND) and other agencies since 1999 to ‘jointly construct’ (共建) 61 universities subordinate to those agencies (see appendix).²⁵ These agreements encompass leading national universities, such as Tsinghua University and Peking University, as well as provincial universities with strong foundations for defence research. The Tracker also identifies similar agreements that show how defence industry conglomerates, such as China’s leading ballistic missile manufacturer, supervise nine universities.²⁶

SASTIND’s joint-construction agreements have become far more common in recent years. Fifty-seven of the 101 agreements were signed in the past five years. In 2016 alone at least 38 agreements were finalised (Figure 2).

Figure 2: SASTIND agreements on the ‘joint construction’ of universities (red bars denote agreements signed by SASTIND’s predecessor, COSTIND)



Through the agreements, SASTIND seeks to build institutions into ‘universities with national defence characteristics’ by expanding their involvement in training and research on defence technology and deepening their cooperation with defence companies.²⁷ Specifically, it works to support the establishment of defence research laboratories, to fund defence-related research areas and to facilitate participation in military projects.²⁸ This has led to the establishment of large numbers of defence laboratories and ‘disciplines with national defence characteristics’ (国防特色学科) in civilian universities, mostly in the past decade. More than 150 universities have received security credentials that allow them to participate in classified weapons and defence equipment projects.²⁹

According to a university supervised by SASTIND, the agency aims to support five to eight defence disciplines and establish one or two defence labs in each university it supervises by 2020 (the end of the 13th Five-Year Plan).³⁰ This hasn’t yet come to fruition and is unlikely to be fully achieved. Nonetheless, it may be the largest push to integrate universities into the defence research system since the beginning of China’s reform and opening, covering as many as 53 universities.³¹

Developing talent for China’s defence industry is an important objective of military-civil fusion in universities. In 2007, the Chinese government established the National Defence Science and Technology Scholarship to encourage high-achieving university students to join the defence sector.³² Every year, the scholarship is given to 2,000 ‘national defence technology students’ who are each sponsored by defence conglomerates or China’s nuclear weapons program to study in designated fields.³³ After graduating, they are required to work for their sponsor for five years.³⁴

Defence laboratories

The China Defence Universities Tracker has identified more than 160 defence-focused laboratories in civilian universities. It primarily catalogues three types of defence laboratories:

- national defence science and technology key laboratories (国防科技重点实验室)
- national defence key discipline laboratories (国防重点学科实验室)
- Ministry of Education national defence key laboratories (教育部国防重点实验室).

By 2009, the Chinese Government had established 74 national defence science and technology key laboratories, all of which are jointly supervised by the PLA and SASTIND.³⁵ The China Defence Universities Tracker has identified 39 in civilian universities; others are found in defence conglomerates and PLA units.

National defence science and technology key laboratories are the best funded and most prestigious kind of defence laboratory, holding the same status as state key laboratories. For example, Northwestern Polytechnical University’s national defence science and technology key laboratory for unmanned aerial vehicles has received over ¥420 million (A\$87 million) in funding since its establishment in 2001.³⁶

Thirty-six national defence key discipline labs, which are lower in status than national defence science and technology key labs and were first established around 2007, have also been identified.³⁷

Ministry of Education defence laboratories are a previously unstudied kind of defence laboratory. Fifty-three of them have been identified at 32 universities. According to Shandong University, which hosts three of the labs, they are:

... approved by the Ministry of Education and entrusted to universities for their establishment in order to expand indigenous science and technology innovation for national defence, cultivate and concentrate high-level national defence science and technology talent, and engage in academic exchange and cooperation on national defence science and technology.³⁸

One of these labs has been accused of carrying out cyberattacks for the PLA (see ‘Espionage’ section on page 12).

Many of these defence labs obscure their defence links in official translations of their names. National defence science and technology key laboratories often simply call themselves ‘national key laboratories’. For example, the National Key Laboratory of Science and Technology on Micro/Nano Fabrication jointly run by Shanghai Jiao Tong University and Peking University was established by the PLA in 1996.³⁹ National defence key discipline laboratories are often known as ‘fundamental science’ laboratories. Ministry of Education defence labs are almost always referred to as ‘Ministry of Education Laboratory (B-category)’ (教育部重点实验室(B类)) or simply as Ministry of Education labs.

Designated defence research areas

SASTIND approves ‘disciplines with national defence characteristics’, such as armament technology and materials science, at universities it supervises after an application process. They’re referred to in the China Defence University Tracker as ‘designated defence research areas’. The tracker identifies more than 400 designated defence research areas in universities. Since 2015, at least 280 of these were approved at 53 universities.⁴⁰

Defence disciplines reflect each university’s specialities for defence research and serve as stepping stones for the establishment of prestigious defence laboratories. Shenyang Ligong University, one of the ‘Seven Sons of the Arms Industry’ supervised by SASTIND, stated that its defence disciplines are ‘a precursor and foundation for the university to apply to establish national defence key discipline laboratories’.⁴¹

It’s difficult to find detailed information on the operation of defence disciplines. However, one university wrote in 2018 that it expected to receive approximately ¥7 million (A\$1.4 million) on average to develop each discipline.⁴² If that figure is representative, it indicates a doubling of the funding allocated to each discipline in comparison to a decade ago.⁴³

Security credentials

‘Security credentials’ refers to the ‘weapons and equipment research and production unit secrecy credentials’ (武器装备科研生产单位保密资格) that are awarded to universities and companies at the institutional level. Security credentials are divided into three tiers: first class, second class and third class—roughly equivalent to top secret, secret and confidential clearances, respectively.⁴⁴ The issuing of security credentials is overseen by National Administration of State Secrets Protection, the Central Military Commission’s Equipment Development Department and SASTIND, or their local equivalents.⁴⁵

Security credentials allow their holders to participate in different levels of classified defence- and security-related projects. Universities with security credentials are required to meet certain standards in their protection and management of classified research and personnel.⁴⁶ The credentials indicate a university's involvement in defence projects, as well as the sensitivity of that work.



A top-secret security credentials plaque awarded to the Beijing Institute of Technology.

Source: Beijing Institute of Technology, 'Our university passes the secrecy credentials examination and certification', 24 April 2006, [online](#).

As of November 2017, more than 150 universities had received security credentials.⁴⁷ The tracker has identified eight universities with top-secret security credentials.

Military units don't appear to be subject to this security credentials system but use it to scrutinise those they work with. For example, many procurement notices from the PLA require organisations submitting tenders to hold security credentials.⁴⁸

Case study: The University of Electronic Science and Technology of China

The military links of the Seven Sons of National Defence are more widely recognised than those of an institution such as the University of Electronic Science and Technology of China (UESTC) in Chengdu. However, UESTC has more in common with the Seven Sons than a typical Chinese university.

UESTC's defence links date back to its earliest days. In 1961, six years after its founding, it was recognised by the CCP Central Committee as one of China's 'seven defence industry academies'.⁴⁹ Since 2000, it's been the subject of three agreements between defence industry agency SASTIND and the Ministry of Education designed to expand its role in the defence sector.⁵⁰

In 2006, defence electronics conglomerate China Electronics Technology Group Corporation (CETC) also became one of the university's supervising agencies.⁵¹ As part of its agreement to supervise the university, CETC stated that it would work with the Ministry of Education to support UESTC's management and reforms, involvement in major research projects, establishment of laboratories

and exchanges of personnel. CETC, which is expanding its overseas presence at the same time as its technologies enable human rights abuses in Xinjiang, remains one of the primary employers of UESTC graduates.⁵²

UESTC hosts at least seven laboratories dedicated to defence research and has 10 designated defence research areas related to electronics; signal processing and anti-jamming technology; optics; and radar-absorbing materials.⁵³ In 2017, 16.4% of its graduates who gained employment were working in the defence sector.⁵⁴ Approximately 30% of its research spending in 2015 went towards defence research.⁵⁵

UESTC also has links to China's nuclear weapons program. In 2012, it was added to the US Government's Entity List, restricting the export of US-made technology to it, as an alias of China's nuclear weapons facility, the Chinese Academy of Engineering Physics. This indicates that UESTC had acted as a proxy for China's nuclear weapons program.⁵⁶ Its High Power Radiation Key Laboratory is jointly run with the Chinese Academy of Engineering Physics.⁵⁷

The university has also been implicated in the rollout of surveillance technology in Xinjiang, where an estimated 1.5 million ethnic Uyghurs and other minorities have disappeared into concentration camps. The dean of its School of Computer Science and Engineering runs a company that supplies video surveillance systems to authorities in Xinjiang.⁵⁸

UESTC's international partnerships have deepened despite its links to the military, nuclear weapons and potential human rights abuses. Its collaborations naturally align with its specialisations, which are also its main areas of defence research. For example, in 2016, with the University of Glasgow, it established a joint college in China that offers degrees in electronics.⁵⁹ UESTC also runs the Joint Fibre Optics Research Centre for Engineering with the University of New South Wales in Australia.⁶⁰

Espionage

China's National Intelligence Law requires entities and individuals to cooperate with intelligence operations. However, that doesn't mean that all PRC entities are equally likely to engage in espionage or related forms of misconduct. Military-civil fusion hasn't meant that all universities are equally integrated into the military's efforts. When analysing cases of espionage and illegal export involving Chinese universities, it becomes clear that institutions with strong military and security links are disproportionately implicated in theft and espionage. This can be helpful in establishing a risk-based approach to collaboration with PRC entities.

The China Defence Universities Tracker has identified at least 15 civilian universities that have been linked to espionage, have been implicated in export controls violations or have been identified by the US Government as aliases for China's nuclear weapons program. Four of the Seven Sons of National Defence have been implicated in espionage or export controls violations. Harbin Engineering University alone has been linked to five cases, including the theft of missile technology from Russia.⁶¹

One of the Seven Sons has been accused of collaborating with the Ministry of State Security to steal jet engine technology. In 2018, US authorities arrested an officer from the Jiangsu State Security Bureau, Xu Yanjun, who allegedly sought to steal engine technology from GE Aviation. The US Department of Justice's indictment of Xu describes how an executive at Nanjing University of Aeronautics and Astronautics (NUAA) helped Xu identify and cultivate overseas targets.



Intelligence officer and part-time NUAA student Xu Yanjun after his arrest.

Source: Gordon Corera, 'Looking for China's spies', *BBC News*, no date, *BBC*.

According to the indictment, the NUAA co-conspirator reached out to a GE Aviation engineer, inviting him to give a lecture at the university's College of Energy and Power Engineering.⁶² The NUAA official then introduced the engineer to Xu, who used an alias and claimed to be from the Jiangsu Association of Science and Technology. Xu began cultivating the engineer and asked him to share proprietary information about fan blades for jet engines. NUAA has confirmed that Xu was also a part-time postgraduate student at NUAA.⁶³

The establishment of defence laboratories fosters close relationships between researchers and the military that can be used to facilitate and incentivise espionage. For example, Wuhan University's Ministry of Education Key Laboratory of Aerospace Information Security and Trusted Computing has been accused of carrying out cyberattacks on behalf of the PLA.⁶⁴ The laboratory is one of the Ministry of Education's 'B-category' laboratories that focuses on defence research and doesn't appear on Wuhan University's main list of labs on its website.⁶⁵ One Taiwanese report, citing unnamed intelligence officials, claimed that an office in Wuhan University is in fact a bureau of the PLA's signals intelligence agency.⁶⁶

The same Wuhan University lab has collaborated with and even sent a visiting scholar to an Australian university. A professor alleged to be the lab's liaison with the PLA has co-authored research with a University of Wollongong cryptographer.⁶⁷ One of the lab's associate professors visited the University of Wollongong in 2010, participating in an Australian Research Council project.⁶⁸

Public and state security links

As the NUAA espionage case shows, some Chinese universities work closely with the Ministry of State Security (MSS), which is China's civilian intelligence and political security agency. The ministry was established in 1983 by merging units responsible for foreign intelligence, economic espionage, counterintelligence, political security and influence work.⁶⁹ It has since grown into a well-resourced agency believed to be a prolific perpetrator of cyberattacks and intelligence operations against companies, governments and universities for political influence and economic espionage.⁷⁰

The MSS operates at least two universities: the University of International Relations⁷¹ in Beijing and Jiangnan Social University⁷² in Suzhou. These universities train intelligence officers and carry out research to support the MSS's work. The University of International Relations has exchange agreements with universities in Denmark, the United States, France and Japan.⁷³

The MSS also leverages civilian universities for training, research, technical advice and possibly direct participation in cyber espionage. For example, a big-data scientist at Hunan University, which hosts the PLA's Tianhe-1 supercomputer, serves as a 'Ministry of State Security specially-appointed expert'.⁷⁴ A professor at Tianjin University has been awarded a 'Ministry of State Security Technology Progress Prize'.⁷⁵ A professor at Southeast University has been awarded two projects under the MSS's 115 Plan, which is a research funding program.⁷⁶ Cybersecurity firm ThreatConnect identified links between Southeast University and a hack of Anthem, one of the US's largest healthcare companies.⁷⁷ The same attack was separately linked to the MSS by another cybersecurity firm.⁷⁸ The MSS recruits hackers from top universities such as Harbin Institute of Technology, Beijing University of Posts and Telecommunications and Zhejiang University.⁷⁹

The Ministry of Public Security (MPS), China's police agency, is also building links with civilian universities. The China Defence Universities Tracker includes entries on several universities that operate joint laboratories with the MPS. Those laboratories carry out computer science and artificial intelligence research to assist the MPS's policing capabilities. The ministry's pivotal role in the abuse of ethnic minorities, religious groups and political dissidents makes it nearly impossible to separate legitimate and illegitimate uses of that research.

The overseas expansion of China's nuclear weapons program and defence industry



Employees of military aircraft manufacturer AVIC graduate from Cranfield University in 2013.

Source: Zhang Xinguo, 'Cooperation progress between AVIC & UK universities', Aviation Industry Corporation of China, 5 May 2016, online.

China's nuclear weapons program and defence industry have expanded their presence in foreign universities. State-owned defence industry conglomerates have established joint research and training programs in Austria, Australia, the UK, France, Germany and Switzerland. Scientists from China's nuclear weapons program have been identified in universities across developed countries.

Defence industry

At least four of China's 12 state-owned defence industry conglomerates (defence state-owned enterprises, or defence SOEs) have a substantial presence in overseas universities. Their work covers military electronics, aviation technology and missiles. These companies seek to increase their access to world-class training, expertise and technology through exchanges and joint laboratories with foreign universities (Table 1). Many of the collaborations involve organisations that are subject to export restrictions by the US Government, raising concerns about the effect they may have on military technology and human rights violations in China.

Table 1: Defence SOE joint laboratories or major investments in foreign universities

Country	Host institution	Joint lab or investment	Year founded	PRC partner	Areas of research
Australia	Monash University	Joint research and development centre	2019	COMAC	3D printing ^a
Australia	Monash University	Investment in aircraft manufacturing research	2017	COMAC	3D printing, material analysis and treatment ^b
Australia	University of Technology Sydney	Australia–China Research Innovation Centre in Information and Electronics Technologies	2017	CETC	Big data, artificial intelligence, quantum information, advanced materials and electronics ^c
UK	University of Manchester	BIAM – University of Manchester Technology Centre	2017 ^d	AECC	Aircraft engine coatings, modelling and simulation ^e
UK	University of Manchester	Sino-British Joint Advanced Laboratory on Control System Technology ^f	2016 ^g	CALT	Control systems, multi-agent systems, robotics ^h
UK	Imperial College London	Advanced Structure Manufacturing Technology Laboratory	2016 ⁱ	CALT	Metal forming technology, process modelling
UK	University of Exeter				
UK	University of Birmingham ^l	EU Horizon 2020 project on manufacturing aerospace components ^k	2016 ^l	AECC's BIAM ^m	Additive manufacturing ⁿ
Austria	TU Graz	Sino-Austrian Electronic Technology Innovation Centre	2015 ^o	CETC	Smart water management, ^p internet of things ^q
UK	University of Manchester	BIAM – University of Manchester Graphene Aerospace Materials Centre	2015 ^s	AECC	Graphene for aircraft engines ^t
Germany	RWTH Aachen University ^u	Artificial Assisted Heart Overseas Research and Development Institution	2013 ^v	CALT	Artificial hearts, axial flow pumps (potential dual use for missile control systems) ^w
Switzerland	Northwestern University of Applied Sciences ^x				
UK	Imperial College London	AVIC Centre for Structural Design and Manufacture	2012	AVIC	Aircraft design and materials, aircraft structural integrity ^y
UK	University of Strathclyde	Space Mechatronic Systems Technology (SMeSTech) Laboratory	2012	CALT	Mechatronic systems, satellites ^z
UK	University of Nottingham	University Innovation Centre	2012 ^{aa}	AVIC	Thermal coatings for turbine blades, impact damage ^{bb}
UK	Imperial College London	BIAM – Imperial Centre for Materials Characterisation, Processing and Modelling ^{cc}	2012 ^{dd}	AECC ^{ee}	Aeronautical materials, ^{ff} lithium-ion batteries, aircraft windshields ^{gg}

AECC = Aero Engine Corporation of China; AVIC = Aviation Industry Corporation of China; BIAM = Beijing Institute for Aeronautical Materials; CALT = China Academy of Launch Vehicle Technology; CETC = China Electronics Technology Group Corporation; COMAC = Commercial Aircraft Corporation of China.

- a Victorian Department of Premier and Cabinet, 'New hi-tech deal great for Victorian jobs', media release, 24 October 2019, [online](#).
- b Monash University, 'Monash University and Commercial Aircraft Corporation of China sign MOU to accelerate aircraft development', media release, 16 May 2017, [online](#).
- c University of Technology Sydney, 'New joint IET research centre with CETC', media release, 26 April 2017, [online](#).
- d University of Manchester, 'Partnership with the Aero Engine Corporation of China', media release, no date, [online](#); BIAM – Manchester UTC, *About us*, no date, [online](#).
- e BIAM – Manchester UTC, *Research*, no date, [online](#).
- f University of Manchester Aerospace Research Institute, *Sino-British Joint Laboratory on Advanced Control Systems Technology*, no date, [online](#).
- g China Academy of Launch Vehicle Technology (CALT), *Sino-British Advanced Control System Technology Joint Laboratory*, 14 May 2016, [online](#) (in Chinese).
- h University of Manchester Aerospace Research Institute, *Our research*, no date, [online](#).
- i CALT, *The Rocket Institute has built 4 overseas R&D institutions*, 13 May 2016, [online](#).
- j The University of Birmingham is listed as the coordinator of the EMUSIC project. See EMUSIC, *Participants*, no date, [online](#).
- k EMUSIC, *Efficient Manufacturing for Aerospace Components Using Additive Manufacturing, Net Shape HIP and Investment Casting (EMUSIC)*, no date, [online](#).
- l EMUSIC, *EMUSIC mid-term report shows progress being made on improving manufacturing efficiency*, 16 January 2018, [online](#).
- m BIAM is a consortium member of EMUSIC. BIAM representatives are listed as project coordinators with members of the University of Birmingham, which is the university that leads the EMUSIC program. See EMUSIC, *Contact us*, no date, [online](#); EMUSIC, *Participants*, [online](#); European Commission, 'Efficient Manufacturing for Aerospace Components using Additive Manufacturing, Net Shape HIP and Investment Casting', *Cordis*, no date, [online](#); EMUSIC, 'Efficient Manufacturing for Aerospace Components Using Additive Manufacturing, Net Shape HIP and Investment Casting', *TRIMIS*, no date, [online](#); 'Efficient Manufacturing for Aerospace Components Using Additive Manufacturing, Net Shape HIP and Investment Casting', *Cimne.com*, no date, [online](#).
- n EMUSIC, *Efficient Manufacturing for Aerospace Components Using Additive Manufacturing, Net Shape HIP and Investment Casting (EMUSIC)*.
- o Department of European Affairs, 'Zhongao Electronic Technology Innovation Center was established in Graz', news release, Ministry of Commerce, PRC Government, 4 December 2015, [online](#) (in Chinese).
- p Das Land Steiermark, 'Chinese IT giant is becoming a global player from Graz', news release, 2 November 2016, [online](#) (in German).
- q European Sustainable Energy Innovation Alliance, 'Cooperation with CETC on the internet of things and new energies', news release, 21 October 2014, [online](#).
- r CALT, *Sino-British Joint Laboratory of Advanced Structures and Manufacturing Technology*, 14 May 2016, [online](#) (in Chinese); University of Exeter, 'Annual review 2015', *Issue*, 5, [online](#).
- s 'Versarien PLC: Term sheet with Beijing Institute of Graphene Tech', *Financial Times*, 15 April 2019, [online](#).
- t University of Manchester, *Partnership with the Aero Engine Corporation of China*, no date, [online](#).
- u CALT, *The Rocket Institute has built 4 overseas R&D institutions*; CALVT, *Artificial assisted heart overseas research and development institutions*, 14 May 2016, [online](#) (in Chinese).
- v CALT, *The Rocket Institute has built 4 overseas R&D institutions*.
- w CALT, *Artificial assisted heart overseas research and development institutions*.
- x CALT, *The Rocket Institute has built 4 overseas R&D institutions*; CALVT, *Artificial assisted heart overseas research and development institutions*.
- y Imperial College London, *AVIC Centre for Structural Design and Manufacture*, no date, [online](#).
- z University of Strathclyde, *Space Mechatronic Systems Technology (SMeSTech) Laboratory*, no date, [online](#).
- aa University of Nottingham, 'Chinese aerospace business funds £3m University Innovation Centre', media release, August 2012, [online](#).
- bb University of Nottingham, *Composites Research Group*, no date, [online](#).
- cc The centre was administered by AVIC before the creation of AECC in August 2016 and was called the 'AVIC Centre for Materials Characterisation, Processing and Modelling'. A formal change of name took place on 12 July 2017. See Imperial College London, *AVIC Centre*, no date, [online](#); Imperial College London, BIAM – Imperial Centre for Materials Characterisation, Processing and Modelling, *Visit of BIAM delegation (31 October 2018)*, [online](#); Imperial College London, BIAM – Imperial Centre for Materials Characterisation, Processing and Modelling, *Events*, no date, [online](#).
- dd Imperial College London, BIAM – Imperial Centre for Materials Characterisation, Processing and Modelling, *Visit of BIAM delegation (31 October 2018)*, [online](#).
- ee The centre was administered by AVIC before the creation of AECC in August 2016 and was called the 'AVIC Centre for Materials Characterisation, Processing and Modelling'. A formal change of name took place on 12 July 2017. See Imperial College London, *AVIC Centre*, no date, [online](#); Imperial College London, BIAM – Imperial Centre for Materials Characterisation, Processing and Modelling, *Visit of BIAM delegation*, 31 October 2018, [online](#); Imperial College London, BIAM – Imperial Centre for Materials Characterisation, Processing and Modelling, *Events*, no date, [online](#).
- ff Imperial College London, BIAM – Imperial Centre for Materials Characterisation, Processing and Modelling, no date, [online](#).
- gg Imperial College London, BIAM – Imperial Centre for Materials Characterisation, Processing and Modelling, *Projects*, no date, [online](#).

Missile technology

The China Aerospace Science and Technology Corporation (CASC) and China Aerospace Science and Industry Corporation (CASIC) are the Chinese military's leading suppliers of missiles, carrier rockets and satellites.⁸⁰ The conglomerates claim to send dozens of scientists abroad every year to train in countries that include Australia, France, Italy, Japan, Russia, Ukraine, the UK and the US.⁸¹

CASC has a significant overseas presence through its subsidiary China Academy of Launch Vehicle Technology (CALT), which develops space launch vehicles and intercontinental ballistic missiles.⁸² CALVT operates six joint labs in Europe and the UK that do research in areas such as additive manufacturing, aerospace materials and control systems.⁸³

CALT scientists sent to work in its overseas labs are often involved in research on subjects such as hypersonic vehicles, missiles and heat-resistant aerospace materials.⁸⁴ For example, Wang Huixia, who visited a CALVT joint lab at the University of Manchester in 2018,⁸⁵ has published on missile flight simulation and missile countermeasures.⁸⁶

CALT has a record of funding civilian technology with dual-use applications for missile systems. In 2013, it set up an ‘artificial assisted heart overseas research and development institution’ in collaboration with Germany’s RWTH Aachen University and Switzerland’s Northwestern University of Applied Sciences.⁸⁷ State-owned news agency *Xinhua* noted in an article on CALT that the technology in artificial hearts is very similar to that in missile control systems.⁸⁸

Aviation technology

The Aero Engine Corporation of China (AECC) and the Aviation Industry Corporation of China (AVIC) are the primary suppliers of aviation technology to the PLA. AECC develops aircraft engines, while AVIC enjoys a monopoly in the supply of military aircraft to the PLA.⁸⁹

Both AECC and AVIC have expanded their relationships with foreign universities by establishing joint laboratories, training programs and partnerships in Europe.⁹⁰

AECC was established to develop China’s own aircraft engine supply chain.⁹¹ China’s military aircraft have long depended on other nations’ jet turbine technology, so the CCP hopes to build indigenous capabilities in this area, which may be advanced by its joint labs. An AECC subsidiary, the Beijing Institute for Aeronautical Materials (BIAM), operates three joint laboratories in the UK—two at the University of Manchester and a third at Imperial College London.⁹² All three labs study aerospace applications of materials such as graphene.⁹³

AVIC has established two joint labs with the UK’s Imperial College London and the University of Nottingham.⁹⁴ Its lab at Imperial College London focuses on topics related to aircraft design and manufacturing, such as ultralight aviation components and metal forming techniques.⁹⁵ The lab is headed by a participant in the Chinese Government’s Thousand Talents Plan (a controversial scheme to recruit scientists from abroad), who explained that the university’s collaboration with Chinese companies can help them become ‘technology leaders’.⁹⁶

The Commercial Aircraft Corporation of China (COMAC), which is described as a defence industry conglomerate by the Chinese Government’s Ministry of Industry and Information Technology, has also expanded its ties with foreign universities.⁹⁷ Monash University entered into a memorandum of understanding with COMAC in 2017, agreeing to host COMAC researchers and conduct collaborative research on aerospace materials.⁹⁸ Through this partnership, the university supplied components for COMAC’s flagship aircraft, the C919, which many China analysts believe could be converted into a military surveillance aircraft.⁹⁹

China’s defence aviation companies are also building ties in Europe and Australia through research collaboration and training programs. More than 700 AVIC engineers and managers have been sent to train at British, Dutch and French universities in the past 10 years.¹⁰⁰ By 2020, the conglomerate plans to send a total of 1,200 of its researchers to study at institutions including Cranfield University, the

University of Nottingham and the Institut Aéronautique et Spatial in France.¹⁰¹ In 2016, the Australian Research Council awarded A\$400,000 to a joint project by the University of Adelaide and AECC on ‘superior rubber-based materials’.¹⁰²

Military electronics

China Electronics Technology Group Corporation (CETC) is China’s leading manufacturer of military electronics such as radars and drone swarms. The conglomerate is a leading supplier of integrated surveillance systems, facial recognition cameras and mobile applications that have been linked to human rights abuses in Xinjiang.¹⁰³ Hikvision, a major manufacturer of security cameras, is part of CETC’s stable of subsidiaries.

Since 2014, CETC has expanded its relationships with foreign universities, establishing joint laboratories in Europe and Australia. Its partnership and joint laboratory with Graz University of Technology in Austria, covering electronic information technology, laid the foundations for the establishment of its European headquarters in Graz.¹⁰⁴

CETC’s relationship with the University of Technology Sydney (UTS) has attracted significant media scrutiny.¹⁰⁵ The two began discussing a formal partnership in 2014 and agreed to establish a joint centre on information and electronics technologies by 2017.¹⁰⁶ The centre was originally poised to receive up to A\$20 million in funding from CETC over five years. Aside from its research on artificial intelligence, quantum information and big data, the centre was also set up as a training centre for CETC staff.

The partnership is still ongoing after a review in 2019, but UTS reportedly abandoned three of its joint projects with CETC after Australia’s Department of Defence raised concerns.¹⁰⁷ Commentators have also drawn attention to the potential for UTS’s collaboration with CETC on ‘public security video analysis’ to contribute to human rights abuses in Xinjiang.¹⁰⁸

Nuclear weapons program

The Chinese Academy of Engineering Physics (CAEP) is responsible for research into and the development and manufacturing of China’s nuclear weapons.¹⁰⁹ It’s also involved in developing lasers, directed-energy weapons and conventional weapons.¹¹⁰

CAEP is expanding its international presence in order to attract leading talent to assist China’s development of nuclear weapons. Since 2000, CAEP researchers have published more than 1,500 papers with foreign co-authors.

In 2012, CAEP established the Center for High Pressure Science and Technology Advanced Research (HPSTAR) to better leverage foreign talent.¹¹¹ The Beijing-based centre claims that it’s ‘committed to science without borders’ and uses English as its official language but doesn’t mention on its English-language website that it’s affiliated with CAEP. HPSTAR is run by a Taiwanese-American scientist who was recruited in 2012 through the Chinese Government’s Thousand Talents Plan—a scientific talent recruitment program that CAEP has used to hire at least 57 scientists from abroad.¹¹²

CAEP also sends large numbers of its employees to study abroad. In 2015, one of the academy’s officials claimed that hundreds of young CAEP researchers are sent to study abroad every year, which has ‘had clear results for building up young talents’.¹¹³

For example, Zhou Tingting, a researcher at CAEP’s Institute of Applied Physics and Computational Mathematics, recently worked as a visiting scholar at Caltech University’s Materials and Process Simulation Center in the US. The institute specialises in design and simulation computation for nuclear warheads and has been involved in at least two espionage cases. It’s been included on the US Government’s Entity List since 1997.¹¹⁴ While at Caltech, Zhou published research on polymer-bonded explosives that was funded by the US Office of Naval Research. Polymer-bonded explosives are used to detonate the cores of nuclear warheads.¹¹⁵

Zhou’s background also illustrates how China’s civilian universities serve as feeder schools for the nuclear weapons program. Before joining CAEP, Zhou studied at Beijing Institute of Technology—one of the Seven Sons of National Defence. As a student, she also visited the same Caltech centre to carry out research on explosives. Her supervisor at the Beijing Institute of Technology was an adviser to the PLA and the government on warheads and hypersonic vehicles.¹¹⁶

Figure 3: China’s twelve Defence Industry Conglomerates



Areas for further research

While the China Defence Universities Tracker includes entries for roughly 160 universities, companies and research institutes, it's far from comprehensive. We intend to update and expand the tracker when that's possible. In particular, there's room for further research on the Chinese Academy of Sciences and its dozens of subordinate research institutes. Twelve of China's defence conglomerates are included in the database, but their hundreds if not thousands of subsidiaries haven't been publicly catalogued. Nor have private companies and other major suppliers of equipment to the military and security apparatus been included in this project. Further research on the role of universities in supporting state surveillance and on companies that develop surveillance technology used in human rights abuses would be valuable.

Engaging with research partners in China

Better managing engagement with research partners in China will help ensure that collaborations align with Australia's values and interests. A deeper understanding of PRC universities and the CCP will strengthen this engagement. Engagement should be built on robust risk management efforts, rather than on efforts to, on the one hand, cut out or, on the other hand, uncritically embrace interactions with PRC entities. Effective risk management won't prevent collaboration between Australian universities and China. It won't affect the vast majority of Chinese students studying in Australia.

Due diligence on research collaboration or visiting scholars and students should primarily take into account:

- the nature of the engagement, such as the potential uses of a technology
- the nature of the foreign partner.

University researchers are generally well placed to understand the nature of a technology and different ways a technology could be applied. This, in part, has led to a disproportionate focus on whether or not technologies have military or security applications; that is, whether they're 'dual-use' technologies.

However, it appears that universities have insufficient expertise, resources and processes for understanding foreign research partners. Universities and researchers won't be able to effectively scrutinise research collaborations without building better understanding of research partners. They should avoid collaborations with Chinese institutions on technologies that are also defence research areas for those institutions or could contribute to human rights abuses. Furthermore, some technology specialists aren't used to considering ethics, values and security as a standard procedure when carrying out their research. The argument that research that leads to published papers is not of concern doesn't consider the range of ways in which research, training and expertise can be misused by foreign partners.

Universities should set the bar higher than compliance with the law. As important civil society institutions, they should embody liberal values, especially in their interactions with overseas partners. As recipients of large amounts of public funding, they have an obligation to avoid recklessly harming human rights or national security, such as by training scientists from nuclear weapons programs or working with suppliers of surveillance technology used in Xinjiang. Universities should approach research collaboration as a way to promote ethical compliance, integrity and academic freedom rather than allowing collaborations to compromise their commitment to those values.

Recommendations for universities

1. Assess the situation.

- Revisit existing collaborations, commissioning independent due diligence of concerning ones.
- Review existing mechanisms for supervising collaborations and partnerships.
- Apply particular scrutiny to engagement with high risk entities identified in the China Defence Universities Tracker.

2. Build capacity.

- Establish an independent research integrity office:
 - The office should report directly to the vice chancellor.
 - It should be resourced to carry out due diligence and compliance work and be able to do country-specific research.
 - It should write annual reviews of research integrity in the university.
 - It should serve as an interface between security agencies and the university.
- University research integrity offices or relevant staff members should form a working group across the university sector to share information and discuss threats.
- Dedicate greater resources to due diligence and compliance work, including linguistic and country-specific capabilities.

3. Build a culture of proactive awareness of risks.

- Hold briefings that are open to all staff on China, research collaboration and security by the government, university due diligence staff and scholars.
- Encourage researchers to consider unwanted outcomes of research collaborations, such as contributions to human rights abuses.
- Encourage researchers to consult the China Defence Universities Tracker when they're considering collaboration or applications from visiting scholars and students.

4. Develop better systems for managing engagement with China.

- Create general guidelines for informal and formal collaboration with PRC entities.
- In all agreements with PRC entities, introduce clauses on ethics, academic freedom and security with provisions to immediately terminate partnerships if they're breached.
- Establish a travel database for staff that's accessible to university executives and research contract, due diligence and research integrity staff.
- Refine the approval process for collaborations with foreign entities:
 - Collaborations should consider risks to the national interest, national security, intellectual property, reputation and human rights.
 - The China Defence Universities Tracker should be used to inform decisions. Universities should avoid collaborating with Chinese institutions on technologies that are also defence research areas for those institutions.
- Develop a policy on collaboration with foreign militaries, security agencies and defence companies.

- Use the China Defence Universities Tracker to improve the vetting of visiting scholars and students.
 - Visitors from the PLA, defence conglomerates or other high risk entities should be subject to greater scrutiny in light of their defence and security links.

5. Ensure the implementation of supervisory systems.

- Enforce contracts and policies on conflicts of interest and external employment.
- Introduce annual reviews of engagement with China and the management of research collaborations.
- Introduce annual reviews of research integrity across the university.

Recommendations for the Australian Government

1. Increase and refine the allocation of government research funding, strengthening the government's ability to encourage universities to better manage research collaboration.

- In general, the government should seek to ensure that its research funding is being used in ways that align with Australia's values, needs and national interests.
- Federal funding agencies such as the Australian Research Council and the Defence Science and Technology Group should use the China Defence Universities Tracker to help investigate and consider the foreign military or security links of current and future funding recipients.
- Federal funding agencies should ensure disclosure of conflicts of interest by grant application assessors.
- Federal funding agencies should ensure that its policies on conflicts of interest and external employment are being followed by grant recipients.

2. Issue clear and public guidance to universities on specific areas of research with important security, economic or human rights implications that should be protected from unsupervised technology transfer.

- The University Foreign Interference Taskforce could serve as a platform to begin developing this guidance in consultation with university representatives.

3. Reform the Defence Trade Controls Act 2012, developing solutions to the Act's failure to control technology transfer to foreign nationals and foreign military personnel in Australia.

4. The Australian Federal Police and Department of Defence should enforce the Weapons of Mass Destruction (Prevention of Proliferation) Act 1995, which restricts the provision of services to assist weapons of mass destruction programs.



5. The Department of Home Affairs should incorporate the China Defence Universities Tracker into its screening of visa applicants.

- PLA officers, PRC defence conglomerate employees and members of PRC security agencies should by default not be given visas if they intend to study dual-use technology in Australia.
- The military and security links of university researchers, particularly those from universities whose government links have been identified in the China Defence Universities Tracker, should be scrutinised.

6. Establish a national research integrity office.

- Its remit should cover universities, the Commonwealth Scientific and Industrial Research Organisation, medical research institutes and any other recipients of government research funding
- It should be mandated to produce public reports evaluating efforts to ensure research integrity across the higher education sector
- It should be empowered to carry out investigations into research integrity
- It should produce annual reports on research integrity across Australia
- It should report to the Education Minister
- It should conduct outreach to universities and researchers and consult them on the development of research integrity guidelines

7. Encourage the establishment of independent research integrity offices in universities.

- The government should introduce a start-up funding program for universities seeking to establish independent research integrity offices.

8. Create an annual meeting of education ministers from Five Eyes countries to deepen research collaboration within the alliance and coordinate on research security.

9. Work with Five Eyes partners to establish a joint centre on managing sensitive technologies.

- It should be resourced to monitor and assess the full course of China's technology transfer activity, tracking China's technology priorities and efforts to exploit resources in Five Eyes countries in service of those priorities.
- It should identify where research on sensitive technologies is being carried out within Five Eyes countries and coordinate both innovation and security efforts.

10. The National Intelligence Community should increase resourcing for efforts to study China's technology priorities and technology transfer efforts.

Appendix: Universities supervised by SASTIND

- Anhui University
- Beijing University of Chemical Technology
- Central South University
- Changchun University of Science and Technology
- Chongqing University
- Dalian University of Technology
- East China University of Technology
- Fuzhou University
- Guilin University of Electronic Technology
- Hangzhou Dianzi University
- Harbin University of Science and Technology
- Hebei University
- Hebei University of Science and Technology
- Hefei University of Technology
- Heilongjiang Institute of Technology
- Heilongjiang University
- Henan University of Science and Technology
- Huazhong University of Science and Technology
- Hunan University
- Hunan University of Science and Technology
- Jiangsu University of Science and Technology
- Jilin University
- Kunming University of Science and Technology
- Lanzhou University
- Lanzhou University of Technology
- Nanchang Hangkong University
- Nanjing Tech University
- Nanjing University
- North China Institute of Aerospace Engineering
- North China University of Science and Technology
- North University of China
- Peking University
- Shandong University
- Shandong University of Technology
- Shanghai Jiaotong University
- Shanghai University
- Shenyang Aerospace University
- Shenyang Ligong University
- Shijiazhuang Tiedao University
- Sichuan University
- Soochow University
- South China University of Technology



- Southeast University
- Southwest University of Science and Technology
- Sun Yat-Sen University
- Tianjin Polytechnic University
- Tianjin University
- Tsinghua University
- University of Electronic Science and Technology of China
- University of Science and Technology Beijing
- University of Shanghai for Science and Technology
- University of South China
- Wuhan Institute of Technology
- Wuhan University
- Xi'an Jiaotong University
- Xi'an Technological University
- Xiamen University
- Xiangtan University
- Xidian University
- Yanshan University
- Zhejiang University

Notes

- 1 The China Defence Universities Tracker was developed by a team of analysts at ASPI's International Cyber Policy Centre including Alex Joske, Charlie Lyons Jones, Dr Samantha Hoffman, Elsa Kania and Audrey Fritz.
- 2 University Foreign Interference Taskforce, *Guidelines to counter foreign interference in the Australian university sector*, Department of Education, Australian Government, November 2019, [online](#).
- 3 *Jun-min ronghe* 军民融合 is officially translated as 'civil-military fusion' and sometimes as 'civil-military integration' or 'military-civil integration'. However, 'military-civil fusion' preserves the original structure of the Chinese phrase, and 'military-civil integration' should be more accurately used as a translation of an earlier Chinese Government effort, *jun-min jiehe* 军民结合. See also Elsa Kania, *Battlefield singularity: artificial intelligence, military revolution, and China's future military power*, Center for a New American Security, November 2017, endnote 9, [online](#); Audrey Fritz, *China's evolving conception of civil-military collaboration*, Center for Strategic and International Studies, 2 August 2019, [online](#).
- 4 '军民融合发展委成立 军工板块再迎重磅利好' [Military-civil fusion development commission established; the military-industrial bloc again welcomes great benefits], *Xinhua*, 23 January 2017, [online](#).
- 5 '我国军民融合产业发展概况' [The status of my country's military-civil fusion industry development], *China High Tech*, 15 April 2019, [online](#).
- 6 Lorand Laskai, *Civil-military fusion: the missing link between China's technological and military rise*, Council on Foreign Relations, January 29, 2018, [online](#).
- 7 赵长禄 [Zhao Changlu], '大学应站在军民融合的前线' [Universities should stand at the front line of military-civil fusion], *The People's Daily*, 18 March 2017, [online](#).
- 8 '做好军民融合背景下的高校保密工作' [Doing university secrecy work in the context of military-civil fusion], National Administration of State Secrets Protection, 27 February 2018, [online](#).
- 9 '2018中国双一流大学排行榜·87所跻身全国百强' [2018 list of China's double first-class universities, 87 universities in the top 100 nationally], *The People's Daily*, 27 December 2017, [online](#).
- 10 '教育部 财政部 国家发展改革委印发《关于高等学校加快“双一流”建设的指导意见》的通知' [Notice on the Ministry of Education, Ministry of Finance, National Development and Reform Commission releasing 'Directions and thoughts on hastening the double first-class development of higher education institutions], *chsi.com*, 27 August 2018, [online](#).
- 11 Audrey Fritz, 'University involvement in military-civilian fusion: the driving force behind achieving the Chinese Dream', senior thesis submitted to the University of Chicago, 17 April 2019.
- 12 Alex Joske, *Picking flowers, making honey: the Chinese military's collaboration with foreign universities*, ASPI, Canberra, October 2018, [online](#).
- 13 See '2018届毕业生就业质量报告' [2018 graduates employment quality report], Harbin Institute of Technology, 2018, 22, [online](#), which defines defence science, technology and industry work units as 'various military-industrial conglomerates (including China Electronics Technology Group Corporation and the Commercial Aircraft Corporation of China) and their subordinate work units, the Chinese Academy of Engineering Physics, SASTIND and its subordinate units, universities subordinate to the Ministry of Industry and Information Technology, and some suppliers of key components for military products'. The defence system is defined more broadly by including relevant PLA units. See, for example, '共建高校2010年度基本情况统计表填报说明' [Explanation of the 2010 jointly constructed universities basic situation statistics form], Ministry of Industry and Information Technology, [online](#).
- 14 51% of 2016 Beihang University PhD graduates joined the defence system: '北京航空航天大学一流大学建设方案(精编版)' [Beihang University first-class university development plan (abridged version)], Beihang University, 29 December 2017, [online](#).
- 15 For example, AVIC was the third largest employer of Harbin Institute of Technology 2018 graduates, after Huawei and China State Construction Engineering Corporation. CETC, CASC and CASIC were the fifth, sixth and seventh largest employers of graduates, respectively. See '2018届毕业生就业质量报告' [2018 graduate employment quality report], Harbin Institute of Technology, 2018, 22-23, [online](#).
- 16 屈艺 [Qu, Yi], '新时代国防特色高校推动军民融合发展的路径研究' [Promotion routes of new era civil-military integration in national defence-oriented university], *Journal of Nanjing University of Science and Technology (Social Science edition)*, October 2018, 31(5): 31. For example, a vice president of Nanjing University of Aeronautics and Astronautics, served as deputy chief architect on structural strength for the J-15 carrier-based fighter jet: see '许希武' [Xu Xiwu], NUAA State Key Laboratory of Mechanics and Control of Mechanical Structures, 17 November 2017, [online](#). See also the biography of Professor Pan Quan (潘泉), an automatic target recognition expert at Northwestern Polytechnical University, who serves on three PLA expert advisory committees, two of which have had parts of their name redacted because of their sensitivity: '潘泉' [Pan Quan], Northwestern Polytechnical University, [online](#).
- 17 Beijing Institute of Technology claims to have received the most defence patents and defence science and technology prizes of any university; see '学校简介' [About the university], Beijing Institute of Technology, December 2017, [online](#).
- 18 屈艺, '新时代国防特色高校推动军民融合发展的路径研究' [Research on the path of promoting the development of military-civil fusion in universities with defence characteristics in the new era], *Journal of Nanjing University of Science and Technology (Social Sciences Edition)*, Vol 5, 2018, 31.
- 19 They are Beihang University (1), Beijing Institute of Technology (2), Harbin Engineering University (4) and Northwestern Polytechnical University (5). See '2018年中国高校人均科研费用前十名·国防七校实力强横!' [In the top 10 universities for research spending per staff member in 2018, the seven national defence schools' strength is outstanding], *Sohu*, August 14, 2018, [online](#); '2017年高等学校科技统计资料汇编' [2017 statistics on higher education institution science and technology], Ministry of Education, 2018, [online](#).
- 20 '哈尔滨工业大学2018科研经费37.6亿' [官方公告栏] [Harbin Institute of Technology's 2018 research spending was ¥3.76 billion (official notice board)], *Netbig*, 15 April 2019, [online](#).
- 21 '北京航空航天大学一流大学建设方案(精编版)' [Beihang University first-class university development plan (abridged version)], Beihang University, 29 December 2017, [online](#).

- 22 Department of Defence, *Defence Portfolio Budget Statements 2019–2020*, Australian Government, 2019, 78, [online](#). Martin Callinan has advocated substantial reforms and increases of defence science and technology funding in Australia. See Martin Callinan et al., *Defence and security R&D: a sovereign strategic advantage*, ASPI, Canberra, January 2019, [online](#).
- 23 ‘当年强盛的兵工七子·如今强悍依旧!’ [The Seven Sons of the Arms Industry that flourished then are still as powerful as before], Sohu, 9 September, [online](#).
- 24 See, for example, Marcel Anglivel de la Beaumelle, Benjamin Spevack, Devin Thorne, *Open arms: evaluating global exposure to China’s defence–industrial base*, C4ADS, 2019, [online](#).
- 25 The main supervising agencies for these universities are the Ministry of Education, provincial governments, or municipal governments. The 69 universities are all included in the China Defence Universities Tracker, [online](#).
- 26 University of Electronic Science and Technology of China (CETC), Xidian University (CETC), Shenyang Aerospace University (AVIC), Shenyang Ligong University (Norinco Group and China South Industries Group), North China Institute of Aerospace Engineering (CASC and CASIC), University of South China (China National Nuclear Corporation), East China University of Technology (China National Nuclear Corporation), Xi’an Technological University (Norinco Group and China South Industries Group) and Jiangsu University of Science and Technology (China State Shipbuilding Corporation and China Shipbuilding Industry Corporation).
- 27 ‘国防科工局与教育部共建16所高校·地方共建25所’ [SASTIND and the Ministry of Education jointly construct 16 universities, 25 jointly constructed with local governments], Thousand Talents Plan Think Tank, 3 August 2016, [online](#).
- 28 See, for example, ‘军民融合! 山东省政府与国防科工局共建山东理工大学’ [Military–civil fusion! The Shandong Provincial Government and SASTIND jointly construct Shandong University of Technology], *Phoenix News*, 22 September 2018, [online](#).
- 29 ‘做好军民融合背景下的高校保密工作’ [Doing university secrecy work in the context of military–civil fusion], National Administration of State Secrets Protection, 27 February 2018, [online](#).
- 30 ‘吉林大学被例如‘十三五’国防科工局·教育部共建高校’ [Jilin University has entered the ranks of universities jointly constructed by the Ministry of Education and SASTIND for the 13th Five-Year Plan], Jilin University, 6 July 2016, [online](#).
- 31 Fifty-three universities were identified as subject to SASTIND joint-construction agreements since 2016. Fifteen of the agreements were signed after 2017, whereas Jilin University’s claim about the agreements dates from 2016, so it’s unclear whether it applies to those universities.
- 32 李玮, ‘国防科技奖学金申请面观’ [A full survey of applying for the National Defence Science and Technology Scholarship], *China Postgraduates*, 2017, 3:53–56.
- 33 ‘Requirements of Sponsoring Units for the 2018 Nanjing University National Defence Science and Technology Scholarship Selection’ [2018年度南京大学国防科技奖学金评选用人单位需求], Nanjing University, 2018, [online](#).
- 34 ‘国防科技奖学金管理办法’ [National Defence Science and Technology Scholarship Management Rules], Harbin Institute of Technology, 2018, [online](#).
- 35 阮汝祥, ‘中国特色军民融合理论与实践’ [The practice and theory of military-civil fusion with Chinese characteristics], Beijing, China Aerospace Publishing House, March 2009, 74; ‘Joint publication by the five departments: the State Key Laboratory and the National Defense Science and Technology Key Laboratory should be open to sharing!’, *Sohu*, 29 June 2018, [online](#). For example, Shenzhen University’s National Laboratory of Automatic Target Recognition states that it ‘accepts the leadership of the PLA General Armaments Department and COSTIND’ in its operations; ‘Shenzhen University ATR National Defense Key Laboratory’, Shenzhen University, [online](#). Regulations from 2003 state that national defence science and technology key laboratories are supervised and established by the Commission of Science, Technology and Industry for National Defense (COSTIND, the predecessor to SASTIND) and the PLA’s General Armaments Department. It’s unclear exactly how this has changed since reforms in 2016 that dissolved the PLA General Armaments Department, but they may now be supervised by both the Central Military Commission Equipment Development Department and the Central Military Commission Science and Technology Commission. ‘国防科技重点实验室管理办法’ [Management regulations for National Defence Science and Technology Key Laboratories], Harbin Institute of Technology, 1 April 2017, [online](#).
- 36 ‘无人机特种技术国防科技重点实验室’ [National Key Laboratory of Science and Technology on UAV], Collaborative Innovation Center of Future Aerospace Vehicle, no date, [online](#).
- 37 ‘首批国防重点学科实验室获批设立’ [First round of national defence key discipline laboratories approved for establishment], *The People’s Daily*, 11 July 2007, [online](#). Shenyang Aerospace University claimed in 2014 that there are a total 34 defence key discipline labs; ‘沈阳航空航天大学2015硕士研究生招生简章’ [Shenyang Aerospace University 2015 Master’s research students recruitment guide], China Education News Web, 10 October 2014, [online](#); Northwestern Polytechnical University claims that one of its defence key discipline labs was established in 2007 as part of the first round of defence key discipline labs; ‘空间生物实验模拟技术重点实验室简介’ [About the Space Biology Experimental Simulation Technology Key Laboratory], Northwestern Polytechnical University, no date, [online](#).
- 38 ‘山东大学两教育部重点实验室通过验收’ [Two Ministry of Education key laboratories at Shandong University pass inspection], Shandong University, 30 September 2013, [online](#).
- 39 See, for example, Jin Yufeng, ‘微米/纳米加工技术国家级重点实验室——从微观领域开掘科技创新空间’ [National Key Laboratory of Science and Technology on Micro/Nano Fabrication — Expanding the space for science and technology innovation from the micro field], *Defence Science & Technology Industry*, 2007, volume 1, 50–51, which states that the lab is run by Peking University and Shanghai Jiao Tong University and was established by COSTIND as a defence laboratory.
- 40 郭萌 and 唐雪, ‘国防科技人才精准培养·这条路可以走’ [This road can be taken for the precise training of national defence science and technology talent], *People’s Liberation Army Daily*, 6 December 2017, [online](#).
- 41 ‘我校五个学科全部成功获批为国家国防特色学科’ [Five of the university’s disciplines have been successfully approved as disciplines with national defence characteristics], Shenyang Ligong University, 24 March 2017, [online](#).
- 42 In 2018, Shenyang Aerospace University stated that it expected to receive ¥35 million in funding to develop its five designated defence research areas. See ‘内涵发展砥砺前行 学科建设再上新台阶’ [Inner development encourages us to move forward, a new platform for the development of disciplines], Shenyang Aerospace University, 13 January 2018, [online](#).

- 43 For the 11th Five-Year Plan (2006–2010), Northwestern Polytechnical University received ¥99.10 million (A\$20.59 million) for 34 defence disciplines, equating to around ¥3 million or A\$620,000 per discipline. See 谢妮 and 任磊, ‘[一流学科建设]西北工业大学‘十一五’国防特色学科专业建设项目顺利通过竣工验收’ [(Development of a first-class universities) Northwestern Polytechnical University’s development of 11th Five-Year Plan disciplines and specialisations projects smoothly passes completion inspection], Northwestern Polytechnical University, 26 April 2018, [online](#). Harbin Institute of Technology claimed to have received ¥133.23 million (A\$27.68 million) for 47 defence disciplines during the period of the 11th Five-Year Plan, equating to ¥2.83 million (A\$59,000) per discipline. See ‘我校‘十一五’国防特色学科专业建设项目顺利通过竣工验收评审’ [Our university’s 11th Five-Year Plan disciplines and specialisations with defence characteristics projects smoothly pass completion inspection], Harbin Institute of Technology, 29 December 2017, [online](#).
- 44 ‘武器装备科研生产单位保密资格审查认证管理办法’ [Weapons and equipment research and production unit secrecy credentials evaluation and approval management guidelines], National Administration for State Secrets Protection, 2008, [online](#). See for a description of security credentials for companies Marcel Anglivel de la Beaumelle, Benjamin Spevack, Devin Thorne, *Open arms: evaluating global exposure to China’s defence-industrial base*, C4ADS, 2019, 28-30, [online](#).
- 45 ‘做好军民融合背景下的高校保密工作’ [Doing university secrecy work in the context of military–civil fusion], National Administration of State Secrets Protection, 27 February 2018, [online](#).
- 46 ‘武器装备科研生产单位保密资格审查认证管理办法’ [Weapons and equipment research and production unit secrecy credentials evaluation and approval management guidelines], National Administration for State Secrets Protection, 2008, [online](#).
- 47 ‘做好军民融合背景下的高校保密工作’ [Doing university secrecy work in the context of military–civil fusion], National Administration of State Secrets Protection, 27 February 2018, [online](#).
- 48 ‘中国人民解放军92896部队屏蔽机房工程采购项目竞争性谈判公告’ [Announcement on competitive decision on PLA Unit 92896 protective machine room engineering procurement project], Bid Center, 17 September 2019, [online](#).
- 49 ‘学校简介’ [About the university], University of Electronic Science and Technology of China, no date, [online](#); ‘Statistics on joint construction of Ministry of Education subordinate universities with specialised departments’, Ministry of Education, PRC Government, no date, [online](#).
- 50 ‘国防科工局与教育部共建16所高校·地方共建25所’ [SASTIND and Ministry of Education jointly construct 16 universities, 25 jointly constructed with regional governments], 1000 Talents Plan Think Tank, 30 August 2016, [online](#).
- 51 ‘教育部 中国电子科技集团公司关于共建电子科技大学的意见’ [The Ministry of Education and CETC’s thoughts on jointly constructing UESTC], Ministry of Education, PRC Government, 2006, [online](#).
- 52 ‘2017届毕业生就业质量年度报告’ [2017 graduates employment quality report], University of Electronic Science and Technology of China, 2017, 15, [online](#).
- 53 ‘University of Electronic Science and Technology of China’, *China Defence Universities Tracker*, [online](#).
- 54 ‘2017届毕业生就业质量年度报告’ [2017 graduates employment quality report], University of Electronic Science and Technology of China, 2017, 15, [online](#).
- 55 ‘Reviewing the 12th Five-Year Plan: five years of documentary work in our school’, *UESTC News*, 16 March 2016, [online](#); ‘2016 年高等学校科技统计资料汇编’ [2016 statistics on higher education institution science and technology], Ministry of Education of China, 2016, 100, [online](#).
- 56 ‘Addition of certain persons to the Entity List; removal of person from the Entity List based on removal request; and implementation of Entity List annual review changes’, *Federal Register*, 19 September 2012, [online](#).
- 57 ‘863 National Key Laboratory of intense radiation’, University of Electronic Science and Technology of China, 11 October 2010, [online](#).
- 58 Alex Joske, ‘The company with Aussie roots that’s helping build China’s surveillance state’, *The Strategist*, 26 August 2019, [online](#).
- 59 University of Glasgow, University of Electronic Science and Technology of China, *World changers welcome, year of publication*, [online](#).
- 60 School of Electrical Engineering and Telecommunications, ‘Welcome Vice President Prof. Caidong Xiong and the delegation from UESTC’, University of New South Wales, April 2008, [online](#).
- 61 Alexandra Taranova, ‘2 scientists held in murky spy case’, *Moscow Times*, 21 September 2010, [online](#); Scholars at Risk, ‘Scholars at Risk calls for letters on behalf of Svyatoslav Bobyshev’, New York University, 26 October 2010, [online](#).
- 62 US District Court, Southern District of Ohio, Western Division, ‘USA vs. Yanjun Xu’, 4 April 2018, [online](#).
- 63 Gordon Corera, ‘Looking for China’s spies’, *BBC News*, no date, [online](#).
- 64 Bill Gertz, ‘Network effects: Chinese university lab linked to PLA cyber attacks’, *The Washington Free Beacon*, 14 May 2013, [online](#).
- 65 One page on Wuhan University’s website calls it the ‘Ministry of Education National Defence Key Laboratory on Aerospace Information Security and Trusted Computing’ (空天信息安全与可信计算教育部国防重点实验室); School of Cyber Science and Engineering, ‘The National Cyber Security College of Wuhan University invites outstanding talents at home and abroad to apply for the National “Thousand Talents Program”’, Wuhan University, 21 April 2018, [online](#) (in Chinese); Wuhan University, *National research platform: National Multimedia Software Engineering Technology Research Center*, 2019, [online](#) (in Chinese); Wuhan University, *Research institutions*, no date, [online](#) (in Chinese).
- 66 The officials claimed that the then PLA General Staff Department Third Department’s Sixth Bureau had offices in Wuhan University; Lo Tien-pin, Jason Pan, ‘PLA cyberunit targeting Taiwan named’, *Taipei Times*, 10 March 2015, [online](#). PLA scholars Mark Stokes, Jenny Lin and Russell Hsiao identified the Sixth Bureau as headquartered in Wuhan and speculated that its mission may focus on Taiwan and South Asia; Mark Stokes, Jenny Lin, Russell Hsiao, *The Chinese People’s Liberation Army signals intelligence and cyber reconnaissance infrastructure*, Project 2049 Institute, 11 November 2011, 9, [online](#).
- 67 See Tang Ming, Qiu ZhenLong, Gao Si, Yi Mu, Liu ShuBo, Zhang HuanGuo, Jin YingZhen, ‘Polar differential power attacks and evaluation’, *Science China, Information Sciences*, 2012, 55(7):1588–1604, MR2947842, listed [online](#).
- 68 Tang Ming, ‘Tang Ming: Key Laboratory of Aerospace Information Security and Trusted Computing, Ministry of Education, Wuhan University School of Computer Science’, [online](#).
- 69 ‘中华人民共和国国家安全部简介’ [About the PRC’s Ministry of State Security], *National Public Servant*, 11 September 2013, [online](#).

- 70 Crowdstrike Global Intelligence Team, 'Huge fan of your work: how TURBINE PANDA and China's top spies enabled Beijing to cut corners on the C919 passenger jet', *Crowdstrike*, October 2019, [online](#); Peter Mattis, 'Everything we know about China's secretive state security bureau', *The National Interest*, 9 July 2017, [online](#); Zach Dorfman, 'How Silicon Valley became a den of spies', *Politico*, 27 July 2018, [online](#).
- 71 'University of International Relations', China Defence Universities Tracker, no date, [online](#).
- 72 'Jiangnan Social University', China Defence Universities Tracker, no date, [online](#).
- 73 'University of International Relations', China Defence Universities Tracker, November 2019, [online](#).
- 74 'Qin Zheng', College of Computer Science and Electronic Engineering, no date, [online](#) (in Chinese).
- 75 College of Mathematics and Informatics, 'Academician Su Yuting, Academician of Tianjin University, April 14th', 12 April 2018, [online](#) (in Chinese).
- 76 Southeast University, 'Application and development trend of modern information security', no date, [online](#). For more information about the 115 Plan, see Bryan Krekel, Patton Adams, George Bakos, *Occupying the information high ground: Chinese capabilities for computer network operations and cyber espionage*, prepared for the US–China Economic and Security Review Commission, Northrop Grumman Corp., 7 March 2012, [online](#).
- 77 'The Anthem hack: all roads lead to China', *ThreatConnect*, 27 February, 2015, [online](#).
- 78 Crowdstrike Global Intelligence Team, 'Huge fan of your work: how TURBINE PANDA and China's top spies enabled Beijing to cut corners on the C919 passenger jet'.
- 79 Beijing University of Posts and Telecommunications, *Graduates going*, 12 May 2018, [online](#) (in Chinese).
- 80 Mark A Stokes, Dean Cheng, *China's evolving space capabilities: implications for US interests*, prepared for the US–China Economic and Security Review Commission, 26 April 2012, 17, [online](#).
- 81 CASC Human Resources Department, '中国航天科技集团有限公司2019年攻读博士学位研究生招生专业目录' [CASC 2019 PhD student research student recruitment areas list], CASC, August 2018, [online](#) (in Chinese); 'China Aerospace Science and Industry Group further promotes high-level personnel training program', *Central Government Portal*, 3 March 2011, [online](#) (in Chinese); 'China Aerospace Science and Technology to create a security system', *Sina*, 3 January 2012, [online](#). CASC also sends senior managers overseas to study in executive education programs at Warwick Manufacturing Group within the University of Warwick; 'WMG in China', *Studylib.net*, no date, [online](#).
- 82 Stokes & Cheng, 'China's evolving space capabilities: implications for US interests', 17.
- 83 University of Strathclyde, *Space Mechatronic Systems Technology (SMeSTech) Laboratory*, no date, [online](#); Aerospace Research Institute, *Our research*, University of Manchester, no date, [online](#).
- 84 Aerospace Research Institute, *Our team*, University of Manchester, no date, [online](#); 程璞; 张鹏宇; 吴小华; 黄兴李; 闵昌万; 阵风条件下高超声速飞行器动力学建模与分析 · 32 : 5 (2014) [online](#); 张鹏宇; 杨明; 王子才; 基于 Lambert 定理的拦截器推进段飞行方案研究; 24 : 01 (2007) [online](#); 'Zhang Zhongwei's appointment as researcher approved', Beijing Institute of Technology, 29 August 2019, [online](#); H Pfeiffer, K Peetz, 'All-ceramic body flap qualified for space flight on X38', *Ads*, Harvard University, no date, [online](#); Fang Jinming, Xu Zhenghui, Zhang Zhongwei, Li Aijun, Tang Zhepeng, 'Multi-scale relationship of pores in carbon cloth stitched preform and deposition of pyrocarbon', *宇航材料工艺*, Issue 5 2015, [online](#) (in Chinese); Feng Zhihai, Zhang Zhongwei, 'High-temperature oxidation behavior of matrix-modified anti-oxidation carbon materials', *Equipment Environmental Engineering*, 2016, 13(3):93–97, [online](#).
- 85 Aerospace Research Institute, *Our team*.
- 86 王成; 王会霞; 导弹飞行仿真系统可视化设计与实现; 31 : 1 (2013) [online](#). 谭浪; 巩庆海; 王会霞; 基于深度强化学习的追逃博弈算法; 36 : 6 (2018) [online](#).
- 87 CALT, *The Rocket Institute has built 4 overseas R&D institutions*; CALT, *Artificial assisted heart overseas research and development institutions*.
- 88 'China uses the technology of rockets to create "artificial assisted heart"', *Science and Technology Daily*, 14 March 2018, [online](#).
- 89 Tate Nurkin, Kelly Bedard, James Clad, Cameron Scott, Jon Grevatt, *China's advanced weapons systems*, Jane's by HIS Markit, 12 May 2018, 72, [online](#); Greg Levesque, Mark Stokes, *Blurred lines: military–civil fusion and the "going out" of China's defense industry*, Pointe Bello, December 2016, 35, [online](#).
- 90 See: Greg Levesque, Mark Stokes, *Blurred lines: military–civil fusion and the "going out" of China's defense industry* for a discussion of AVIC's overseas expansion.
- 91 Brenda Goh, 'After stealth fighters and jumbo jets, China's "secret weapon": aero engines', *Reuters*, 4 November 2016, [online](#).
- 92 University of Manchester, 'Partnership with the Aero Engine Corporation of China', news release, no date, [online](#); Imperial College London, *BIAM – Imperial Centre for Materials Characterisation, Processing and Modelling*, 2012, [online](#).
- 93 Imperial College London, *BIAM – Imperial Centre for Materials Characterisation, Processing and Modelling*; University of Manchester, 'Partnership with the Aero Engine Corporation of China'.
- 94 University of Nottingham, 'Chinese aerospace business funds £3m university innovation centre', news release, 31 August 2012, [online](#); 'China Aviation Industry Corporation thank you letter', Embassy of the PRC in the UK, 30 March 2010, [online](#) (in Chinese).
- 95 L Zhu, N Li, PRN Childs, 'Light-weighting in aerospace component and system design', *Propulsion and Power Research*, 2018, 7(2):103–119, [online](#); Fabrizio Micari, Livan Fratini, *Metal Forming 2014*, TTP, Pfaffikon, Switzerland, 1107.
- 96 AVIC Centre for Structural Design and Manufacture, *People*, no date, [online](#); 'Professor Lin Jianguo, a member of the Royal Academy of Engineering, was invited to give an academic report', Taiyuan University of Science and Technology, 3 May 2016, [online](#) (in Chinese); Bill Priestap, 'China's non-traditional espionage against the United States: the threat and potential policy responses', statement before the Senate Judiciary Committee, Washington DC, 12 December 2018, [online](#).
- 97 '共建高校2008年度基本情况统计表填报说明' [Explanation of jointly constructed universities 2008 basic information statistics form], Ministry of Industry and Information Technology, [online](#) (in Chinese); '共建高校2010年度基本情况统计表填报说明' [Explanation of jointly constructed universities 2010 basic information statistics form], Ministry of Industry and Information Technology, no date, [online](#).
- 98 Monash University, 'Monash University and Commercial Aircraft Corporation of China sign MOU to accelerate aircraft development', news release, 16 May 2017, [online](#).

- 99 Sijia Jiang, Minnie Chan, 'Plan in the wings to convert Chinese passenger jets for military missions, analysts say', *South China Morning Post*, 20 September 2015, [online](#). Victorian Department of Premier and Cabinet, 'Victoria's advanced manufacturing sector flying high', media release, 16 May 2017, [online](#).
- 100 马燕生公参访问图兹航空航天学院并看望中航工业国家公派留学学员' [Minister Counsellor Ma Yansheng visits IAS to see AVIC government-sponsored students in France], Embassy of the PRC in France, 25 April 2017, [online](#) (in Chinese); '航空工业举行航空青年骨干公派留学回国汇报会暨行前动员' [AVIC holds reporting meeting of young core staff returning to China after studying abroad], AVIC, 21 August 2018, [online](#) (in Chinese); '我国将公派航空工业领域骨干人才出国留学' [The country is sending aviation talent to study abroad], CHSI, 14 December 2010, [online](#) (in Chinese).
- 101 Zhang Xinguo, *Cooperation progress between AVIC & UK universities*, Aviation Industry Corporation of China, 5 July 2016, [online](#). AVIC also sends personnel to study in executive education programs at the University of Reading and the University of Warwick; Zhang Xinguo, *Cooperation progress between AVIC & UK universities*; Henley Business School, *Transforming people, transforming performance*, University of Reading, 2013–14, [online](#); 'WMG in China', *Studylib*, no date, [online](#); A Rugman, Q Nguyen, 'Modern international business theory and emerging market multinational companies', in A Cuervo-Cazurra, R Ramamurti (eds), *Understanding multinationals from emerging markets*, Cambridge University Press, Cambridge, 2014, doi:10.1017/CBO9781107587632.007; Amanda Boscus, 'Editorial', *IAS Alum'News*, 2018, [online](#); Institut Aéronautique et Spatial (IAS), *2016 edition of the IAS Summer Program*, 2016, [online](#).
- 102 Clive Hamilton, Alex Joske, 'Australian taxes may help finance Chinese military capability', *The Australian*, 10 June 2017, [online](#) (paywall).
- 103 *China's algorithms of repression*, Human Rights Watch, 1 May 2019, [online](#); Chris Buckley, Paul Mozur, 'How China uses high-tech surveillance to subdue minorities', *New York Times*, 22 May 2019, [online](#).
- 104 '中国科技企业在奥地利设立欧洲总部' [Chinese science company establishes European headquarters in Austria], Austrian Business Agency, 23 November 2016, [online](#) (in Chinese); '中国成奥地利吸引外资重要来源国' [China becomes a major source of foreign investment for Austria], Embassy of the PRC in Austria, 23 January 2017, [online](#) (in Chinese).
- 105 University of Technology Sydney (UTS), 'UTS CETC Review', news release, 13 September 2019, [online](#).
- 106 *Mapping China's tech giants*, ASPI, Canberra, April 2019, [online](#); Asha Barbaschow, 'UTS partners with China for electronics innovation centre', *ZDNet*, 27 April 2017, [online](#).
- 107 UTS, 'UTS CETC Review'; Sean Rubinsztein-Dunlop, Mario Christodoulou, Sashka Koloff, Lauren Day, Echo Hui, 'Are Australian universities putting our national security at risk by working with China?', *ABC News*, 15 October 2019, [online](#).
- 108 Danielle Cave, Brendan Thomas-Noone, 'CSIRO cooperation with Chinese defence contractor should raise questions', *The Guardian*, 3 January 2017, [online](#); Hamilton & Joske, 'Australian taxes may help finance Chinese military capability'; Sophie McNeill, Jeanavive McGregor, Meredith Griffiths, Michael Walsh, Echo Hui, 'UTS, Curtin unis announce reviews over links to surveillance tech used by Chinese Government', *ABC News*, 16 July 2019, [online](#); UTS, 'UTS CETC Review'.
- 109 '背景介绍' [Background introduction], China Academy of Engineering Physics, no date, [online](#) (in Chinese).
- 110 '铸国防基石 做民族脊梁—记中国工程物理研究院2015校招会' [Smelting a keystone for national defence, serving as a national backbone—Recording the Chinese Academy of Engineering Physics' 2015 university recruitment event], Shandong University, 21 September 2015, [online](#).
- 111 HPSTAR was added to the US Government's Entity List in 2019; 'Revisions to the Unverified List (UVL)', *Federal Register*, 11 April 2019, [online](#); 'HPSTAR scholars and the 209 Office hold academic exchange', Key Laboratory of Neutron Physics, 4 January 2015, [online](#) (in Chinese); '北京高压科学研究中心研究方向简介' [About HPSTAR's research areas], CAEP Graduate School, 8 September 2017, [online](#) (in Chinese).
- 112 'Mao Ho-Kwang', China Academy of Engineering Physics, 4 December 2014, [online](#) (in Chinese). HPSTAR's director, Mao Ho-Kwang (毛河光), is sometimes simply described as a CAEP scientist; 'Name list of members of the 2nd committee of the Chinese Neutron Scattering Society', Chinese Neutron Scattering Society, no date, [online](#) (in Chinese); '2014年我院17名海外高层次人才入选"千人计划"' [In 2014, 17 of our academy's high-level talents entered the national 'Thousand Talents Plan'], China Academy of Engineering Physics, 10 June 2015, [online](#).
- 113 铸国防基石 做民族脊梁—记中国工程物理研究院2015校招会' [Smelting a keystone for national defence, serving as a national backbone—Recording the Chinese Academy of Engineering Physics' 2015 university recruitment event], Shandong University, 21 September 2015, [online](#).
- 114 Department of Commerce, Bureau of Export Administration, Revisions to the Export Administration Regulations: additions to the Entity List, *Federal Register*, 30 June 1997, 62(125), [online](#).
- 115 Qi An, William A Goddard III, Sergey V Zybin, Andres Jaramillo-Botero, Tingting Zhou, 'Highly shocked polymer bonded explosives at a nonplanar interface: hot-spot formation leading to detonation', *Journal of Physical Chemistry C*, 2013, 117(50):26551–26561, [online](#).
- 116 '黄风雷' [Huang Fenglei], Beijing Institute of Technology, no date, [online](#).

Acronyms and abbreviations

AECC	Aero Engine Corporation of China
AVIC	Aviation Industry Corporation of China
BIAM	Beijing Institute for Aeronautical Materials
CAEP	Chinese Academy of Engineering Physics
CALT	China Academy of Launch Vehicle Technology
CASC	China Aerospace Science and Technology Corporation
CASIC	China Aerospace Science and Industry Corporation
CCP	Chinese Communist Party
CETC	China Electronics Technology Group Corporation
COMAC	Commercial Aircraft Corporation of China
defence SOE	defence state-owned enterprise
HPSTAR	Center for High Pressure Science and Technology Advanced Research
MPS	Ministry of Public Security
MSS	Ministry of State Security
NUAA	Nanjing University of Aeronautics and Astronautics
PLA	People's Liberation Army
PRC	People's Republic of China
SASTIND	State Administration of Science, Technology and Industry for National Defense
UESTC	University of Electronic Science and Technology of China
UTS	University of Technology Sydney

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