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EVALUATING GLOBAL EXPOSURE TO CHINA'S DEFENSE-INDUSTRIAL BASE

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行政概要

Executive Summary

The Chinese Communist Party (CCP) has placed great emphasis on transforming the People's Liberation Army (PLA) into a next-generation warfighting force. To build the modern defense-industrial base needed for this task, the CCP is stepping up its strategy of Military-Civil Fusion (MCF). MCF seeks to harness the sophistication and output of China's civilian economy for the benefit of defense supply chains. MCF is ushering Chinese companies into the defense economy even as Beijing's policies encourage companies to innovate by acquiring and adapting foreign technology. The confluence of MCF with this approach, called "Introduce, Digest, Absorb, and Re-Innovate" (IDAR), obscures the distinction between civilian and military uses. Given China's extensive business and academic presence abroad, there is a clear risk that foreign strategic technologies and expertise could inadvertently contribute to China's growing military capabilities.

However, with this challenge comes opportunity. For MCF to succeed, the PLA and China's defense apparatus must radically alter their opaque postures to operate in a market environment. MCF compels China's defense supply chains to become increasingly transparent, creating visible indicators of participation in the defense economy that can be evaluated using publicly available information (PAI). While the indicators of participation may evolve as the ecosystem does, a segment of these supply chains will always be visible as long as China seeks to involve its civilian sector. The burden is on states, companies, and universities engaging with Chinese firms and institutions to proactively prevent misappropriation of their technology.

This report uses PAI to provide decision advantage to those on the outside of China's defense-industrial base. The authors identify 14 public indicators that regulators, investigators, and due diligence officers can use to evaluate counterparty risk (see *Risk Signals: An Assessment Tool* on page 64). To do so, the report analyzes China's defense ecosystem and the activities and characteristics of Chinese companies participating in military supply chains by:

Mapping China's defense-industrial ecosystem using research by Chinese scholars, international experts, official Chinese media, and policy documents

Examining 8,430 military procurement announcements for trends in the goods acquired by the Chinese military and offered by their suppliers

Analyzing 65,727 import records and 429 investment transactions related to a sample of 1,655 companies linked to China's defense-industrial base

Diving into three commercial networks in China's defense-industrial base that exhibit multiple risk signals and have international partners

The report reveals that MCF and IDAR have resulted in concrete gains for the PLA.

- The case of China South Rail demonstrates how PAI can be used to trace how an ostensibly commercial deal was coopted for military purposes (p. 47).
- The case of Beijing Highlander exemplifies how an openly pro-MCF company has historically developed technologies with international partners for the PLA Navy, and continues to do so (p. 51).
- The case of Bright Laser Technologies highlights how relationships within the defense-industrial base can entail increased exposure to China's defense supply chains (p. 55).

Contents

Glossary

ABBREVIATION	MEANING	CHINESE
CCP	Chinese Communist Party	中国共产党
CMC	Central Military Commission	中央军事委员会
GJB	National Military Product Standards	国家军事标准
IDAR	Introduce, Digest, Absorb, and Re-Innovate	引进、消化、吸收、再创新
IDDS	Innovation-Driven Development Strategy	国家创新驱动发展战略纲要
MCF	Military-Civil Fusion	军民融合
MCF FYP	13th Five-Year Special Plan for the Development of MCF in Science and Technology	“十三五”科技军民融合发展专项规划
MIIT	Ministry of Industry and Information Technology	工业和信息化部
MLDP	National Medium- and Long-Term Plan for the Development of Science and Technology (2006–2020)	国家中长期科学和技术发展规划纲要 (2006—2020 年)
MOST	Ministry of Science and Technology	科学技术部
PAI	Publicly Available Information	
PLA	People’s Liberation Army	中国人民解放军
PLAA	People’s Liberation Army Army	中国人民解放军陆军
PLAAF	People’s Liberation Army Air Force	中国人民解放军空军
PLAN	People’s Liberation Army Navy	中国人民解放军海军
PLARF	People’s Liberation Army Rocket Force	中国人民解放军火箭军
PRC	People’s Republic of China	中华人民共和国
R&D	Research and Development	
RDA	Research, Development, and Acquisition	
S&T	Science and Technology	
SASTIND	State Administration for Science, Technology, and Industry for National Defense[1]	国家国防科技工业局

PRC DEFENSE-INDUSTRIAL ECOSYSTEM

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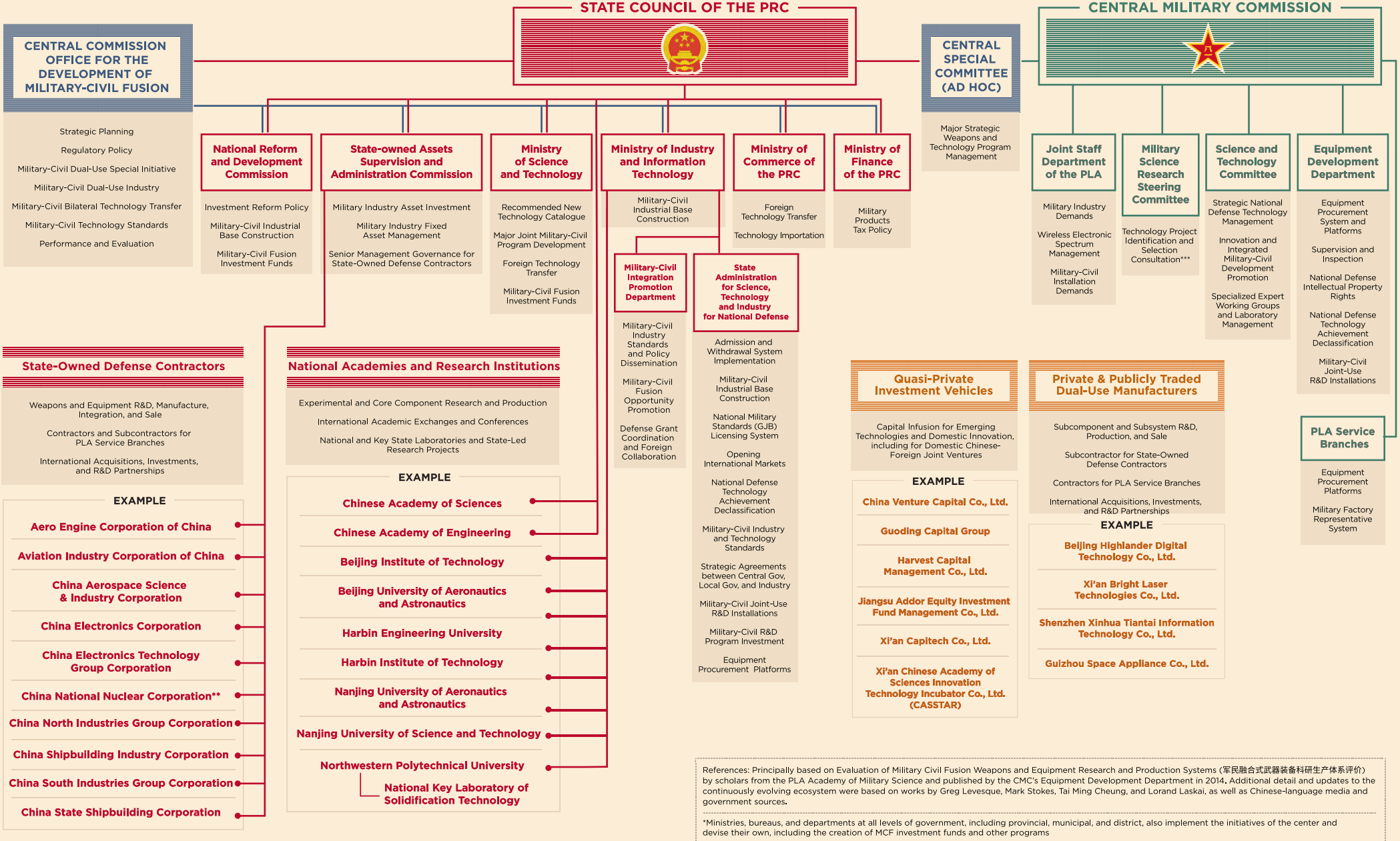

References: Principally based on Evaluation of Military Civil Fusion Weapons and Equipment Research and Production Systems (军民融合式武器装备科研生产体系评价) by scholars from the PLA Academy of Military Science and published by the CMC's Equipment Development Department in 2014. Additional detail and updates to the continuously evolving ecosystem were based on works by Greg Levesque, Mark Stokes, Tai Ming Cheung, and Lorand Laskai, as well as Chinese-language media and government sources.

*Ministries, bureaus, and departments at all levels of government, including provincial, municipal, and district, also implement the initiatives of the center and devise their own, including the creation of MCF investment funds and other programs

**China National Nuclear Corporation merged with China Nuclear Engineering & Construction Group in 2018

***Established in 2017, its role is ill-defined, but state-media has compared it to the United State's Defense Advanced Research Projects Agency

Note: This chart is not exhaustive and does not show all bodies, organizations, or companies involved in PRC defense technology development and acquisition.

方法概述

Methodology

This report is a pilot project that aims to demonstrate the effectiveness of using publicly available information (PAI) to map, track, and otherwise reveal the activities and characteristics of companies participating in China's defense-industrial base and PLA supply chains.[3]

First, the authors constructed a model of China's defense-industrial ecosystem, with an emphasis on MCF implementers (see chart on page 6). To do so, the authors surveyed authoritative sources from Chinese scholars and organizations, previous research by foreign academics, and policy documents, as well as both Chinese and international news media. Based on this research, the authors mapped out the pathways through which civilian companies signal their interest in selling to the military and how they become eligible to do so. The authors also identify ways in which the PLA solicits civilian sector participation in military procurement.

Second, the authors identified four actor groups participating in the country's defense-industrial base, and built a sample of 1,665 civilian entities. This was done by first compiling a sample of 51 known defense supply chain participants, including China's 11 largest state-owned defense contractors[4], a group of prominent defense-related academic research institutions known as the "Seven Sons of National Defense," six investment vehicles explicitly highlighted by the Chinese government for supporting MCF, and 27 private dual-use manufacturers from a PLA-run military equipment procurement website.[5, 6] Using the Chinese corporate registry, the authors next identified the direct shareholders and subsidiaries of these 51 initial entities, creating a total sample of 1,665 entities participating in, or linked to, China's defense-industrial base.

Third, the authors investigated the commercial activities of the sample entities both in China and abroad. This was accomplished in two ways. First, procurement announcements, product listings, and supplier profiles on the aforementioned procurement platform were analyzed using Palantir Foundry. Second, the entire sample of entities was searched through Panjiva, a trade data aggregator, and Thompson Reuters EIKON, a financial intelligence repository. The results allowed the authors to comment on the nature, number, and source of goods that the PLA and sample entities are procuring, as well as the types of investments they are pursuing. Based on the results, the authors were able to identify 14 risk indicators signaling participation in defense supply chains.

This report's methodology has several limitations. First, the analysis and conclusions in this study are rooted exclusively in PAI. Second, MCF in China has undergone many iterations since its inception and will continue to do so. As a result, China's defense-industrial base is also evolving. This study captures a snapshot of the defense ecosystem at the time of the research. Third, the trade and investment data were accessed using the third-party aggregators listed above. Any gaps in these datasets will be reflected in subsequent analysis. Finally, the risk indicators identified in this report should not be conflated with evidence of legal wrongdoing. Unless otherwise specified, nothing in this report should be construed as alleging illicit activity.

Notes 1-6

1 Formerly the Commission for Science, Technology, and Industry of National Defense 国防科学技术工业委员会 (COSTIND).

2 This model is based largely on works produced prior to the major and ongoing government and military reorganizations that began in 2015 and 2016. The nature, extent, and implications of these reorganizations are still being assessed. Where possible, the authors have made every attempt to update older conclusions to reflect new developments.

3 Throughout this paper, authors will refer to China' s defense-industrial base, defense-industrial ecosystem, defense economy, PLA/military/defense supply chains to refer various aspects of the interactions between the private sector, and the defense sector' s procurement

4 The initial sample and analysis included China' s top 12 defense firms. Two of these firms merged in 2018, leaving 11 companies.

5 These were selected based on two sub-groupings. The first subgroup includes 19 companies offering over 25 products of any kind on the PLA platform. The second subgroup of eight companies is composed of any manufacturer listed on the platform with more than four products containing key words (in Mandarin) for ordnance, armament, guns, rifles, and missiles. One company is included in both subgroups, bringing the total number to 27.

6 Details and data held by authors.

Introduction

In the 40 years since China's Reform and Opening, the Chinese economy has become increasingly intertwined with those of foreign partners. Chinese firms have adopted and improved upon international best practices, integrated high-quality infrastructure, and learned from their international peers. At the same time, China's leaders place great emphasis on transforming the People's Liberation Army (PLA) into a modern warfighting force,[7] which requires a sophisticated defense-industrial base.

Since 1979, the Chinese government has welcomed foreign investment in research and development (R&D) to capture foreign expertise in critical sectors.[8] Numerous endeavors to cultivate technology transfer from overseas businesses and research institutions continue today, as detailed in works by Greg Levesque[9] and James Mulvenon,[10] among others. Similarly, PLA scientists attend world-leading universities for the purpose of bringing expertise back to China.[11] The goal of these efforts and other mechanisms to access international science and technology (S&T) expertise is not simply to replicate existing technologies, but to stimulate domestic innovation. In 2016, Beijing released its Innovation-Driven Development Strategy (IDDS), asserting that whether China can innovate will dictate the nation's fate (命运).[12] It presents a roadmap[13] to becoming a "world powerhouse in scientific and technological innovation" (成世界科技创新强国) by 2050.[14]

In service of this goal, the Chinese government has promoted a stopgap measure to stimulate innovation. The approach, named after its phases, is called IDAR (Introduce, Digest, Absorb, and Re-innovate). China's National Medium- and Long-Term Plan for the Development of Science and Technology (2006–2020) (MLDP) directs the industrial base to "digest and absorb advanced technology, conquer critical technologies bearing on the national strategic interest, [and] develop major equipment and critical products that harness independent knowledge," while urging the economy to expand international R&D cooperation.[15] In practice, Chinese companies are encouraged to acquire foreign technology and then "re-innovate" those products for domestic markets.[16] This re-innovation approach, and other forms of engagement with the international community, have greatly benefitted the Chinese economy. Among other achievements, China's world-renowned high-speed rail system was partly the product of such re-innovation.[17] Tai Ming Cheung finds that "since the 1990s, a combination of foreign technology transfers and advanced imitation has allowed key portions of the Chinese defense economy to catch up" to those of Western states.[18]

While IDAR and similar initiatives stimulate the import of advanced technologies, Military-Civil Fusion (MCF) is the domestic initiative creating opportunities for Chinese companies to sell their technology to the PLA. MCF in science and technology is explicitly described as the intersection of the IDDS[19] and military reform, according to the 13th Five-Year Special Plan for the Development of MCF in Science and Technology (MCF FYP).[20] At its core, MCF is a domestic strategy to catalyze resource sharing between the civilian and military spheres to build a modern defense industrial complex. Among the goals stated in the MCF FYP is "mutual open sharing of basic S&T resources" and "effective two-way technology transfer."[21] Essentially, it aims to open China's defense markets to a broad pool of civilian participants in order to benefit from existing policies designed to stimulate innovation in the civilian industrial base.[22] In the context of IDAR, MCF creates the channels through which civilian actors with established international ties and access to advanced foreign technology can participate in China's defense technology supply chains.

Military-Civil Fusion in Context[23]

The roots of Military-Civil Fusion reach back to Mao Zedong's 1940s edict of "giving consideration to both the army and the people" (军民兼顾). In the 80s, Deng Xiaoping prescribed "combining military and civilian activities, combining peacetime and wartime preparations, giving priority to military products, and letting the civilian sector support the military sector" (军民结合、平战结合、军品优先、以民养军). Deng's guidance became the touchstone and definition for military-civil integration (MCI, 军民结合) over the following decades. However, highly secretive defense needs, complex bureaucracies, an inadequate civilian base, and vested interests have consistently stifled resource sharing and conversion of civilian R&D for military use. Xi Jinping's MCF builds on attempts in the 90s and early 2000s to break down these barriers. MCF also vastly expands the scope of MCI. In addition to perfecting cooperative S&T and civilian participation in China's defense supply chains, MCF also seeks to leverage the civilian economy and its infrastructure to ensure military mobilization capacity in case of war and to provide talent and training for the military apparatus. Moreover, MCF works to reform China's defense innovation ecosystem alongside many other initiatives. These include the 863, 973, and Torch programs, which all include a dual-use or MCF component. As with MCF, these programs are organized by numerous government, party, and military bodies.

While innovation strategies like IDAR and MCF have existed in China for decades, the risk of technology transfer to the PLA is growing. First, the applicability of commercial technology (e.g., drones and artificial intelligence) to military hardware make leveraging China's sophisticated civilian industrial base for military needs more effective. Second, today's MCF is invigorated by significant capital, as well as concrete policies through which civilian companies can participate in China's defense technology supply chains. Xi Jinping promoted MCF to a national strategy in 2015,[24] and a Central Commission for the Development of Military-Civil Fusion (中央军民融合发展委员会) was set up in 2017.[25] The commission is personally chaired by President Xi and is complemented by provincial MCF leading small groups[26] around the nation.[27] Lorand Laskai further notes "a significant shift in how China's state-owned defense sector and [the PLA] interact with the private economy,"[28] particularly through capital distribution initiatives. In 2018, the seven largest state-backed MCF funds were putting up 56.9 billion USD to stimulate civilian-military collaboration.[29]

The result is that MCF is—by design—blurring the lines between industrial and defense supply chains. MCF creates the opportunity for the PLA to indirectly procure cutting-edge civilian and dual-use technology that has benefitted from foreign input. The 2001 edition of China National Defense University's Science of Military Strategy acknowledged that civilian actors "maintain [China's] capability to get scientific, technical, and economic strategic resources from various international channels and in various ways." [30] Increasing engagement between the state, the military, and the civilian economy has led to tangible advances in the PLA's technological capabilities.[31] As shown in this report's case studies, examples of MCF achievements that incorporate foreign technology include China's first aircraft carrier and China's first large domestically-produced passenger plane, the C919, which some speculate will be adapted for military use.[32] This is not just a point of concern for foreign governments and defense institutions. Academia and private enterprise, especially those producing potentially sensitive technology and research, are at risk of inadvertently contributing to China's military rise. The issue at hand is how any stakeholder can assess this risk before technology enters China's defense-industrial economy.

Highlight

From Civilian to Military Use[33]

The story of how British semiconductor technology wound up in advanced Chinese naval aviation and weapon systems reveals how the civilian business ventures of China South Locomotive & Rolling Stock Corp (CSR) evolved to serve military goals. CSR was a Chinese train manufacturer that achieved breakthroughs in domestic semiconductor manufacturing in the years following its acquisition of a British technology company. Simultaneously, CSR and its corporate network were participating in defense-oriented programs, applying for military production licenses, winning recognition for MCF achievements, and breaking into the market for military vessels. For more information, see *From Civilian to Military Use* on page 47.

As Chinese parties involved in MCF and the defense economy generally need to credibly signal their participation to one another and the PLA, observers can assess risk using publicly available data. MCF and the domestic environment it seeks to build necessitate that the state and PLA publicize the avenues through which civilian companies can enter defense supply chains. Likewise, civilian companies are incentivized to signal to the government and military their value and desire to sell defense products. To the extent that these signals are publicly available, they create a trail of observable behaviors around companies participating in those supply chains that can be used by screening agencies and interested parties to better scope the risks of transactions and control their strategic goods. These signals, which will be discussed throughout this report, include:

PRIMARY RISK SIGNALS

Listed Military Supplier
Military Production License
Declared MCF Business Strategy
Military Factory Representatives On-Site
Offices in MCF-linked Industrial Zones
Defense Contractor Partnerships
Defense R&D University Collaboration
Defense Contractor or Defense University Subsidiary
MCF Funding Provider or Recipient

SECONDARY RISK SIGNALS

Defense Conference Participant
National, State, Provincial, or Enterprise Lab Host
Military Trade Show Participant
Sensitive Technology Imports
Indirect Investment for Control

Notes 7-33

7 For discussions of various components of China' s military strategy, concepts, and force development, see, for example, testimonies by Taylor M. Fravel, Christopher Yung, and others in their June 20, 2019 testimonies before the United States-China Economic and Security Commission (https://www.uscc.gov/Hearings/%E2%80%98world-class%E2%80%99-military-assessing-china%E2%80%99s-global-military-ambitions; https://perma.cc/BRP5-HVN9) as well as works be Elsa B. Kania, including her report Battlefield Singularity (https://www.cnas.org/publications/reports/battlefield-singularity-artificial-intelligence-military-revolution-and-chinas-future-military-power; https://perma.cc/WH3F-EE8C).

8 Kathleen Walsh, "Foreign High-Tech R&D in China: Risks, Rewards, and Implications for U.S.-China Relations," (Washington, D.C.: The Henry L. Stimson Center, 2003), https://www.stimson.org/sites/default/files/file-attachments/Foreign%20Tech%20FINAL.pdf (https://perma.cc/8LB4-JBX4); Testimony before the U.S.-China Economic and Security Review Commission Hearing on What Keeps Xi Up at Night: Beijing' s Internal and External Challenges (2019) (testimony of Greg Levesque), https://www.uscc.gov/sites/default/files/Levesque_USCC%20Testimony_Final_0.pdf (https://perma.cc/SV4T-9SST).

9 Testimony before the U.S.-China Economic and Security Review Commission Hearing on What Keeps Xi Up at Night: Beijing' s Internal and External Challenges (2019) (testimony of Greg Levesque), https://www.uscc.gov/sites/default/files/Levesque_USCC%20Testimony_Final_0.pdf (https://perma.cc/SV4T-9SST).

10 William C. Hannas, James Mulvenon, and Anna B. Puglisi, Chinese Industrial Espionage: Technology Acquisition and Military Modernization, (New York, NY: Routledge, 2013).

11 Alex Joske, "Picking Flowers, Making Honey: The Chinese Military' s Collaboration with Foreign Universities," International Cyber Policy Centre Policy Brief, No. 10(2018), https://s3-ap-southeast-2.amazonaws.com/ad-aspi/2018-10/Picking%20flowers%2C%20making%20honey_0.pdf?H5sGNaWXqMgTG_2F2yZTQwDw6OyNfH.u (https://perma.cc/3UEW-FRCU).

12 "中共中央 国务院印发"国家创新驱动发展战略纲要"," [The State Council' s Central Committee issues the "Innovation-Drive Development Strategy Outline"], 新华通讯社 [Xinhua News Agency], May 19, 2016, http://www.xinhuanet.com/politics/2016-05/19/c_1118898033.htm (https://perma.cc/6TDP-ZCR9).

13 Although not publicly released until 2016, the IDDS builds on and subsumes at least a decade of strategies, policies, and sectoral industrial initiatives aimed at stimulating national innovation.

14 "国家创新驱动发展战略纲要" [National Innovation-Driven Development Strategy Outline], 中国国土整治网 [China Land Consolidation and Rehabilitation], May 20, 2016, http://www.lcrc.org.cn/zhzsk/zcfg/gwgb/gwywj/201801/P020180110557547697363.pdf (https://perma.cc/23V3-LWZ9); "China Concentrates on Sci-Tech Innovation," 新华通讯社 [Xinhua News Agency], September 18, 2017, http://www.xinhuanet.com//english/2017-09/18/c_136618501.htm (https://perma.cc/RMT8-Z22W).

15 "国家中长期科学和技术发展规划纲要 (2006 - 2020 年)" [National Medium- and Long-Term Science and Technology Development Plan (2006-2020)], 中华人民共和国中央人民政府 [The Central People' s Government of the People' s Republic of China], http://www.gov.cn/jrzg/2006-02/09/content_183787.htm (https://perma.cc/4X3A-LL7B).

16 Wang Xiaohong 王晓红, "引进消化吸收再创新的出发点" [The Starting Point for Introduce, Digest, Absorb, Re-Innovate], 人民网 [People' s Daily Online], April 3, 2006, http://theory.people.com.cn/GB/49154/49155/4262325.html (https://perma.cc/JCA9-8P6R); Office of the U.S. Trade Representative, Executive Office of the President, Findings of the Investigation into China' s Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation under Section 301 of the Trade Act of 1974, (Washington, D.C., 2018), https://ustr.gov/sites/default/files/Section%20301%20FINAL.PDF (https://perma.cc/LE5W-D8NE).

17 Xu Fei徐飞, "坚持走中国特色自主创新道路: 中国高速铁路的成功实践" [Adhering to the Road of Independent Innovation with Chinese Characteristics: The Successful Practice of China' s High-Speed Railway], 求是网 [QS Theory], February 15, 2017, http://www.qstheory.cn/dukan/qs/2017-02/15/m_1120454301.htm (https://perma.cc/7LF9-Y4C2); Environmental and Energy Study Institute, 2018, Fact Sheet: High Speed Rail Development Worldwide, https://www.eesi.org/papers/view/fact-sheet-high-speed-rail-development-worldwide#3 (https://perma.cc/6TA6-MVED).

18 Tai Ming Cheung, "The Role of Foreign Technology Transfers in China' s Defense Research, Development, and Acquisition Process," Study of Innovation and Technology in China Policy Brief, No. 5(2014), https://escholarship.org/content/qt4dp213kd/qt4dp213kd.pdf (https://perma.cc/5SZZ-HNG5).

19 MCF is also given its own section in the Innovation-Driven Development Strategy describing how China' s goal for broader innovation in science and technology will benefit the country' s military power. See "中共中央 国务院印发"国家创新驱动发展战略纲要"," [The State Council' s Central Committee issues the "Innovation-Drive Development Strategy Outline"], 新华通讯社 [Xinhua News Agency], May 19, 2016, http://www.xinhuanet.com/politics/2016-05/19/c_1118898033.htm (https://perma.cc/6TDP-ZCR9).

20 "十三五"科技军民融合发展专项规划 (全文)" [The Full Text of the "13th Five-Year Plan for the Integration of Civilian and Military], 爱思想 [Aisixiang], September 26, 2017, http://www.aisixiang.com/data/106161.html (https://perma.cc/4A9N-HVYL).

21 Translation Note: "mutual open sharing of basic S&T resources" (军民科技基础资源实现双向开放共享) and "effective two-way technology transfer" (军民科技成果双向转化运用卓有成效); "十三五"科技军民融合发展专项规划 (全文)" [The Full Text of the "13th Five-Year Plan for the Integration of Civilian and Military], 爱思想 [Aisixiang], September 26, 2017, http://www.aisixiang.com/data/106161.html (https://perma.cc/4A9N-HVYL).

22 There are a number of other aspects to MCF, including finance, logistics, and education. For additional context on how MCF is attempting to integrate the civilian industrial base and defense economy and other goals, please see, for example: "十三五"科技军民融合发展专项规划 (全文)" [The Full Text of the "13th Five-Year Plan for the Integration of Civilian and Military], 爱思想 [Aisixiang], September 26, 2017, http://www.aisixiang.com/data/106161.html (https://perma.cc/4A9N-HVYL); Tai Ming Cheung, ed. Forging China' s Military Might: A New Framework for Assessing Innovation, (Baltimore: Johns Hopkins University Press, 2014); Testimony before the U.S.-China Economic and Security Review Commission Hearing on What Keeps Xi Up at Night: Beijing' s Internal and External Challenges (2019) (testimony of Greg Levesque), https://www.uscc.gov/sites/default/files/Levesque_USCC%20Testimony_Final_0.pdf (https://perma.cc/SV4T-9SST); Jiang Luming姜鲁鸣, "统筹国家安全和发展的总方略: 学习贯彻习主席关于军民融合发展战略的重要论述" [The Overall Strategy for Coordinating National Security and Development: Studying and Implementing President Xi' s Important Exposition on the Strategy of Military-Civilian Integration], 中国军网Chinamil Online, http://www.81.cn/gfbmap/content/21/2016-06/02/03/2016060203_pdf.pdf (https://perma.cc/B8ZW-AGMZ); Phillip C. Saunders, ed., Arthur S. Ding, ed., Andrew Scobell, ed., Andrew N.D. Yang, ed., and Joel Wuthnow, ed., Chairman Xi Remakes the PLA: Assessing Chinese Military Reforms, (Washington, D.C.: National Defense University Press, 2019), https://ndupress.ndu.edu/Portals/68/Documents/Books/Chairman-Xi/Chairman-Xi.pdf (https://perma.cc/2YCZ-FWSN).

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国防工业

The Defense-Industrial Base

This section discusses China's model for importing foreign technology, the types of actors participating in the defense-industrial economy, and the processes for entering the marketplace. These factors result in a number of key risk indicators. Understanding the defense-industrial base is thus critical to developing risk profiles for companies that may be contributing to PLA supply chains.

Importing Innovation

China's defense-industrial base is a natural beneficiary of the country's internationalized business community and many state-led innovation initiatives, including those that seek to harness civilian ties overseas for domestic development. Since 2006, the CCP has encouraged the IDAR approach across China's economy writ large.[34] Chinese companies have attempted to implement the model's four steps (described below) and learn from international partners, often through licit channels. However, Xi Jinping has called on companies to distinguish between "what can be [re-innovated], what can be developed cooperatively with others, and what must be independently invented" as "many technologies are a double-edged sword."[35] Thus, in striving to close the innovation gap between China and its competitors in the name of national security,[36] IDAR as an explicit model may be falling out of favor as "indigenous" (原始) and "independent" (自主) innovation are emphasized.[37] Still, the 2013 edition of Science of Military Strategy advises that IDAR remains important to closing the technology gap between the PLA and world militaries, especially as China is cut off (封锁) from high-tech goods in the defense space.[38] As late as February 2018, director of the Chinese Ministry of Education's Science and Technology Development Center (中华人民共和国教育部科技发展中心) described IDAR as a core component of "independent" innovation.[39]

It is natural that Chinese companies would seek to participate in strategies that both improve their commercial performance as well as advance their country's national security interests. Thus, it is the responsibility of foreign states and businesses to adapt their screening policies to secure their strategic goods and knowledge against unwanted technology transfers.

Highlight
Importing National Security[54]

A dive into the international and domestic activities of Beijing Highlander Digital Technology Co., Ltd. show how the IDAR approach furthers China's military capabilities. Highlander is a maritime systems manufacturer and a supplier of the PLA Navy that actively pursues international R&D opportunities with state support. The publicly traded company holds all of the relevant licenses for producing military goods and identifies MCF as a core pillar in its development strategy. The company proudly claims its products are found in many Chinese warships, including the Liaoning aircraft carrier. For more information, see *Importing National Security* on page 51.

Models of International Engagement

IDAR is a flexible approach which can be adapted to a number of pathways, all with the objective of bringing foreign technological expertise into China. Importantly, all of these programs are fundamentally licit. As such, they often appear to foreign companies as lucrative business opportunities to generate new revenues for their shareholders or excellent avenues for professional development. Instead, without enhanced due diligence, they expose companies to risk. Examples of potential IDAR pathways include:

» Technology transfer organizations, such as the China International Technology Transfer Center and the Jiangsu Center of International Technology Transfer, partner with similar technology transfer centers around the world to bring together Chinese and foreign enterprises, universities, and research institutions to exchange knowledge, develop joint research programs, and manufacture new products.[40] One such organization, the International Technology Transfer Network, allegedly has over 200 partner organizations in 15 countries.[41] In some cases, these centers have directly facilitated the development of technologies for the Chinese military as will be discussed in the *Importing National Security* on page 51.

» Foreign talent programs, such as the Thousand Talents Plan,[42] seek to recruit and extract technical knowledge from experts by recruiting and funding research in China that often draws from concurrent government-funded research in other countries.[43] By 2018, more than 6,000 individuals had been recruited to the Thousand Talents Plan,[44] far exceeding initial recruitment estimates.[45] The same year, Zhejiang provincial authorities announced up to 1.4 million USD in grants for the Thousand Talents Plan supporting scientists focusing on a variety of sectors, including artificial intelligence, integrated electronics, quantum communications, integrated circuits, biomedicine, and advanced materials,[46] all potentially dual-use domains.

» Study abroad programs can also exploit academia for the repatriation of advanced research findings. The US Department of Defense's Defense Innovation Unit asserts that "Chinese science and engineering students frequently master technologies that later become critical to key military systems, amounting over time to unintentional violations of U.S. export control laws."[47] In certain cases, the Chinese military specifically seeks to exploit the open environments of foreign universities. By some estimates, the PLA has "sponsored more than 2,500 military scientists and engineers to study abroad" since 2007.[48]

» State-industry innovation alliances bring together government, state, and private sector stakeholders, and in some cases foreign enterprise, to lead "the combined efforts of PRC government, corporations, and academia to identify and absorb cutting-edge foreign research, technology, and talent in support of national S&T priorities."[49] An early example from 2003 was the Computer World Army-Supporting Alliance on Science and Technology, which donated approximately 4.5 million USD[50] in IT equipment to the PLA with the help of at least four US firms: Semantica, Network Associates, Sybase, and Luxeon.[51]

» Business-to-business and business-to-university R&D partnerships can lead to advances in dual-use technologies. Prominent examples include Microsoft's Project Brainwave for artificial intelligence chips with Peking University and others,[52] and Baidu's partnership with BlackBerry for autonomous vehicles.[53] Distinguishing the motives behind these and other relationships, commercial or otherwise, can be difficult. Often, it may be both, or may begin as a commercial endeavor only to later become something that benefits China's military needs, as shown by *From Civilian to Military Use* (page 47).

Meet the Players

MCF is a whole-of-government mission to overhaul China's defense innovation ecosystem. This ecosystem is shaped by numerous government, party, and military bodies. It is driven by the State Council's Central Commission for the Development of Military-Civil Fusion.[55] Other ministries, namely the Ministry of Science and Technology (MOST) and the Ministry of Industry and Information Technology (MIIT), govern policies regulating strategic industrial development and state-funded research programs, including those for dual-use products, according to the needs of the Central Military Commission.[56, 57] Within MIIT sits the State Administration for Science, Technology, and Industry for National Defense (SASTIND), responsible for administering civilian participation in defense supply chains and coordinating programs[58] that facilitate technological development relevant to national defense.[59, 60] At nearly every level of government, and for almost all state-led industrial initiatives, there are mechanisms to support breakthroughs in dual-use technology or stimulate civilian-to-military transfers.

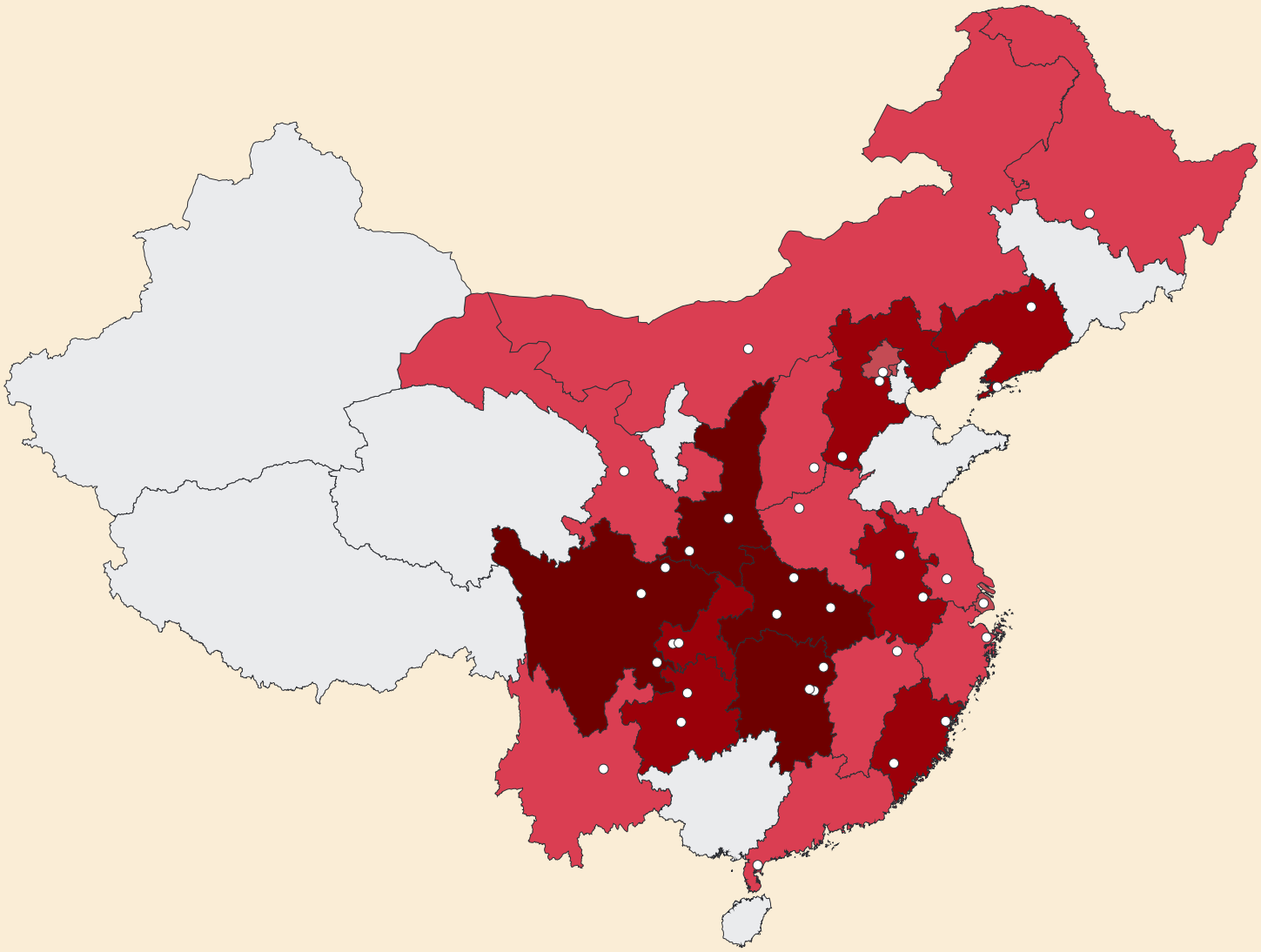
Thus, MCF is a nearly unavoidable consideration for Chinese companies. Under MIIT and MOST, China has undertaken a number of initiatives to pool civilian and military resources to drive innovation. Several examples of these initiatives are included below.

» Dedicated MCF funds seek to allocate state capital efficiently toward would-be civilian defense innovators. For example, the Mianyang Science and Technology City Military-Civilian Fusion Achievements Conversion Fund (绵阳科技城军民融合成果转化股权投资基金) was established in 2016. The fund raised 290 million USD to invest and provide loans for, among other activities, "overseas mergers and acquisitions" (海外并购业务).[61] As noted above, the seven largest state-backed MCF funds are contributing 56.9 billion USD toward this effort.[62]

» Security- and defense-focused trade fairs and conferences bring together state-owned defense contractors and private dual-use manufacturers (as well as foreign companies).[63] For example, the 7th China National Defense Informatized Equipment and Technology Expo (第七届中国国防信息化装备与技术展览会) in June 2018 was organized to promote MCF in the information sector.[64]

» Special-purpose industrial zones incubate innovation in strategic sectors, including high-tech goods. Further, the 13th MCF FYP specifically identifies high-tech industrial innovation zones as important test beds for military-civilian collaboration.[65] Additionally, as of March 2019, MIIT's National New Industrial Demonstration Base (国家新型工业化产业标范基地) initiative included 36 MCF-specific bases on its website. [66, 67]

The authors identify four key groups of actors contributing to China's military R&D: state-owned defense contractors, defense-related academic research institutions, investment vehicles, and select private dual-use manufacturers. Knowledge of these actors and their roles along the procurement value chain is critical to understanding how MCF is implemented in practice. This, in turn, allows stakeholders to measure exposure when assessing counterparty risk.



MCF Demonstration Bases by Province

Meet the Players

State-Owned Defense Contractors

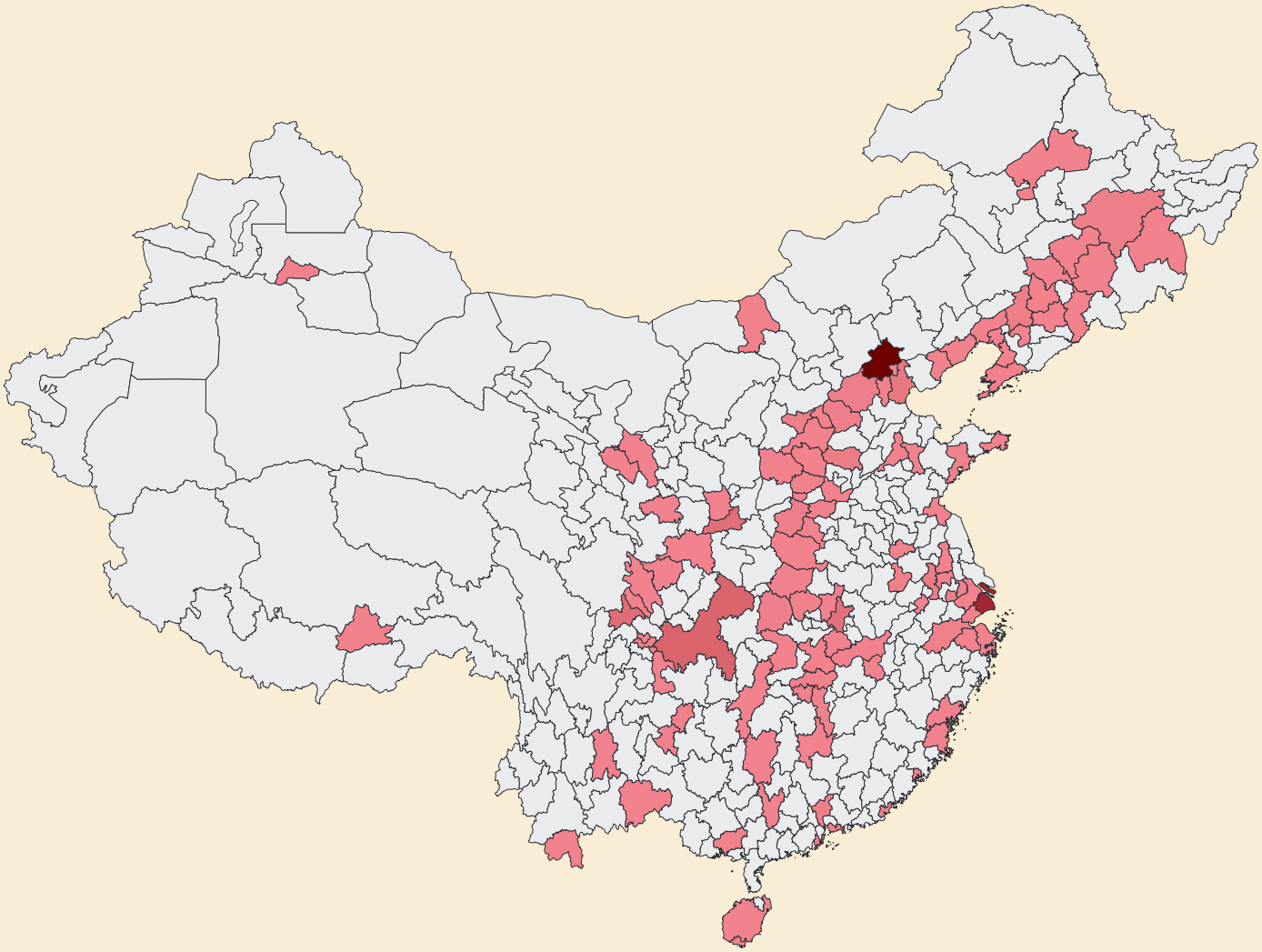
The first group of actors are the state-owned defense contractors. These firms are directly owned by China's State-owned Assets and Administration Commission of the State Council (SASAC; 国务院国有资产监督管理委员会).[68] They have traditionally held exclusive purview over China's military manufacturing and they continue to dominate the defense economy, from R&D, to systems assembly, to sales.[69] Today, each of the 11 firms controls a host of subsidiaries, numbered institutes, and factories that serve a myriad of functions, including civilian output. Many subsidiaries, such as the Shanghai Merchant Ship Design & Research Institute under China Shipbuilding Industry Corporation, are largely geared toward civilian output or are even publicly traded.[70] Straddling the lines between military and commercial institutions, these firms and their subsidiaries regularly conduct commercial activities beyond China's borders, including outgoing investment and incoming trade.

Among the 1,665 companies in the sample, the defense contractors constitute the largest group: after a first-level buildout in the Chinese corporate registry, these 11 companies yielded 818 subsidiaries and branch companies—an average of approximately 74 per firm.[71] The largest defense firm, China Shipbuilding Industry Corporation, has a direct shareholding in 166 companies.[72] While nominally civilian, these companies ultimately answer to some of the key players in China's military-industrial complex.

NUCLEAR TECHNOLOGY 核武器	ARMAMENTS & ORDNANCE 军备 军械	ELECTRONICS & INFORMATION TECHNOLOGY 电子信息技术	SHIPBUILDING 造船	SPACE & AEROSPACE TECHNOLOGY 航天技术	AVIATION TECHNOLOGY 航空技术
China National Nuclear Corporation (China Nuclear Engineering & Construction Group Corp)*	**China North Industries Group Corporation**	**China Electronics Technology Group Corporation**	**China State Shipbuilding Corporation****	**China Aerospace Science and Technology Corporation**	**Aviation Industry Corporation of China**
	China South Industries Group Corporation	**China Electronics Corporation**	**China Shipbuilding Industry Corporation****	**China Aerospace and Industry Corporation**	**Aero Engine Corporation of China**

* Merged with CNNC in 2018
** Planned merger confirmed as of July 2019

China's State-Owned Defense Contractors



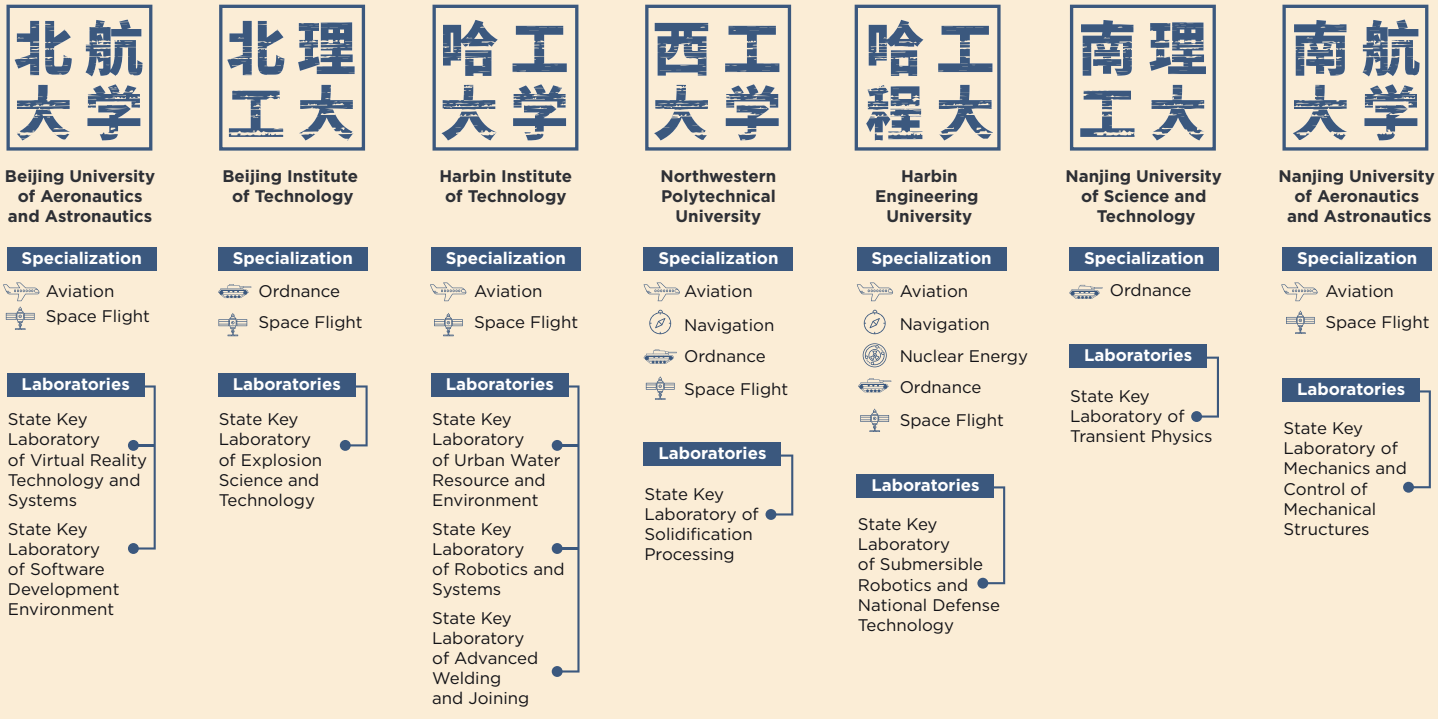
Geographical Distribution of Sample Companies by Type and Prefecture:
State-Owned Defense Contractors

Meet the Players

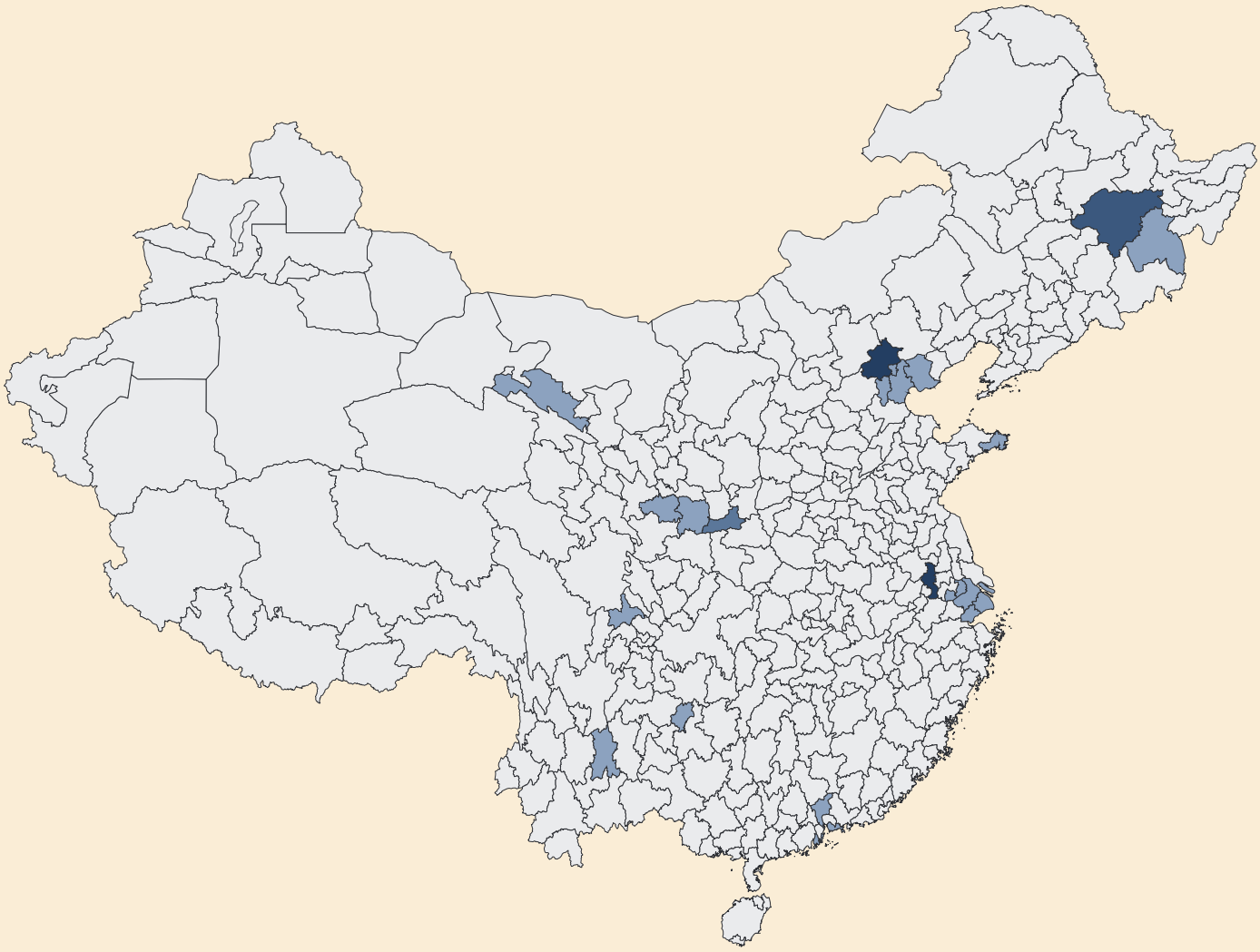
Defense-Related Academic Research Institutions

The second group is composed of prominent defense-related academic research institutions, which play a large role in China's defense R&D. The PLA has a network of 43 universities under direct supervision of the Central Military Commission.[74] State-run think tanks, namely the Chinese Academy of Sciences and Chinese Academy of Engineering,[75] and other universities have emerged as leaders in defense technology and engineering. These are often grouped by areas of specialization and given pithy names, including the Six Schools of Military Engineering (军工六校),[76] the Seven Sons of Ordnance (兵工七子),[77] and the Seven Sons of National Defense (国防七子).[78] The latter group of schools is administered by MIIT and produces research that feeds directly into China's weapons systems.[79]

Each of the Seven Sons of National Defense is home to at least one Key State Laboratory (scientific research hubs designated by MOST to stimulate breakthroughs in fundamental and applied sciences[80]), and each university has its own corporate network that engages the international business community. This is quickly made apparent by examining their direct ownership linkages: the Seven Sons have the third largest corporate footprint of the sample categories, with a total of 191 companies at the first level. As seen in the adjacent map, these subsidiaries of defense-related academic institutions are typically concentrated in the same cities as their parent university.



The Seven Sons of National Defense[73]



Geographical Distribution of Sample Companies by Type and Prefecture:
Seven Sons of National Defense

Meet the Players

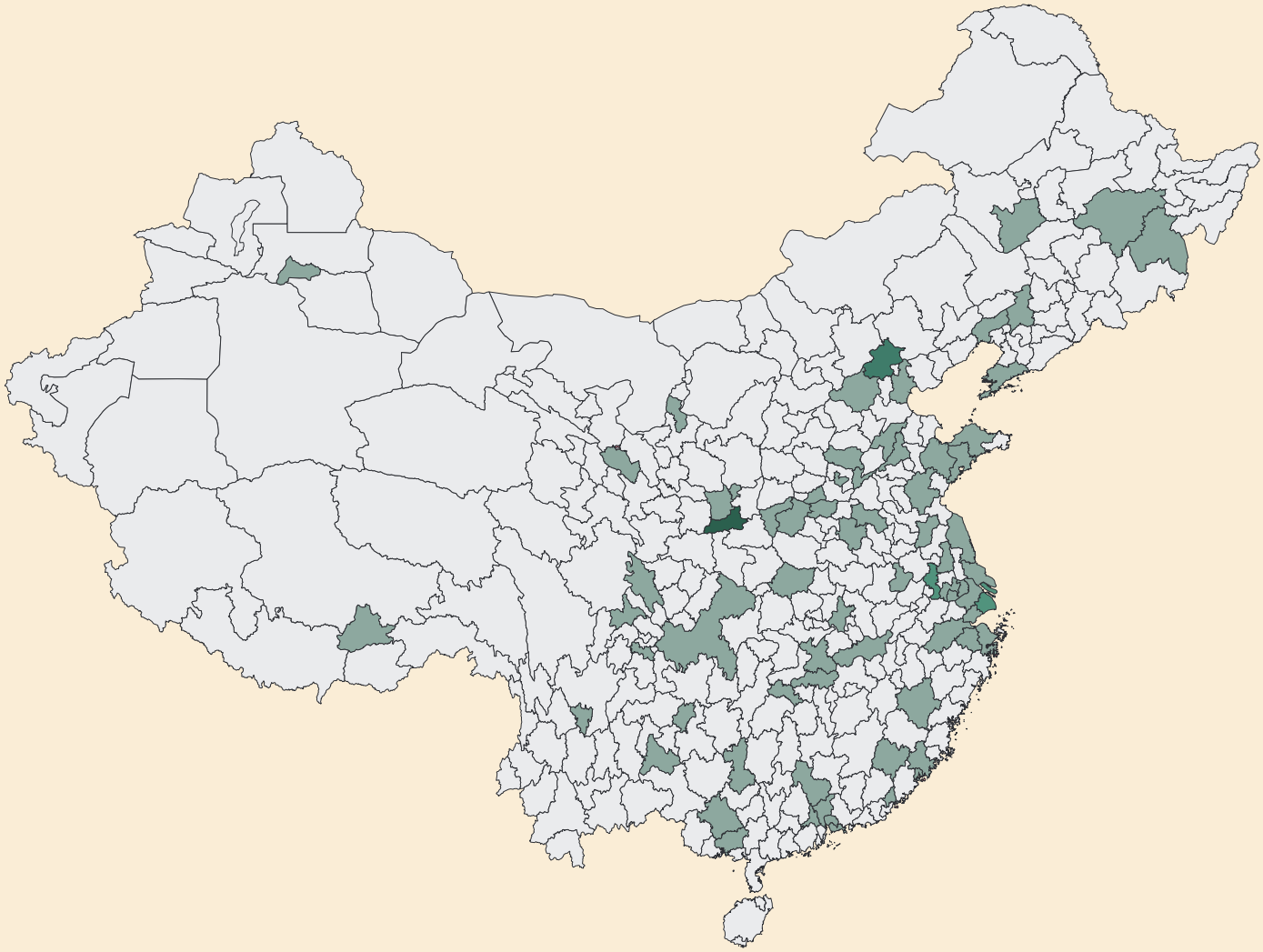
Investment Vehicles

The third group of actors is quasi-private investment vehicles, such as venture capital firms, private equity, and incubator funds. Not to be confused with state-administered MCF funds, investment vehicles stimulate entrepreneurship and support "indigenous innovation" across a wide range of sectors. There are six venture capital and private equity firms that have been explicitly lauded by MIIT as "implementing MCF development strategy, empowering market forces, and leading...military-civilian dual-use conversion."[81] Notably, while these firms appear to be privately owned, the ultimate beneficial owner of at least one is a municipal government committee and another is an offshoot of the Chinese Academy of Sciences mentioned above. Together, these six quasi-private investment vehicles wholly or partially own 232 companies, at an average of 39 investees per vehicle. China Venture Capital Co., Ltd. comprises over 40% of this total. While the vast majority of the recipients of MCF funds are wholly Chinese firms, some are Chinese-foreign joint ventures. One example is Aozon Electronic Material, an investee of China Venture Capital that professes to be a subsidiary of an unnamed "Australian experimental lab."[82]

中科创星	丰年资本	国鼎资本	西高投资	毅达资本	中国风投
Xi'an Chinese Academy of Sciences Innovation Technology Incubator Co., Ltd.	**Harvest Capital Management Co. Ltd.**	**Guoding Capital Group**	**Xi'an High-Tech Industry Risk Investment Co. Ltd.**	**Jiangsu Addor Equity Investment Fund Management Co., Ltd.**	**China Venture Capital Co. Ltd.***
Focus	**Focus**	**Focus**	**Focus**	**Focus**	**Focus**
Photonics Manufacturing	High-Tech Manufacturing	Information Equipment	Information Electronics	Advanced Manufacturing	Military Aviation
Artificial Intelligence	Advanced Technology	Information Security	New Materials Development	New Materials Development	Rapid Transportation
Big Data Processing	Military Manufacturing	Military Engineering	Advanced Manufacturing	Health Industry Products	New Materials Development

*There is more than one company in China using this English name. The company investigated for this research was 中国风险投资有限公司.
The listed areas of specialization are not exhaustive

Prominent Investment Vehicles



Geographical Distribution of Sample Companies by Type and Prefecture:
Investment Vehicles

Meet the Players

Private Dual-Use Manufacturers

The final group is private dual-use manufacturers that complement state-owned defense contractors. These companies sell both directly to the PLA and through partnerships with the defense contractors. Private companies principally contribute R&D and subcomponent production for China's military supply chains.[83]

This group of 27 companies listed on a national-level procurement platform has the smallest corporate footprint at 120 subsidiaries after a first-level ownership examination. Investigating the full corporate structure of these companies was outside the scope of the study. It is possible that this group may include subsidiaries of other entities in the sample. For example, one of the companies found in our selection, CRRC Shijiazhuang 7420 Factory (中车集团石家庄七四二零工厂), is a subsidiary of CRRC, the state-owned group examined in *From Civilian to Military Use* on page 47. This is a further indication of the persistent dominance of the sprawling state-owned defense contractors and may undercut the perceived diversification of China's military supply chains.

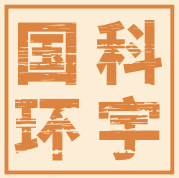
Guizhou Space and Electronics Holding Co., Ltd.

Industry Tags

- Aerospace Equipment
- Maritime Equipment
- Communications Technology
- Electronics Technology

Example Product:

Small-Scale High -Powered Sealed DC Electromagnetic Relays



Guoke Huanyu Space Technologies Co. Ltd. *

Industry Tags

- Information Technology
- Computing Technology

Example Product:

Solid State Hard Drives

Beijing Aerospace Measurement & Control Technology Co., Ltd.**

Industry Tags

- Electronics Technology
- Semiconductor Technology
- Machine Engineering
- Engine Machinery & Equipment

Example Product:

Autonomous Equipment Maintenance Support Systems

Ningbo Ship Group Co., Ltd. (sic)

Industry Tags

- Electronics Technology

Example Product:

Video-Capable Coaxial Cables

Jinan Changqing Applied Computing Co., Ltd.***

Industry Tags

- Reconnaissance & Surveillance Technology
- Information Technology
- Computing Technology

Example Product:

Dual-Band Infrared Flame Detector

Chengdu Phase Lock Electronic Technology Co., Ltd

Industry Tags

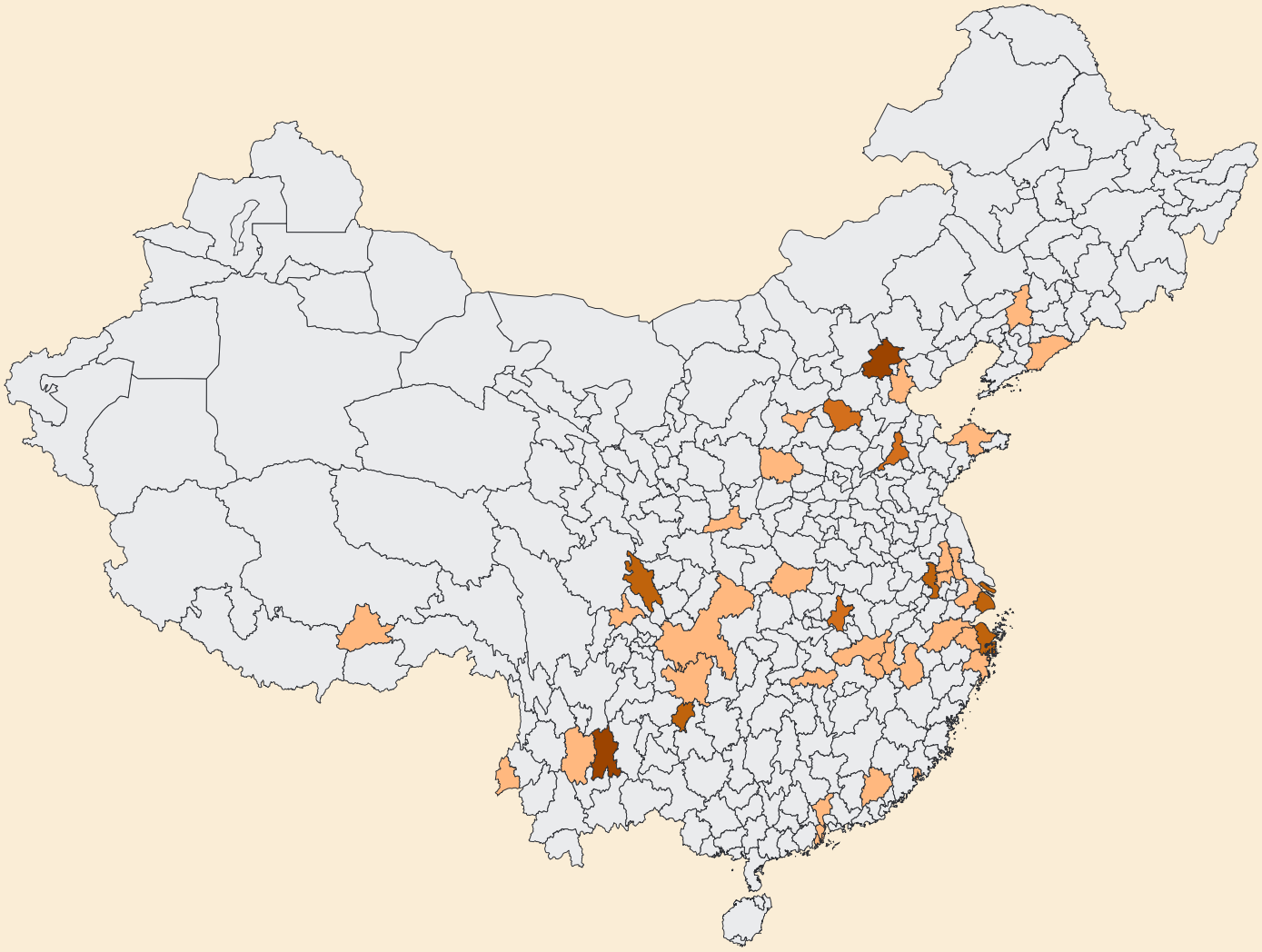
- Communications Technology
- Machine Engineering
- Testing Technology

Example Product:

Radar Testing Equipment

* Of the University of Chinese Academy of Sciences
** Of CASIC
*** Unofficial translation

Subset of Private Dual Use Manufacturers



Geographical Distribution of Sample Companies by Type and Prefecture:
Private Dual-Use Manufacturers

These four entity groups do not operate in isolation from one another, nor are their areas of operation always distinct. For example, subsidiaries of the state-owned defense contractors may serve as vehicles to stimulate private sector R&D.[84] The defense-related academic research institutions and their subsidiaries participate in procurement activities. Private dual-use manufacturers may participate in the production or testing of sensitive systems in special cases. In some cases, entities across multiple groups come together to collaborate. When assessing a potential acquisition or partnership, involvement of multiple actor groups may suggest an increased exposure to China's defense-industrial complex.

Civilian entities have stepped up to participate in defense supply chains. Increased participation is resulting in a more competitive and innovative marketplace; however, the PLA has created barriers to entry to ensure that what could be an unruly market responds to central direction. The next section discusses some of these barriers, such as the licensing system that governs participation in some of the most sensitive aspects of China's military supply chains.

Highlight

Relational Risk Signals[85]

The history and domestic business ties of Xi'an Bright Laser Technologies Co., Ltd. (BLT) exemplify how relationships between actors in China's defense ecosystem, and not just their activities, can raise red flags. Bright Laser Technologies is a metal additive 3D printing manufacturer based in the Xi'an Hi-Tech Industries Development Zone. It was born from both a Key State Laboratory and one of the Seven Sons universities and has received funding from a MCF investment vehicle. Further, it has commercial relationships with eight of the 11 state-owned defense contractors. Simultaneously, Bright Laser has been upgrading its research relationships with foreign firms in recent years. For more information, see *Relational Risk Signals* on page 55.

Risk Signals

China's defense economy has opened its doors to participation by a much broader segment of the industrial base. In doing so, the PLA, SASTIND, and other state bodies have created the systems through which Chinese companies access the market. These systems include barriers to entry like military production licenses and PLA inspections, as well as online procurement platforms and defense industry exhibitions. These systems are necessarily public-facing, and companies that actively participate in them often leave observable traces that can be used as risk signals when evaluating prospective Chinese-foreign business relationships. Below, several of these signals are discussed in detail. A list of all risk signals identified throughout the authors' research can be found in *Risk Signals: An Assessment Tool* on page 64.

In 2005, a licensing system was created to regulate participation in China's defense supply chains. SASTIND (then called COSTIND) implemented the "Measures to Implement Permission for Weapons Equipment Research, Development, and Production" (武器装备科研生产许可实施办法).[86] Through 2009, the regulation, which is periodically updated,[87] identified two categories. The first consisted of complete weapons systems, key subcomponents, and core support products. These licenses were restricted to state-owned firms.[88] The second category consisted of non-critical subcomponents and supporting products, which were open to private civilian manufacturers.[89] The system further distinguished between "military products" and "civilian products for the military."[90]

Depending on the type of product firms wish to produce, companies are required to apply for and receive up to four[91] licenses before researching, developing, manufacturing, or selling these products for or to the military. These military production licenses, called the Four Military Industry Permits (军工四证),[92] are exclusively available to Chinese-owned companies. Direct foreign ownership is forbidden, and even indirect foreign ownership over 20%[93] (including ownership by a Chinese national with a foreign spouse) renders a company ineligible.[94] Hong Kong, Macau, and Taiwan are all treated as foreign jurisdictions in the licensing system.[95]

武器装备科研生产单位保密资格证	**武器装备科研生产许可证**
Weapons and Equipment Research and Production Unit Classified Qualification Permit	**Weapons and Equipment Research and Production Certificate**
武器装备质量管理体系认证	**装备承制单位资格**
Weapons and Equipment Quality Management System Certificate	**Equipment Manufacturing Unit Qualification**

The Four Military Industry Permits

Whether a given company has two of the licenses—the Weapons and Equipment Quality Management System Certificate and Equipment Manufacturing Unit Qualification[96]—can often be found online by searching "GJB" alongside the company name. GJB is an abbreviation of "National Military Product Standards" (国家军品标准). A survey of 70 Weapons and Equipment Quality Management System Certificates suggests that they authorize companies to research, test, or produce a specific product or type of product. The license below allows Shenzhen Xinhua Tiantai Information Technology Company Ltd. (深圳市欣华天泰信息技术有限公司)—which claims to have a strategic partnership with South Korea's LG Electronics[97]—to "research and develop

data storage systems (individual cloud computing service, SD cards, and SSD cards) as well as computing applications and software and mobile phone applications."[98] In 2017, PLA Daily reported that "more than 1000" companies had been issued GJB licenses.[99] While certain companies choose to publicize their licenses, not all do so.


副本

北京天一正认证中心有限公司

国军标质量管理体系认证证书

兹证明

深圳市欣华天泰信息技术有限公司

质量管理体系符合

GJB 9001B—2009 标准

质量管理体系认证所覆盖的范围

数据储存系统（私人云服务器、SD 卡、SSD 卡）的研发；计算机应用软件、手机应用软件的开发。

中国航天

GJB9001B-2009 Weapons Quality Management Certificate for Shenzhen Xinhua Tiantai Information Technology Company Ltd. [100]

The licensing system has become more permissive over time, underscoring the Chinese government's objective of integrating civilian participation into defense supply chains. Indeed, the list of regulated products, called the Weapons and Equipment Research and Development Permit Catalogue (武器装备科研生产许可目录), has been reduced by 62% since 2015.[101] The latest update (which occurred in 2018) struck off 175 products governed by the licensing system, leaving 285 products requiring approval. [102] By 2018, the National Defense Intellectual Property Office of the CMC's Equipment Development Department had declassified over 7,000 national defense patents.[103] These patents were issued between 2015 and 2016, and cover dual-use materials, radar detection, satellite navigation, and telecommunications technology.[104] Thus, an increasing number of products can be manufactured without a specialized license. [105]

For the PLA and Chinese government, these licenses ensure that China's military services are only receiving vetted, trusted goods that meet a certain standard of production. For Chinese companies, the licenses likely serve multiple purposes. As they require a significant investment in resources, time, effort, and sensitive relationships, these licenses demonstrate a company's intent to participate in China's defense supply chains.[106] They can also show civilian consumers that the company produces high-quality goods. Finally, these licenses can indicate to potential business partners that the company is in good standing with the Party. For international observers, however, these licenses can signal that a company is currently participating in China's military supply chains.

Perhaps the most visible manifestations of MCF today are the interactions on dedicated military equipment procurement platforms. There are numerous national,[107] provincial,[108] and non-governmental[109] procurement platforms. These sites serve multiple functions, including connecting civilian enterprises with military counterparts and providing information on procurement requirements and regulations. Companies advertise their available products, while various military departments and units publish tenders requesting specific products. Through these platforms, the PLA hopes to harness civilian resources to fulfill military requirements. Interested parties can use the same information to screen companies of interest, as well as analyze military-civilian interactions in real time, as is described in *Selling to the PLA* on p.35. Private websites that aim to facilitate the entry of more Chinese companies into defense supply chains are also appearing. For example, the Comprehensive Demand Search MCF Technology Platform offers guidance on obtaining licenses, hosts articles on MCF's development and opportunities, and publishes what appear to be procurement tenders from government and military departments. Indeed, the PLA Daily ran an article decrying the number of unofficial MCF platforms that have appeared in the last few years and warned of fraud.[110]

Procurement platforms are just one pipeline for integrating civilian firms into the defense-industrial base. Other avenues include military embeds at civilian companies. For decades, the Chinese military has maintained a network of Military Representative Offices (MRO; 地区军事代表室), which serve to protect the interests of the PLA in civilian manufacturing. These representatives are tasked with ensuring contract compliance and maintaining quality control at factories and research institutes as civilian firms contribute to the military's research, development, and acquisition process.[111] Each service branch has its own representatives. For example, Wuhan Guide Infrared Co., Ltd. (武汉高德红外股份有限公司) has PLA Army, Navy, Air Force, and Rocket Force representative embeds at its facilities.[112] Companies without MRO embeds are still answerable to provincial and municipal military representatives, such as Shanghai's or Shenzhen's MRO, if they are working on defense contracts.[113]

As a national-level strategy, MCF attempts to harness civilian resources for military applications. To accomplish this goal, the PLA must continue to radically alter its opaque posture and operate in a market environment where leaving a public footprint is unavoidable. For their part, companies actively broadcast their desire and eligibility to engage in military supply chains to secure lucrative contracts. This results in discoverable PAI signals that can be used by researchers to determine a company's proximity to China's defense sector.

Notes 34-113

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71 National Enterprise Credit Information Publicity System 国家企业信用信息公示系统, http://gsxt.gdgs.gov.cn/.

72 National Enterprise Credit Information Publicity System 国家企业信用信息公示系统, http://gsxt.gdgs.gov.cn/.

73 "直属高校" [Subordinate Institutions], 中华人民共和国工业和信息化部 [Ministry of Industry and Information Technology of the People's Republic of China], http://www.miit.gov.cn/n1146322/n4423969/index.html, via Internet Archive, https://web.archive.org/web/20170214002342/http://www.miit.gov.cn/n1146322/n4423969/index.html (https://perma.cc/RX5E-48EV).

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75 Tai Ming Cheung, Fortifying China: The Struggle to Build a Modern Defense Economy (Cornell University Press: Ithaca, 2009).

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84 James Mulvenon and Rebecca Samm Tyroler-Cooper, “China’s Defense Industry on the Path of Reform: Prepared for the US-China Economic and Security Review Commission,” Defense Group Inc., October 2009, https://www.uscc.gov/sites/default/files/Research/REPORT_DGI%20Report%20on%20PRC%20Defense%20Industry111009.pdf (https://perma.cc/SP9F-ZNPK).

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89 Tai Ming Cheung, Fortifying China: The Struggle to Build a Modern Defense Economy (Cornell University Press: Ithaca, 2009); “中华人民共和国国防科学技术工业委员会令” [Order of the National Defense Science and Technology Industry Commission of the People’s Republic of China], 中华人民共和国中央人民政府 [The Central People’s Government of the People’s Republic of China], May 26, 2005, http://www.gov.cn/ziliao/flfg/2006-01/18/content_162254.htm (https://perma.cc/36ZE-J8SE).

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95 “武器装备科研生产单位保密资质认证” [Weapons Equipment Research and Production Unit Confidential Qualification Certification], 中国军民融合平台 [China Military-Civil Integration Platform], http://www.iptrm.com/views/content/junmin/introduction/front/detail_5.jsp (https://perma.cc/3W5Z-S3KX).

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102 Zou Weirong 邹维荣, “2018年版武器装备科研生产许可目录发布” [The 2018 Edition of the Weapons and Equipment Research and Production License Directory has been Released], 中国军网 [Chinamil Online], December 27, 2018, http://www.81.cn/bqtd/2018-12/27/content_9389660.htm (https://perma.cc/GEN8-B5WP).

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商业活动

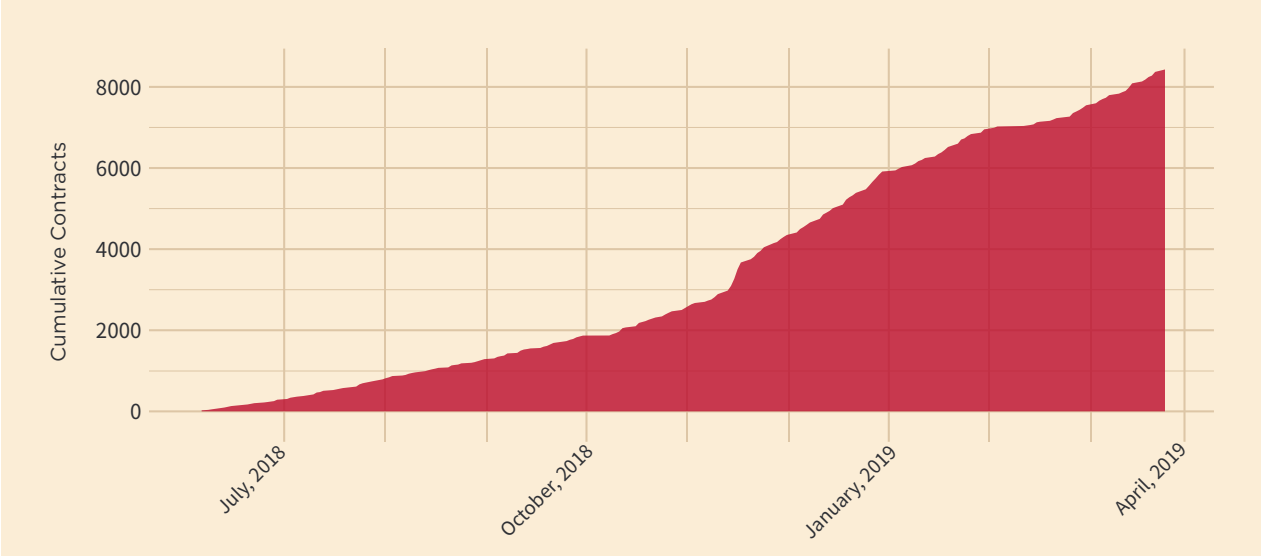
Commercial Activities

Military-Civil Fusion has compelled the PLA and state to become less secretive regarding the avenues through which Chinese civilian companies can enter the defense economy. Concomitantly, the strategy is also creating windows through which observers can evaluate the activities undertaken by the PLA and these companies in contributing to China's defense-industrial base. Specifically, observers can judge what technologies are being targeted for acquisition by the PLA and which companies are offering those products. The most visible manifestations of this activity are the national and provincial procurement websites, through which China has sought to implement a more competitive bidding process.[114] Once companies of interest have been identified, investigators can use trade and investment data to further explore their corporate risk profiles.

Selling to the PLA

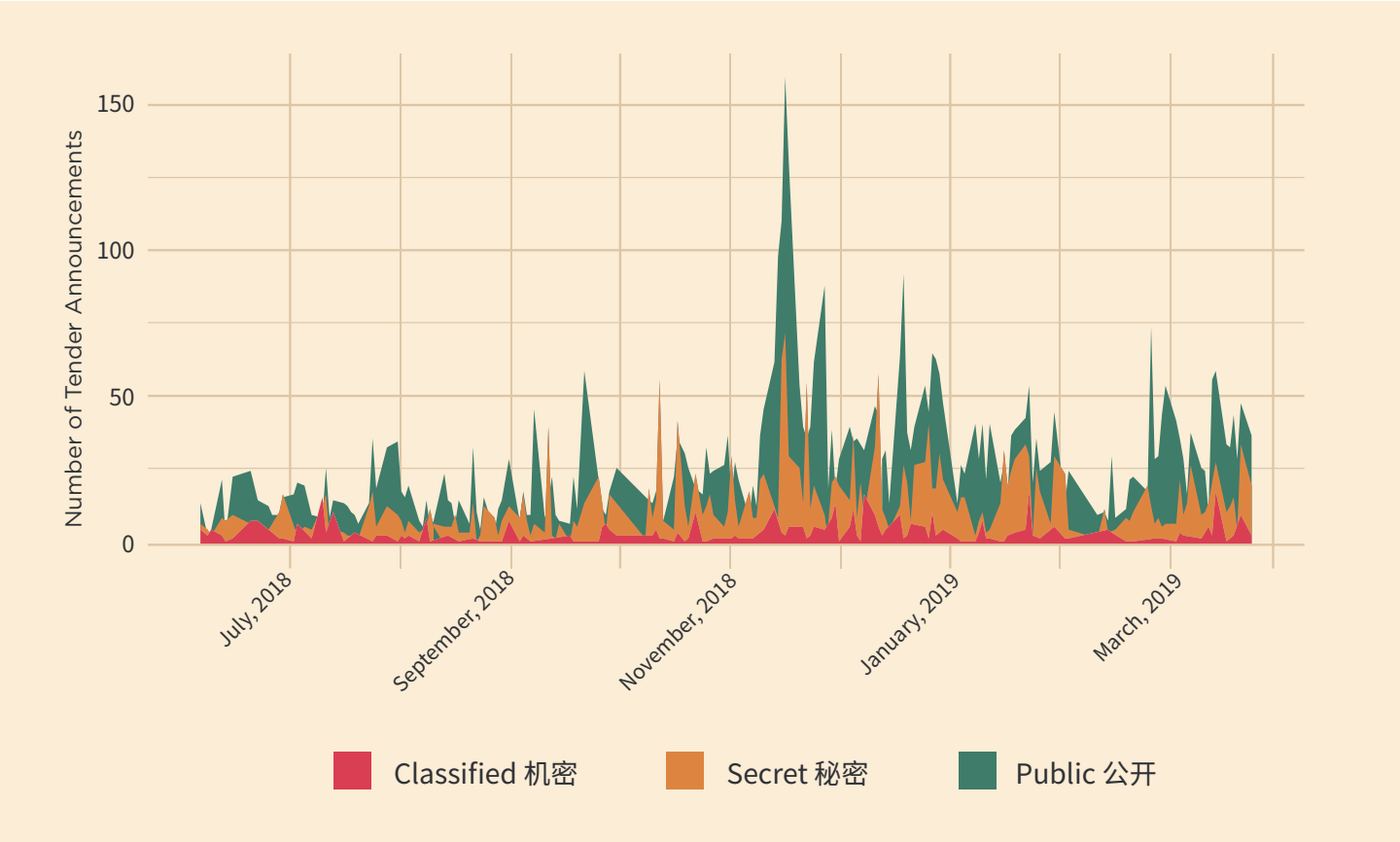
As mentioned above, online military equipment procurement websites facilitate private sector engagement in the military-industrial economy. Participation on these platforms is a clear and visible marker that a company is supplying products to China's armed services. For this report, the authors examined the underlying data for a national-level procurement platform, including procurement announcements, products categorized by keyword, and Chinese civilian suppliers.

The platform examined for this report publishes procurement announcements, including both tenders and notices of successful bidding.[115] In the 10 months between June 6, 2018 and March 26, 2019 (the timeframe of the data examined), the platform published 8,430 tender announcements.[116] Of these, 6,522 (77%) are invitations for bids on products. The remaining 1,908 announcements comprise award declarations for previously announced tenders. There is a slight but distinct upward trend in tender announcements on the site, suggesting stakeholders are actively engaging the platform. Nevertheless, there is a discrepancy between the number of tenders announced (6,552) and the number of awards published (1,908). It is unknown whether 71% of tenders go unfulfilled, are fulfilled through the procurement platform but not announced, or are fulfilled through external channels and not announced on the platforms.



Cumulative Tender Announcements Recorded Between 2018-06-06 – 2019-03-26

Tender announcements on the platform typically refer to the classification level of the tender itself. More than 60% are designated public (公开), 30% are secret (秘密), and just 7% are classified (机密). The remainder are either unspecified or contain a combination of the above terms. This distribution appears to fit ongoing attempts to declassify China's defense ecosystems.



Procurement platform tender announcements by classification, June 2018 through March 26, 2019

Notably, activity on the platform is relatively consistent, but may fall far below what the Party hopes to achieve. The timeline of announcements shown below reveals a surge in activity beginning in November 2018 and ending in December of the same year. Over just these two months, 40% of all announcements examined were published. The peak occurred November 16, one day after the Central Commission Office for the Development of Military-Civil Fusion released an assessment of MCF systems.[117] This surge of activity demonstrates the latent potential in MCF engagement and may suggest that these activities respond to Party signaling.

The platform's product section includes product name, industry category, supplier name, product keywords, and a product overview. This allows for the analysis of civilian participation within supply chains for specific types of goods and technologies. For example, there are 36 suppliers for one or more of 66 products containing the term "drone" (无人机) in its name or description. Similarly, there are 148 products which contain the word "infrared" (红外), supplied by 50 companies. In both of these markets (drones and infrared), the products offered by the top supplier account for over 20% of all products within the category. More general key words are also applicable: the platform includes 120 "intelligent " products ("智能") such as "intelligent weapon racks" ("智能枪弹柜") and "maritime environment monitoring platforms" ("中型海洋环境智能综合监测平台") offered by 93 unique suppliers. Investigations can rely on this information to target counterparties by product or service type, and examine others involved in similar offerings.

A Top Supplier to the PLA

Listing 259 products, Guizhou Space Appliance Co., Ltd. (贵州航天电器股份有限公司) is the procurement platform's top supplier. The company manufactures electrical components such as relays, connectors, and cables.[A] In its 2017 annual report, Guizhou Space Appliance highlighted MCF as a focus area, citing China's 13th Five Year Plan.[B] In 2008, the company's largest investor was listed as Stanford University,[C] despite Guizhou Space Appliance's identity as the 10th Research Institute of China Aerospace Science and Industry Corporation (CASIC).[D]

A "中国航天科工集团完成公司制改制 旗下上市公司望受益" [China Aerospace Science and Industry Group Completes Corporate Restructuring and its Listed Companies Hope to Benefit], 金融界 [Financial Sector Website], November 22, 2017, http://stock.jrj.com.cn/2017/11/22131223678579.shtml (https://perma.cc/U94S-H3EG).

B "贵州航天电器股份有限公司 2017 年年度报告全文"

C [Guizhou Space Appliance Co., Ltd., 2017 Annual Report], Sina.com, 2017, http://file.finance.sina.com.cn/211.154.219.97:9494/MRGG/CNSESZ_STOCK/2018/2018-4/2018-04-10/4205174.PDF (https://perma.cc/3JZN-8RXL); The report also lists deepening Military-Civilian fusion as a countermeasure to market fluctuations."贵州航天电器股份有限公司 2017 年年度报告全文" [Guizhou Space Appliance Co., Ltd., 2017 Annual Report], Sina.com, 2017, http://file.finance.sina.com.cn/211.154.219.97:9494/MRGG/CNSESZ_STOCK/2018/2018-4/2018-04-10/4205174.PDF (https://perma.cc/3JZN-8RXL); The report also lists deepening Military-Civilian fusion as a countermeasure to market fluctuations.

D "中国航天科工集团完成公司制改制 旗下上市公司望受益" [China Aerospace Science and Industry Group Completes Corporate Restructuring and its Listed Companies Hope to Benefit], 金融界 [Financial Sector Website], November 22, 2017, http://stock.jrj.com.cn/2017/11/22131223678579.shtml (https://perma.cc/U94S-H3EG).

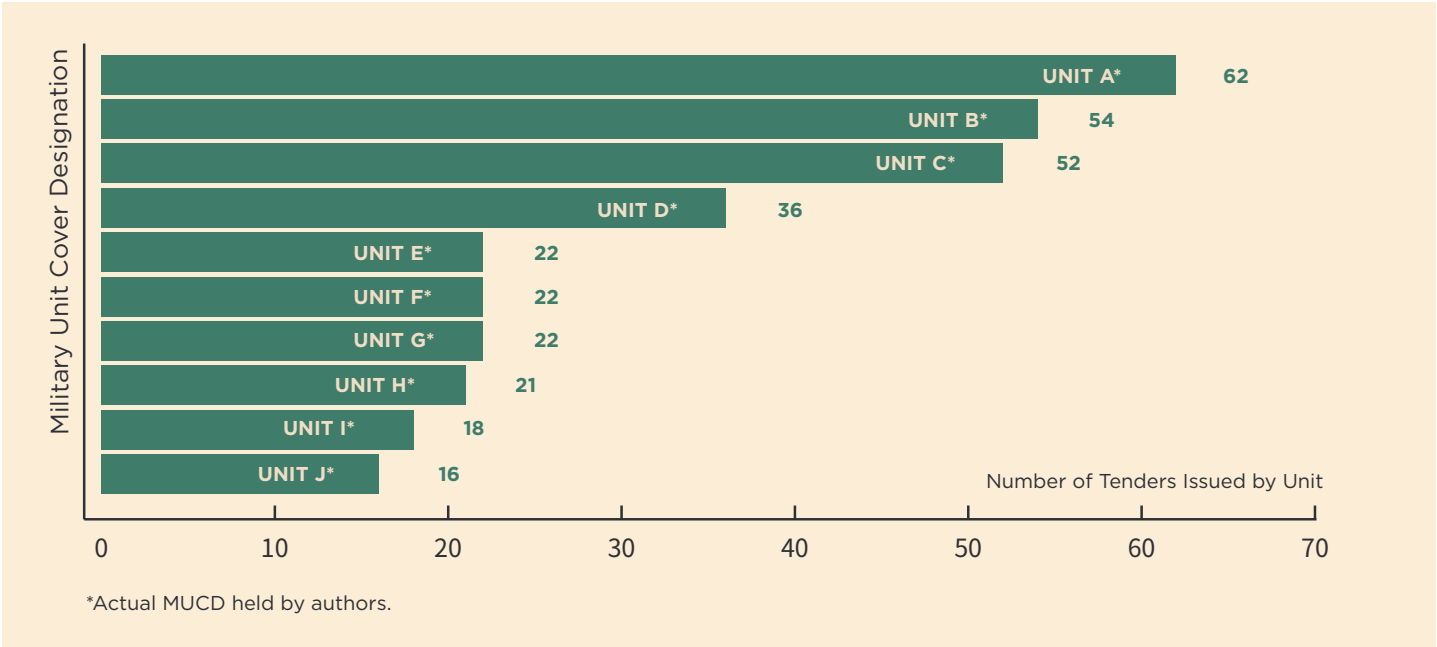
	Category (English)	Category (Chinese)	No. of Products
	Information Technology / Computing Technology	信息技术 / 计算机技术	694
	Electronics / Electronics Components	电子技术 / 电子元器件	638
	Mechanical Engineering / Advanced Manufacturing	机械工程 / 先进制造技术	523
	Communications / Communications Systems	通信 / 通信系统	491
	Aviation / Aviation Equipment	航空 / 航空设备	329
	Ship, Maritime / Ship Equipment	船舶、海洋 / 船舶设备	320
	Electronic Technology / Semiconductor Technology	电子技术 / 半导体技术	294
	Aerospace / Aerospace Measurement and Control Technology	航天 / 航天测控技术	293
	Safeguard Engineering Tech / Reliability, Testing, and Maintenance Support Technology	保障工程技术 / 可靠性测试性维修性保障性技术	287
	Information Technology / Information Systems	信息技术 / 信息系统	233
	Detecting, Tracking, and Reconnaissance Monitoring / Detection Technology	探测跟踪侦察监视 / 探测技术	233

Top Procurement Platform Product Categories by Number of Products as of March 2019

Researchers can also examine these products to derive information regarding the PLA's state of affairs. For example, the top two product categories (shown below) are information/computer technology and electronics, possibly reflecting the PLA's traditional weakness in high-tech goods and focus on pursuing enhanced digital warfighting capabilities.[118]

The public areas of the examined platform do not publish tenders or bids in full, nor do they typically release information on how to contact potential buyers directly. However, the titles of tender announcements occasionally point to the buyers' identity. Of the 8,430 tenders analyzed for this report, the title of 693 announcements referenced specific military unit cover designators (MUCD; 部队代号), a series of numbers used to obscure the identity of particular military units in public reporting.[119] In total, 113 unique MUCD are found in the sample. For example, procurement announcements for Unit 61886, allegedly one of the PLA's premier offensive cyber units, include air conditioning equipment, LEDs, as well as Huawei servers and storage equipment. In a separate example, another unit is listed on a tender from summer 2018 procuring ship targeting technology based on deep-learning. A follow-up announcement declares the tender fulfilled.[120]

The available data suggests that participation in MCF is increasing. By leveraging various sectors of the civilian economy, the PLA hopes to develop increasingly competitive and innovative supply chains. However, as evinced above, a byproduct of MCF has been increasing visibility into suppliers of the PLA. Guided by an understanding of MCF platforms and various ecosystems, observers can leverage PAI to glean insight into the composition and distribution of procurement activities within China.



Top 10 most frequent military units mentioned in procurement platform tender announcements

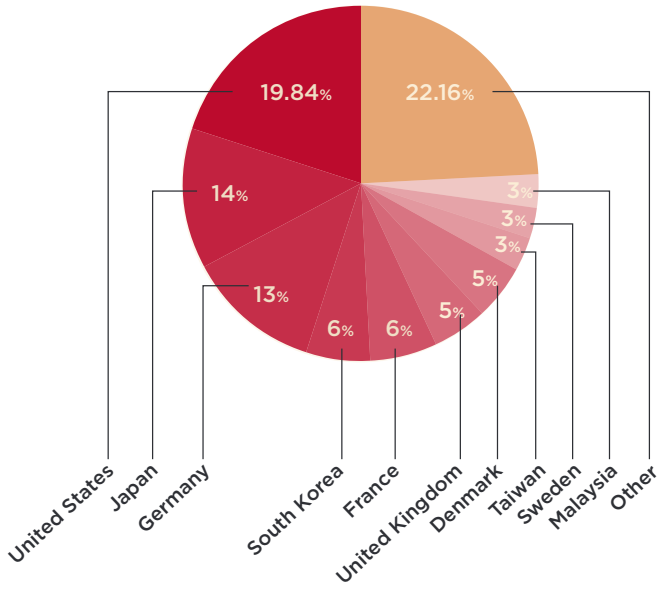
Buying from Abroad

In this section, the report examines trade and investment data for the 1,665 sample companies to evaluate foreign exposure to the Chinese defense-industrial complex. Available trade data revealed 136,507 individual imports or exports between April 2014 and April 2019 for the sample companies. A total of 66,182[121] shipments originated in China, bound for foreign markets, while a total of 65,727[122, 123] shipments were destined for China. As this study is focused on the potential ways in which foreign goods and technology may be incorporated into Chinese defense supply chains, trade analysis will center on Chinese imports rather than exports.

In total, just over 10%[124] of the sample companies were responsible for all the known import shipments. Commensurate with their size, capital, and influence, the 11 major state-owned defense contractors and their subsidiaries accounted for 74% of all shipments imported to China. Leading the pack were China State Shipbuilding Corporation (CSSC) and Aviation Industry Corporation of China (AVIC), with 25% and 21% of all imports, respectively. The investment vehicles and their associated corporate networks were the second largest group of actors to import goods to China, with 6,075 shipments. The defense-related academic research institutions and their subsidiaries were third, accounting for 5,718 incoming shipments. Lastly, private dual-use manufacturers participating in China's military equipment procurement platforms accounted for just 4%[125] of imports.

Notably, 79% of imports were shipped to the top 20 consignees, none of which are linked to the subset of private dual-use manufacturers extracted from the procurement platform. Fifteen of the consignees are state-owned defense contractors or their subsidiaries. The remaining top consignees consist of three investment vehicles and two defense-related academic research institutions. Taken with the statistics above, trade data further evinces the continuing primacy of these state-owned behemoths, despite the call for broader civilian participation in military supply chains. Interestingly, however, the companies linked to the investment vehicles are second most likely to engage in overseas procurement.

Top origin countries for imports



Comparing imports by country shows that 58% of the 65,727 shipments destined for China were shipped from just five countries. The most frequent origin country is the United States, and eight of the top 10 origin countries are US-allied states.[126] Most shipments in the available data include the HS code under which the shipment was made. Cross-referencing these with those found in the European Union's (EU) lists of export-controlled goods[127] reveals that participants in PLA supply chains may be procuring sensitive goods and technology. However, it should be noted that while export-controlled goods can be an indication of potential dual-use at the end market, even non-controlled goods could ultimately be adapted for military use. Thus, the use of broad HS codes is a means to assess risk. Although imperfect, HS code-based analysis has successfully led to the interception of sensitive goods and targeted sanctions enforcement.[128]

HS CODES

HS is an abbreviation for the Harmonized Commodity Description and Coding System, an international classification system for shipped goods. HS codes range from two- to six-digits in length and are progressively more specific as they get longer. However, even at their most specific, internationally recognized length (6 digits) they classify groups of products, not specific goods.[A] As a result, it is not possible to definitively identify shipment content.

A "What is the Harmonized System (HS)?", World Customs Organization, http://www.wcoomd.org/en/topics/nomenclature/overview/what-is-the-harmonized-system.aspx (https://perma.cc/75EX-HTPR).

In total, 40,157 shipments (61% of all imports) in the available data include HS codes for potentially dual-use goods. The top five potentially dual-use HS code matches include the categories of products shown below.

The top five countries of origin for possibly sensitive products (by number of shipments) remain the same as those of all imports. The potentially dual-use shipments account for approximately 60% of total exports from the United States, Japan, Germany, and South Korea.

HS CODE	DESCRIPTION	NO. OF SHIPMENTS	TOP ORIGIN (% of total HS Code exports)	SCREENING LIST(S)[129] (description in footnote)
848180	Taps, cocks, valves and similar appliances	1,365	Germany (22%)	Australia Group, Missile Technology Control Regime, Nuclear Suppliers Group, Wassenaar Arrangement,
854239	Electronic integrated circuits	1,135	Malaysia (15%)	Missile Technology Control Regime, Nuclear Suppliers Group, Wassenaar Arrangement
401693	Vulcanized rubber, gaskets, and seals	1,047	United States (17%)	Nuclear Suppliers Group
880330	Aircraft and spacecraft; parts of aeroplanes or helicopters	787	United States (22%)	Missile Technology Control Regime, Wassenaar Arrangement
732690	Iron or steel; articles n.e.s.[130] in heading no. 7326	768	United States (21%)	Missile Technology Control Regime, Nuclear Suppliers Group, Wassenaar Arrangement, Australia Group

Top Five EU Control List-matched HS codes

COUNTRY OF IMPORT	NUMBER OF POTENTIALLY DUAL-USE GOOD SHIPMENTS	DUAL-USE GOOD SHIPMENTS AS PERCENT OF TOTAL EXPORTS FROM COUNTRY
United States	7,407	57%
Japan	5,603	62%
Germany	4,975	60%
South Korea	2,433	58%
France	2,163	56%

Top origin countries for imports of potentially dual-use products

There are 413 shipments from Taiwan that fall under HS code 8542—electronic integrated circuits. These products hit on three export control regimes: the Missile Technology Control Regime, the Nuclear Suppliers Group regime, and the Wassenaar Arrangement, which seeks to prevent the proliferation of dual-use military equipment.[131] Nearly half of these shipments were sent to companies within the corporate network of China Electronics Corporation (CEC, 中国电子信息产业集团有限公司), a state-owned defense electronics manufacturer.[132, 133] Another 12% were shipped to investees[134] of Xi'an Capitech (西安高新技术产业风险投资有限责任公司), an investment vehicle discussed in *Relational Risk Signals* on page 55.

Japan and South Korea have the first and third rates of exposure to the PRC defense economy in terms of percent of potentially dual-use goods (rather than total number of exports), at 62% and 58%, respectively. There are 173 shipments of goods from Japan under HS code 852691—radio navigational aids. One recipient (of 22 shipments) was Jiangnan Shipyard Group, the China State Shipbuilding Corporation subsidiary currently constructing China's third aircraft carrier and other warships.[135]

While HS codes alone do not prove these products' military use, they do highlight that the corporate networks of companies participating in military supply chains are procuring, in large numbers, components that are at best within the same internationally-recognized product category as dual-use goods. Thus, trade data can be leveraged to accomplish three goals. First, it can, in combination with other indicators discussed in earlier sections, aid with assessing potential risks. Second, it can inform observers on possible weaknesses in export control regimes. Finally, it can potentially highlight technological gaps in the PLA's procurement.

Investing in Rivals

In addition to trade, investment is another form of engagement with the international community. As seen in both F*rom Civilian to Military Use* (p.47) and *Importing National Security* (p.51), Chinese companies seeking to expand their access to critical technologies do not shun opportunities to legally acquire or invest in foreign companies. Indeed, some observers allege there exists a "China Premium" in mergers and acquisitions, in which Chinese companies willingly pay higher prices to offset their limited brand power and the risks of government scrutiny derailing the deal.[136] Therefore, investment activity is an equally important pathway to consider when using PAI to assess Chinese defense industrial economies.

Searching the 1,665 sample companies through an investment database revealed 429 deals[137] occurring over a period of 10 years. The overwhelming majority of this activity (407 deals) understandably took place in China as domestic firms merged. Almost 75% of these takeovers were initiated by state-owned defense contractors. These giants not only dominate the opportunities of MCF and participation in the military industrial complex, but are also quickly absorbing smaller firms into their sprawling corporate structures. The investment vehicles likewise spent more than 4 billion USD in 100 domestic transactions over the last decade.[138] The investments of the defense-related academic research institutions and companies participating in the procurement platform were negligible in the available data, amounting to less than 1% of known deals.

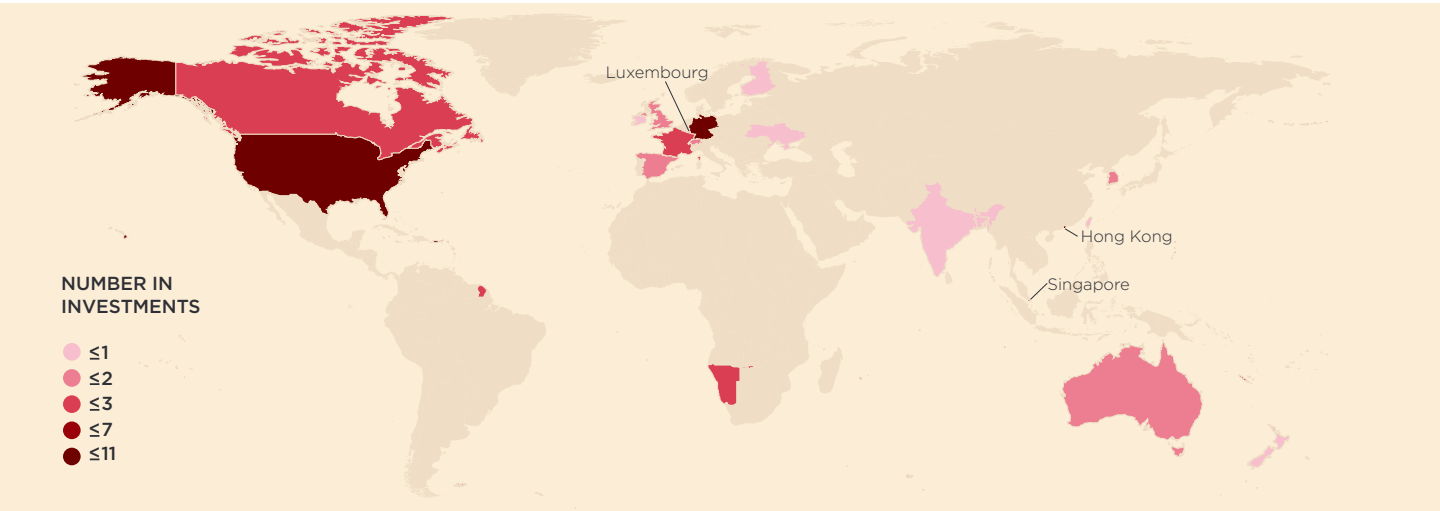
In the available investment data for the companies in the sample, only 22 deals involved acquisitions outside of China.[139] Outbound investment occurred between February 2011 and November 2018, and the majority was conducted after 2014. These transactions were distributed across nine destination countries: United States, France, Luxembourg, Spain, Germany, Namibia, Ireland, New Zealand, United Kingdom.[140] As with the domestic deals, overseas investment activity was overwhelmingly the work of companies in the state-owned defense contractors' corporate networks (21 of 22 deals).[141] The proportion of investments conducted by state-

owned defense contractors in the EIKON data is much higher than that observed by the American Enterprise Institute's (AEI) China Global Investment Tracker.[142] Out of 1,546 investments valued at over 100 million USD logged by the China Global Investment Tracker, 59.7% were made by companies that are majority-controlled by state-owned enterprises. [143]

Some of the international deals may warrant further scrutiny. Reuters reported that, in January 2016, the Chinese firm Aerospace Hi-Tech Holding Group acquired full ownership of Hiwinglux S.A and Navlight S.A.R.L., as well as 97% of International Electronics Engineering S.A.[144] These investments totaled nearly 250 million USD,[145] well over double Aerospace Hi-Tech's registered capital.[146] The products designed and manufactured by these companies include automotive surveillance sensors and electrical systems.[147] Together, Aerospace Hi-Tech's acquisitions owned a combined 96% of All Circuits SAS in France,[148, 149] a company "possessing globally leading manufacturing capacity in passenger identification and controlling systems,"[150] and allegedly the first electronics manufacturing services company in France.[151]

A European Commission staff working document emphasizes that Aerospace Hi-Tech is a publicly listed company.[152] While it is true that Aerospace Hi-Tech is listed on the Shenzhen stock exchange, Aerospace Hi-Tech's largest shareholder is CASIC,[153] a state-owned defense contractor. A job posting for Aerospace Hi-Tech describes the company as a "military-civil fusion hi-tech company," highlighting one of its core principles as working towards a "first-class army in China."[154] Although ultimately approved, the deal for All Circuits took 681 days to complete, a delay the staff working document attributes to "the strategic and indirect character of the acquisition."[155] Notably, this method of indirect acquisition was previously observed in the *From Civilian to Military Use* on page 47.

The question remains: why were so few international deals found among the sample companies? One explanation is that there are additional deals involving these corporate networks, but these transactions are occurring beyond the one-level buildout used to create this study's sample group of companies. Expanding the search to include one additional layer of ownership reveals an additional 116 transactions globally, while expanding the search to include the full corporate structures of companies involved in China's defense-industrial base, particularly those of the state-owned defense contractors, reveals almost 200 additional deals across 20 countries. While these additional transactions were not included in the above analysis for the sake of methodological consistency, they nevertheless constitute investment activity on behalf of the corporate networks of sample companies:



World map of overseas investment

	TOTAL NO. OF TRANSACTIONS	NO. OF TRANSACTIONS (IN CHINA)	NO. OF TRANSACTIONS (OUT OF CHINA)	NO. OF PARTY COUNTRIES
Sample Group, Parents, and Subsidiaries	429	407	22	9
Acquirer, Investor, or Parent (one additional layer)	545	508	37	15
Full Corporate Buildout	668	604	64	20

However, even when including the broader corporate network, only 64 international deals are observed between 2009 and 2019. The limited number of overseas acquisitions may suggest that the companies participating in dual-use manufacturing are not typically the companies that look beyond China's borders to acquire sensitive technology. Although this analysis shows these companies and their subsidiaries do occasionally venture abroad, it is plausible that there exist other vehicles for international acquisitions, which may achieve plausible deniability and decreased scrutiny. Nevertheless, monitoring investment behavior is critical to understanding which technologies might be at risk of entering China's defense economy.

Notes 114-155

114 Tai Ming Cheung, ed., "The Chinese Defense Economy Takes Off: Sector-By-Sector Assessments and the Role of Military End-Users," Study of Innovation and Technology in China Policy Briefs, 2013, http://dragonreport.com/Dragon_Report/Corp_China_files/504355.pdf (https://perma.cc/8V6N-NDJC).

115 The actual tenders themselves and the precise names of the buying or selling organizations are not always available. The notices are announcements that tenders have been issued and that they have been fulfilled.

116 These 8,430 tender announcements include 152 tenders with duplicative product descriptions, however these may still constitute separate requests for the same products.

117 "军民融合发展总体情况第三方评估顺利完成" [The Third-Party Military-Civilian Integration Development Review has been Successfully Completed], 新华通讯社 [Xinhua News Agency], November 15, 2018, http://www.xinhuanet.com/fortune/2018-11/15/c_1123720429.htm (https://perma.cc/5TQZ-WKRX).

118 Tai Ming Cheung, ed., "The Chinese Defense Economy Takes Off: Sector-By-Sector Assessments and the Role of Military End-Users," Study of Innovation and Technology in China Policy Briefs, 2013, http://dragonreport.com/Dragon_Report/Corp_China_files/504355.pdf (https://perma.cc/8V6N-NDJC).

119 Adamni, "Cover designation system for military units explained," PLA Corner, August 17, 2017 https://placornerblog.wordpress.com/2017/08/17/designators-of-military-units-explained/ (https://perma.cc/8466-LXYB); Peter Mattis, "Combing Through An Invaluable Resource On The People' s Liberation Army," War on the Rocks, February 16, 2016, https://warontherocks.com/2016/02/combing-through-an-invaluable-resource-on-the-peoples-liberation-army/ (https://perma.cc/89NK-LMCM).

120 Data and documents held by authors.

121 Includes 1,798 shipments to Hong Kong and 188 shipments to Macau from mainland China.

122 This includes 988 shipments to China for which the consignee was blank. It also includes 423 shipments from Hong Kong and 9 shipments from Macau to mainland China.

123 This excludes 4,143 rows for which the origin of a shipment to China was also listed as China.

124 171 companies

125 2,359 shipments

126 Treaty Affairs Staff of the Office of the Legal Adviser, "Treaties in Force: A List of Treaties and Other International Agreements of the United States in Force on January 1, 2019," United States Department of State, January 1, 2019, https://www.state.gov/wp-content/uploads/2019/06/2019-TIF-Bilaterals-6.13.2019-web-version.pdf (https://perma.cc/EF5L-FU3Z); Treaty Affairs Staff of the Office of the Legal Adviser, "Section 2: Multilateral Treaties and Other Agreements", United States Department of State, January 1, 2019, https://www.state.gov/wp-content/uploads/2019/05/2019-TIF-Multilaterals-web-version.pdf (https://perma.cc/XX3B-XDHM).

127 Missile Technology Control Regime is an export control regime aimed at preventing the spread of missile technology. Nuclear Suppliers Group is an export control regime aimed at preventing the spread of materials, equipment, and technology used for the production of nuclear weapons. Wassenaar Arrangement is an export control regime aimed at preventing the spread of dual-use technologies. Australia Group is an export control regime aimed at preventing the spread of materials and technology used in the production of chemical and biological weapons.

128 David Thompson, "Risky Business," C4ADS, Juen 12, 2017, https://c4ads.org/s/Risky-Business-C4ADS.pdf.

129 Missile Technology Control Regime is an export control regime aimed at preventing the spread of missile technology. Nuclear Suppliers Group is an export control regime aimed at preventing the spread of materials, equipment, and technology used for the production of nuclear weapons. Wassenaar Arrangement is an export control regime aimed at preventing the spread of dual-use technologies. Australia Group is an export control regime aimed at preventing the spread of materials and technology used in the production of chemical and biological weapons.

130 "n.e.s." stands for "Not elsewhere specified." Similarly, "n.e.c." stands for "Not elsewhere contained."

131 "About Us," The Wassenaar Arrangement, https://www.wassenaar.org/about-us/, (https://perma.cc/SG5J-8P68).

132 James Mulvenon and Rebecca Samm Tyroler-Cooper, "China' s Defense Industry on the Path of Reform: Prepared for the US-China Economic and Security Review Commission," Defense Group Inc., October 2009, https://www.uscc.gov/sites/default/files/Research/REPORT_DGI%20Report%20on%20PRC%20Defense%20Industry111009.pdf (https://perma.cc/SP9F-ZNPK).

133 Specifically, China GreatWall Technology Group Co., Ltd. (中国长城科技集团股份有限公司) and China Greatwall Computer Shenzhen Co., Ltd. (中国长城计算机深圳股份有限公司): http://www.gwoversea.com/about.html

134 Specifically, Xi' an Shenya Electronics Co., Ltd. (西安深亚电子有限公司) and Xi' an Microelectronics Co., Ltd. (西安智多晶微电子有限公司).

135 "江南造船厂产能有多强：10多艘神盾舰与航母同时开工" [How Strong is Jiangnan Shipyard' s Production Capacity: More than 10 Aegis Ships and Aircraft Carriers Start Construction at the Same Time], 新浪军事 [Sina Military News], March 14, 2019, https://mil.news.sina.com.cn/jssd/2019-03-14/doc-ihrfqzkc3727599.shtml (https://perma.cc/5VX7-MJCK).

136 Jan Bogaert, "China Newsletter: Challenges to Chinese Outbound M&A in the Year of the Rooster," Lexology, https://www.lexology.com/library/detail.aspx?g=4a2c5ffb-f2b6-4659-802f-3cb36c134053 (https://perma.cc/S5W6-TUH2); David Rothnie, "China Re-Defines the M&A Landscape," International Financing Review, 2016, http://www.ifre.com/china-re-defines-the-ma-landscape/21268269.fullarticle (https://perma.cc/AK36-CG9F); Fang Xue, Yuefan Wang, and Qi Yue, "Recent Trends and Issues in Outbound Acquisitions by Chinese Companies," The M&A Lawyer 10, No.10 (2016), https://www.gibsondunn.com/wp-content/uploads/documents/publications/Xue-Recent-Trends-and-Issues-in-Outbound-Acquisitions-by-Chinese-Companies-MA-Lawyer-December-2016.pdf (https://perma.cc/YAW5-BJXA).

137 In Thomson Reuters EIKON, "deals" refer to transactions a company has been involved in across different asset classes (loans, bonds, M&A, equity).

138 Thomson Reuters EIKON (2019)

139 The authors are aware of other transactions involving the companies in the original sample of companies that do not appear in the investment database used for this analysis. The analysis in this report relied on a third-party aggregator for investment data and another for trade data. Due to the potential for jurisdictional gaps and censored reporting, this data should not be considered comprehensive

140 Thomson Reuters EIKON (2019)

141 Thomson Reuters EIKON (2019)

142 China Global Investment Tracker, Database of Chinese Overseas Investment and Construction (2005 – Present) https://www.aei.org/china-global-investment-tracker/

143 China Global Investment Tracker, Database of Chinese Overseas Investment and Construction (2005 – Present) https://www.aei.org/china-global-investment-tracker/

144 "BRIEF: Aerospace Hi-Tech Holding Group Completes Acquisition of Three Firms," Reuters, November 6, 2016, https://www.reuters.com/article/idUSL4N1D81GE (https://perma.cc/KV8C-72QD).

145 "Aerospace Hi-Tech Acquires Electronic Automotive Assets in Europe and Scandinavia for RMB1.7bn," China Go Abroad, January 19, 2016, http://www.chinagoabroad.com/en/recent_transaction/aerospace-hi-tech-acquires-electronic-automotive-assets-in-europe-and-scandiavia-for-rmb1-7bn (https://perma.cc/2YGG-GP36).

146 National Enterprise Credit Information Publicity System 国家企业信用信息公示系统, http://gsxt.gdgs.gov.cn/.

147 "Our History," Company Website, https://www.iee.lu/en/about-innovation/our-company/our-history (https://perma.cc/Y8Q5-7TMP).

148 All Circuits Société par Actions Simplifiée, Statuts Constitutifs [All Circuits SAS, Articles of Incorporation], Les Greffes des Tribunaux de Commerce [The Registrars of the Commerical Courts], 2015-05-13.

149 Press Release: All Circuits, A Major Actor in The Field of Electronic Production in France, Enters A Significant New Era Through Its Acquisition by IEE S.A., July 1, 2015, http://www.mslcircuits.com/mediatheque/presse/ALL%20CIRUITS%20PRESS%20RELEASE.pdf

150 European Commission, "Commission Staff Working Document on the Movement of Capital and the Freedom of Payments," European Commission, November 4, 2018, https://ec.europa.eu/info/sites/info/files/2018-capital-market-monitoring-analysis-annex-1.pdf (https://perma.cc/H5YK-G9XR)

151 Company Website, http://allcircuits.com, (https://perma.cc/5MNK-YC9N); "The MMI Top 50 for 2018," newventureresearch.com/the-mmi-top-50-for-2018 (https://perma.cc/XN4N-DGK6).

152 European Commission, "Commission Staff Working Document on the Movement of Capital and the Freedom of Payments," European Commission, November 4, 2018, https://ec.europa.eu/info/sites/info/files/2018-capital-market-monitoring-analysis-annex-1.pdf (https://perma.cc/H5YK-G9XR).

153 Aerospace Hi-Tech is 11.16% owned by CASIC, a figure which jumps to 28.04% with the addition of CASIC' s wholly controlled subsidiary HiWing Tech Academy' s 16.88%, see National Enterprise Credit Information Publicity System 国家企业信用信息公示系统, http://gsxt.gdgs.gov.cn/.

154 "航天科技控股集团股份有限公司云南分公司" [Aerospace Technology Holdings Group Co., Ltd. Yunnan Branch], 智联招聘[Zhaopin], http://company.zhaopin.com/CZ726159390.htm (https://perma.cc/G6H3-HKJ8).

155 European Commission, "Commission Staff Working Document on the Movement of Capital and the Freedom of Payments," European Commission, November 4, 2018, https://ec.europa.eu/info/sites/info/files/2018-capital-market-monitoring-analysis-annex-1.pdf (https://perma.cc/H5YK-G9XR)

Case Study

Key Takeaways

- » IDAR in Practice
- » State Recognition for MCF Achievements
- » Military Manufacturing Licenses
- » Partnerships with Defense Research Institutions

For a review of these indicators, see: Risk Signals: An Assessment Tool on page 64

From Civilian To Military Use

In 2017 and 2018, news media citing unnamed "military" and "executive" sources revealed how military scientists were producing high-tech equipment for Chinese warships, including an Electromagnetic Aircraft Launch System (EMALS) for its aircraft carrier program and an electromagnetic railgun. The key to this innovation? British semiconductors "re-innovated" and manufactured in China.[156]

The story of how technology produced by UK-based Dynex Semiconductor wound up in the hands of PLA engineers, as assessed through PAI, reveals both how a civilian acquisition was co-opted for military purposes and how a state-owned Chinese locomotive firm transformed into a military equipment manufacturer.

In 2008, the state-owned China South Rail (CSR) Locomotive & Rolling Stock Corporation Limited[158] indirectly acquired 75% of Dynex Semiconductor. Hong Kong-listed Zhuzhou CSR Times Electric acquired the controlling stake in Dynex Semiconductor when it purchased the company's Canada-based parent, Dynex Power Inc.[159] China Economic Weekly—a publication of the CCP mouthpiece People's Daily—touted the purchase as China's first large overseas acquisition in the semiconductor industry.[160] Then-executive director and CEO of Times Electric, Lu Penghu, told reporters that the most important driver for

ELECTROMAGNETIC AIRCRAFT LAUNCH SYSTEM

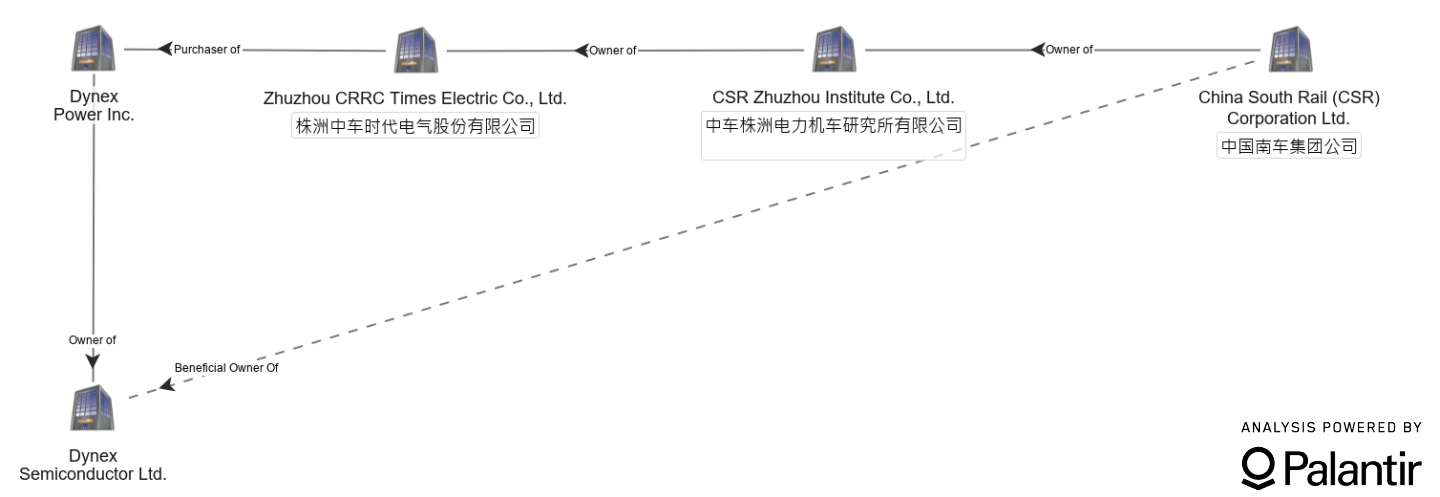
EMALS is an advanced aircraft catapult system used to assist the takeoff of a wide-variety of aircraft while also meeting the needs of increasingly digital and electronics-heavy warships.[A] The system could be particularly important for China, whose J-15 fighter jets are particularly heavy.[B] Its successful deployment will bring China's naval technology closer to near-peer status with the United States, which uses EMALS on its newest carrier class, the USS Gerald R. Ford.[C]

A https://www.defenseindustrydaily.com/emals-electro-magnetic-launch-for-carriers-05220/ (https://perma.cc/8D6V-VTNQ); https://www.military.com/defensetech/2007/04/05/emals-next-gen-catapult (https://perma.cc/27RL-R7T8)

B https://www.scmp.com/news/china/diplomacy-defence/article/2120391/chinas-aircraft-carrier-conundrum-hi-tech-launch-system (https://perma.cc/3LEF-WFJN)

C http://www.ga.com/electromagnetic-aircraft-launch-system (https://perma.cc/WJ4B-HRPL)

the investment was Dynex's R&D and production of insulated-gate bipolar transistors (IGBT)[161]—the same high-voltage semiconductor that allegedly enabled breakthroughs in China's EMALS production[162] and that China's MOST had designated as a critical technology in 2007.[163]



Dynex Beneficial Ownership Chain[157]

Possible EMALS and Traditional Steam-based Test Catapults at Huangdicun Base [164]

The deal was a watershed moment in domestic IGBT production.[165] It was portrayed as a win for China's locomotive industry,[166] and the deal may have been genuinely civilian in nature. Times Electric's stated goal was to combine Dynex's cutting-edge technology with CSR Locomotive's industrial base and capital.[167] To that end, Times Electric retained Dynex's staff and began rapidly expanding the company's R&D capacity.[168] According to a China Daily article re-published on Dynex's own website, Dynex's IGBT-focused R&D team grew from 12 to 40 people by 2013, including a contingent of researchers from China.[169]

In the year following Dynex's buyout, IGBT were written into the UK's Strategic Export Control List as dual-use goods per EU Regulation 428/2009.[170] However, new regulations failed to stop the transfer of expertise and technology to China. Times Electric began expanding the Dynex R&D team in 2010.[171] Beginning in 2012,

"Dynex's management team helped Times Electric construct a similar IGBT manufacturing facility in Zhuzhou, Hunan province, and shared the Dynex know-how and technology on IGBT semiconductor manufacturing with the team there," according to China Daily.[172] An article posted on Dynex's website reads: "the intellectual property rights of the newly developed semiconductor technology are shared between the two companies."[173]

The transfer of IGBT technology did not stop at Times Electric. China Youth Daily (the official newspaper of China's Communist Youth League) credited Times Electric's parent company,[174] CSR Zhuzhou Institute, with achieving breakthroughs in domestic IGBT manufacturing.[175] In 2013, Zhuzhou Institute brought together specialists and experts from around the country, including from the Chinese Academy of Sciences and Chinese Academy of Engineering (both of which are significant defense R&D research institutions)[176] to work out the development and domestic production of IGBT.[177] Zhuzhou Institute may have also drawn on previous international collaboration, having established the ZELRI-MSU Power Research Center with Michigan State University in the United States in 2005.[178] Then-CMC Vice Chairman Xi Jinping visited the Institute in 2011, where its chairman expressed that "under tremendous support of the central leadership of the Party, the State Council, and all levels of government, [Zhuzhou Institute] was vigorously participating in introduction, digestion, absorption, and re-innovation"[179]—or IDAR.

By the time Dynex and Times Electric were deepening their R&D collaboration in 2013, Zhuzhou Institute and CSR Locomotive's broader family of companies were becoming involved in defense R&D and production. That year, Zhuzhou Institute participated in an MCF observation tour of a Hefei defense industry *danwei* (军工单位)[180] at the request of the provincial-level MCF Promotion Office (see chart on page 6).[181] Also in 2013, a CSR subsidiary contributed to the development of what state media ordained as the world's largest super capacitor[182]—an energy storage technology with possible dual-use applications, including for high-energy consumption systems like EMALS and railguns.[183] At the same time, other CSR subsidiaries began obtaining military production licenses.[184] CSR Yuchai, a likely reference to Sichuan CSR Yuchai Propulsion Engine Co. Ltd. (四川中车玉柴发动机股份有限公司), won MCF recognition in 2014 as a "Top Ten Innovative Chinese Enterprise for Civilian-Military Dual-Use Goods" for its work on lubricants for high-speed propulsion engines.[185] One year later, Zhuzhou Institute was producing breakthroughs in naval technologies, with local media noting that the company had entered the "military vessel sector in recent years."[186]

Alleged Photograph of Chinese PLAN's Railgun in Testing

The relationship between Times Electric and its acquisition has only continued to deepen. In January 2019, Times Electric consolidated control over Dynex by purchasing all remaining public shares and privatizing Dynex Semiconductor's Canadian parent company.[187] CSR and its subsidiaries continue to expand their acquisitions and partnerships. Times Electric's buyout of Specialist Machine Developments (SMD) and its subsidiary, Soil Machine Dynamics, in 2015 appears to be repeating the same pattern of behavior seen with Dynex. SMD is a British subsea equipment, submersibles, and remotely-operated vehicles manufacturer.[188] Following the acquisition, Chinese media claimed SMD would establish a manufacturing base in China, just as Dynex had done for Times Electric.[189]

CSR's[190] actions were conducted within traditional systems of trade and investment. In fact, CSR did remarkably little to obscure its activities as they evolved. There were strong signals of its transformation from a civilian to a military supplier since at least 2013. CSR subsidiaries received approval for military production licenses.[191] It developed IGBT manufacturing through partnerships with defense-related academic institutions.[192] Its subsidiaries were receiving state praise for MCF achievements.[193] As of writing, British authorities do not appear to have publicly re-evaluated what may have amounted to an "Intangible Technology Export" of significant knowledge and expertise.[194] Moreover, CSR appears to have had foreign R&D partnerships in countries such as the US, UK, and Australia.[195, 196, 197] Regulators in these jurisdictions may consider a renewed assessment of CSR's partnerships and activities in light of its clear involvement in China's defense industry.

Case Study

Key Takeaways

- » IDAR in Practice
- » MCF-Oriented Business Strategy
- » Military Production Licenses
- » Partnerships with Defense Contractors
- » State-backed International Collaboration
- » Participation in MCF Organizations

For a review of these indicators, see Risk Signals: An Assessment Tool on page 64

Importing National Security

Beijing Highlander Digital Technology (北京海兰信数据科技股份有限公司) is a leading provider for the People's Liberation Army Navy (PLAN), which is actively and quickly building itself into a "world-class" navy.[198] Already, the PLAN is said to comprise more vessels than the United States Navy.[199] Private enterprise with international ties has been particularly critical to this effort, as "shipbuilding's commercial dual-use nature has long facilitated transfer and absorption of much foreign technology, standards, design and production techniques…."[200] This allowed China to "[leapfrog] key steps, focusing less on research and more on development, thereby saving time and resources and enjoying the most rapid growth in modern history."[201] Highlander is one company facilitating the rapid advancement of shipboard technologies available to the PLAN.

Highlander—a group of at least 21 Chinese corporate entities—is a producer of shipboard technology, maritime sensors, and oceanography instruments.[202] Its companies have or had subsidiaries, acquisitions, and R&D partnerships in at least 10 countries, including Germany,[203] Italy,[204] and Canada.[205] Chief among Highlander's business strategies is "Internationalization as a Driver of Localization."[206] Highlander's website describes this as actively pursuing international cooperation.[207] The company believes that market investment and acquisitions facilitate rapid development.[208] However, the People's Daily is more explicit in stating that Highlander has "established a unique 'dumbbell model' of international R&D," by which Highlander imports and combines foreign technology from two or more countries to then "re-innovates" new products in China.[209] In other words, Highlander employs the IDAR approach to defense innovation (see *Importing Innovation*, page 14).

In what was possibly its first international collaboration, Beijing Highlander reportedly partnered with the Swedish Consilium Group in 2004 to develop a critical piece of technology called a Voyage Data Recorder (VDR; 航行数据记录仪).[210] VDRs are safety devices that monitor and record data related to a vessel's activity, including "position, movement, physical status, command and control," much like an airplane's "black box."[211] Consilium Group and its principal VDR designer, Sal Navigation, are themselves leading suppliers for the Royal Swedish Navy and other world navies.[212] Consilium hasstated that the two companies began designing and manufacturing VDR with Highlander Digital Technology in China in 2004[213]—the same year that Highlander became a PLAN supplier.[214] Highlander's 2017 investor report explicitly states that it contributed technology for the Liaoning,[215] China's first aircraft carrier. Chinese media confirms that the contributed technology was VDR.[216]

Highlander's Chinese-language website clearly indicates that the company's products are sold to the PLAN, Chinese coast guard, fisheries administration, and other maritime-oriented Chinese government bodies.[217] The website and investor reports both confirm that the company holds the military production licenses required to develop critical technologies for military use.[218] In fact, MCF is another core pillar of Highlander's development strategy.[219] The standard model of Highlander companies is to rapidly produce military-use equipment from civilian product lines.[220] In addition to the Liaoning carrier, the company claims that it has on-boarded its products to "all models" of Chinese warships.[221]

Yet Highlander's English-language website does not include a single reference to the company's major defense clients or the company's MCF-focused strategy, except for a one-line reference to "coastguards" as recipients of its products.[222] The English-language version of Highlander's corporate history scrubs all mention of the PLAN and military production licenses. There is no list of awards revealing Highlander's other links to state-led MCF initiatives, unlike the Chinese-language site.[223] Among these awards is a certificate showing that Highlander is a Deputy Director of the MCF Industrial Alliance of Zhongguancun Science Park (中关村国家自主创新示范区)[224] in Beijing—a science and technology park whose MCF programs are led by a former deputy director of the PLA's Second Artillery Force (中国人民解放军第二炮兵).[225]

The above certificates from Highlander's website declare the company deputy director of a MCF industrial alliance and its status as a Beijing City International Science and Technology Cooperation Base[226]

Also missing from Highlander's English website is another pillar of its business model: "One Support System."[227] Highlander's declared mission is to support the Chinese state in implementing its maritime great power strategy, MCF, and other policies. To do so, Highlander actively seeks collaborative relationships with state-owned defense contractors.[228] Speaking at a symposium for military industry and national defense enterprises in March 2019, Highlander's chairman claimed the company had "united with a central state-owned military contractor to set up a maritime information service company, a shining MCF project."[229] He also announced that through "the acquisition of foreign maritime technology companies [Highlander would] fill the nation's [technological] gap."[230]

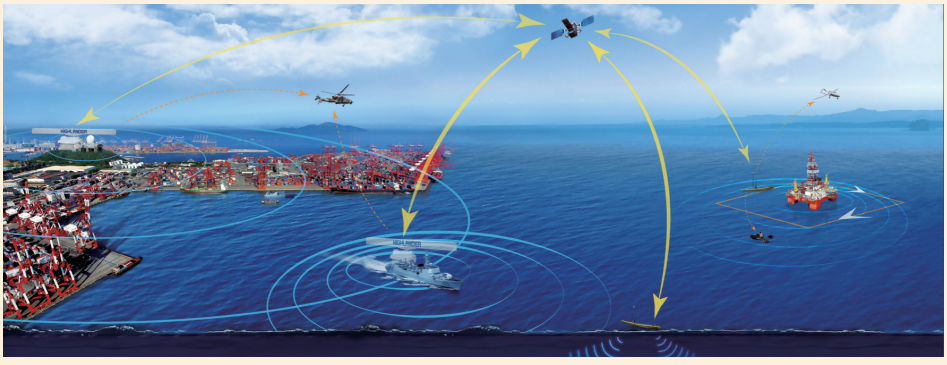
Highlander's support for the state is reciprocated. Highlander's 2014 report to investors indicates the company was the recipient of approximately 150,000 USD from the MCF fund in Beijing's Haidian district.[231] Highlander's chairman has stated that Highlander is "the beneficiary of support and encouragement derived from the Beijing Municipal Science and Technology Commission (北京市科学技术委员会)," [232] which designated the company an International Science and Technology Cooperation Base (国际科技合作基地) in 2013.[233] More specifically, a company spokesman stated in 2014 that "the foreign resources of the Beijing Municipal Science and Technology Commission's International Cooperation Office create an excellent platform for international exchange.... [and have] assisted the company in finding partners and opportunities for overseas collaboration."[234]

In Italy, for example, Highlander partnered with AIDOS Systems S.R.L. with the support of Chinese government programs.[235] AIDOS is a radar and telecommunications engineering firm that receives European Regional Development Funds[236] meant to "strengthen economic and social cohesion in the European Union" by stimulating research and innovation.[237] The Beijing Municipal Science and Technology Commission, a city-level body under MOST, allegedly arranged the collaboration.[238] The relationship was further facilitated by

the China-Italy Technology Transfer Center, a MOST country-level program,[239] to jointly develop x-band radar antennae sometime between 2012 and 2015.[240]

In addition to directly selling to the PLAN, Highlander further serves as a gateway between international business and China's defense contractors. The company is currently working to develop "intelligent" ships in collaboration with Shanghai Merchant Ship Design and Research Institute (上海船舶研究设计院), a civilian-shipping subsidiary of state-owned defense contractor China State Shipbuilding Corporation (中国船舶工业集团公司).[241] Highlander claims that its efforts are in support of the "Intelligent Ship Development Action Plan (2019-2021)" (智能船舶发展行动计划(2019-2021年)).[242] Never far from its IDAR roots, Highlander purchased 51% of Germany's Rockson Automation in 2016,[243] whose flagship product is an automated shipboard monitoring, alert, and response system that interfaces with ship controls.[244] Highlander is further leveraging Rockson technology for inertial navigation systems,[245] which it began researching in Italy in 2014 at an R&D center established during the AIDOS partnership.[246, 247] Inertial navigation systems are featured in nearly all modern defense technologies, from missiles, to aircraft, to warships.[248]

Other examples of Highlander's investment in maritime technology include its Subsea Observatory Network (海底观测网).[249] The system consists of an on-shore monitoring station that communicates with equipment on the ocean floor.[250] Chinese media has emphasized the military application of such a system in tracking and deterring incursion into Chinese waters by enemy submarines.[251] Highlander alludes to the military orientation of its subsea network on the cover of its promotion materials, which read: "contribution to the ocean, devotion to national defense" (贡献海洋，献身国防).[252] The technology allegedly leverages the capabilities of "Highlander OceanWorks" (海兰信OceanWorks)[253]—a reference to Canada-based subsea technology company OceanWorks International Corporation.[254] Highlander's director, Shen Wanqiu (申万秋) personally acquired control over OceanWorks in 2016 "through a network of front companies" for the specific purpose of developing its subsea observation network.[255] Canadian authorities ordered an unnamed "BEIJING COMPANY" (likely Highlander) to divest from OceanWorks in 2017 according to US Department of Justice document, and OceanWorks' former director is currently under indictment in the United States for knowingly transferring information on US naval systems to the PLAN through "BEIJING COMPANY."[256]



Highlander's national near-seas radar network as depicted in a company brochure[257]

Highlander is also working on a maritime surveillance radar network,[258] possibly with Russian technology. This network is called the Intelligent Radar Monitoring System (智能雷达监控系统) or National Near-Seas Radar Network (全国近海雷达网). It claims to track ships and aircraft by integrating CCTV, AIS, GPS, and small-target radar.[259] Although Highlander does not directly reference foreign collaboration in the development of these monitoring capabilities, small-target radar detection systems have been a focus of the company's collaborations with Russia's Sinftech.[260] The network is currently set up in at least four provinces: Shandong, Zhejiang, Fujian, and Hainan.[261] Promotional materials do not explicitly reference military applications, but images of Chinese warships and military helicopters are seen in explanatory depictions.[262] Such a system, if integrated with PLA surveillance mechanisms, could improve China's coastal and near-seas defense infrastructure.

Highlander is a prime example of a privately-held Chinese company that is deeply committed to supporting national defense through MCF and IDAR. Highlander has been an overt participant in PLA supply chains for years. Despite certain possible bad faith representations of intent and the use of alleged "front" companies, as detailed in the US Department of Justice's indictment mentioned above, all of Highlander's activities have taken advantage of licit channels of trade and finance. As a publicly traded company on the Shenzhen stock exchange,[277] Highlander's activities are relatively well documented in Chinese media and in its investor reports.[278, 279] Indeed, Beijing Highlander Digital Technology Co., Ltd. and its overseas partners are even thoroughly detailed in a profile on the Zhongguancun Yunti Technology Innovation Alliance's website.[280] The burden is on foreign countries and companies to conduct enhanced due diligence to ensure these clear and visible signals are properly understood.

COUNTRY	COMPANY	PURPOSE
Singapore	--	Distribution & Sales [263]
Norway	DNVGL[264]	--
	MARIS [265]	IMO approval for ship-board radar
	Ship Equipment [266]	Maritime broadband systems
Sweden	Consilium [267]	Voyage data recorder
Denmark	Thrane [268]	Integrated maritime communication modules
UK	Cobham [269]	Hi-Cloud (海兰云) Vessel and Maritime Domain Awareness Information Platform[270]
Australia	Speedcast [271]	Hi-Cloud (海兰云) Vessel and Maritime Domain Awareness Information Platform [272]
Italy	AIDOS Systems S.R.L [273]	Navigation radar, R&D center
Germany	Rockson Automation [274]	Inertial navigation systems, Intelligent ship development
Russia	Sinftech [275]	Small-target detection radar systems
Canada	OceanWorks [276]	Subsea observation technology

Highlander's Foreign Acquisitions and Partnerships

Case Study

Key Takeaways

- Partnerships with State-Owned Defense Contractors
- Shared Corporate Network with Key State Laboratories
- Military Production Licenses
- Collaboration with Defense-Related Academic Institutions

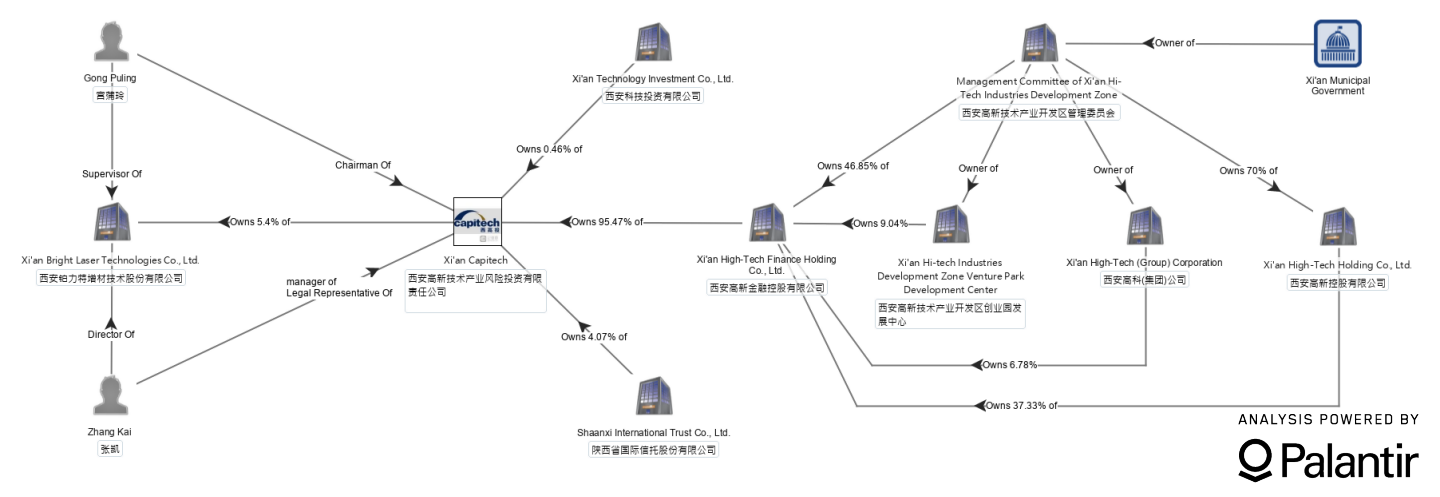
For a review of these indicators, see Risk Signals: An Assessment Tool on page 64

Relational Risk Signals

The complex relationships between actors in the defense-industrial base blur the distinction between commercial and military ventures. One company that engages both civilian and defense partners is Xi'an Bright Laser Technologies Co., Ltd., an ostensibly private company specializing in metal additive manufacturing, or 3D printing.[281] Bright Laser produces components for a wide variety of items—automobiles, electronics, aviation systems, and satellites—and counts Airbus and Safran, two European aerospace manufacturers, as its research partners.[282, 283, 284] At the same time Bright Laser also works with eight of China's 11 major state-owned defense contractors[285] and has foundational ties to Northwestern Polytechnical University (NPU), one of the Seven Sons of National Defense.[286, 287, 288] Thus, this case highlights how enhanced due diligence can evaluate business relationships and corporate history to build a deeper risk assessment.

Bright Laser's history reveals deep and enduring ties to China's defense-industrial base. On the Chinese-language version of its "About Us" page, Bright laser boasts of having won a first and a second prize of the National Defense Science and Technology Awards through two separate projects in 2017.[289] Bright Laser's founder and president, Huang Weidong, created the company in 2011 with the express purpose of commercializing the output from NPU's Key State Laboratory of Solidification Processing (凝固技术国家重点实验室).[290, 291, 292, 293] The laboratory describes itself as primarily serving national defense demands for critical materials in the aviation and aerospace domains.[294] This aligns with NPU's broader focus on aviation, space flight, navigation, and ordnance.[295, 296] The university's alumni were critical engineers on the Chengdu J-series fighter jet (including the J-10) developed by AVIC.[297] Today, the laboratory continues to provide "technical support" to the company.[298]

In addition to links to eight state-owned defense contractors, one of the Seven Sons of National Defense, and a Key State Laboratory, Bright Laser also receives funding from Xi'an Capitech, one of six investment vehicles lauded by MIIT for their contribution to MCF.[300] Capitech is owned by the Xi'an municipal government through a series of management companies, as shown above,[301] and emphasizes investments in companies developing aerospace and military electronics and satellite communication and navigational equipment.[302] In 2016, Capitech acquired a 5.4% stake in Bright Laser for nearly 500,000 USD.[303] Beyond its investment, Capitech also shares two corporate officers with Bright Laser. Capitech's chairman Gong Puling (宫蒲玲) is a supervisor on Bright Laser's board of directors, [304] and Capitech's legal representative and manager Zhang Kai (张凯) is a director on Bright Laser's board.[305]



Bright Laser and Xi'an Capitech Ownership Map[299]

Finally, Bright Laser is located in Xi'an's Hi-Tech Industries Development Zone (西安高新技术产业开发区), a MIIT-designated innovation base.[306] Like many of these bases, the Zone's administrative structure includes a MCF department responsible for establishing dual-use projects.[307] Bright Laser makes no secret of its involvement in China's defense supply chain. The English and Chinese versions its corporate website both indicate that the company possesses at least one of four military production licenses (see *Relational Risk Signals* page 55).[308] The company's principal MCF achievement appears to be manufacturing the world's largest laser-printed titanium alloy structure for China's first large passenger plane, the C919.[309]

Bright Laser is growing the nexus between foreign civilian companies and the broader Chinese defense sector through its international collaborations. This is occurring via cooperative R&D partnerships. For example, Bright

THE C919

The C919 is China's first large domestically designed and manufactured passenger jetliner, which China hopes will one day compete with Airbus and Boeing.[A] The C919 is frequently lauded as a MCF achievement. Chinese and foreign observers have speculated that the plane could be used for radar or early warning systems by the PLA Air Force.[B] Although the aircraft marks a significant advance in China's domestic manufacturing capabilities, it is nevertheless reliant on many foreign systems from over 15 international companies.[C] The plane belongs to Commercial Aircraft Corporation of China (COMAC), a state-owned civilian aviation company that was established in part because the "Chinese government hoped or believed that Western (especially U.S.) strictures on exports of technologies would be looser if foreign companies were dealing with an exclusively commercial aircraft manufacturer" rather than defense contractors.[D]

A http://paper.people.com.cn/rmrbhwb/html/2017-02/18/content_1751264.htm (https://perma.cc/8NAV-ECMF)

B http://www.zgccmichallenges.cn/html/2017/movement_0924/14.html (https://perma.cc/7TVT-TYK3); https://www.scmp.com/news/china/diplomacy-defence/article/1859958/military-mission-wings-chinese-civilian-aircraft

C https://www.scmp.com/business/article/2093122/chinas-narrow-body-jet-c919-makes-maiden-flight-shanghai (https://perma.cc/9BUQ-EFVU); https://mil.news.sina.com.cn/jssd/2019-03-14/doc-ihrfqzkc3836542.shtml (https://perma.cc/N3MT-83GK)

D Keith Crane, Jill E. Luoto, Scott Warren Harold, David Yang, Samuel K. Berkowitz, and Xiao Wang, The Effectiveness of China's Industrial Policies in Commercial Aviation Manufacturing, (RAND Corporation, 2014), https://www.jstor.org/stable/10.7249/j.ctt6wq85j.9?seq=8#metadata_info_tab_contents (https://perma.cc/HV8F-5WFB).

Laser, China Aviation Supplies Holding Company,[311] and Safran[312] signed such a cooperation agreement in 2014.[313] In another example, Bright Laser celebrated upgrading its relationship with Airbus from "sole supplier of additive manufacturing in Asia" to a full research partnership. [314] Around the same time, the company signed a cooperative agreement with NPU and Airbus (Beijing) Engineering Technology Center Co. Ltd. [315, 316] Airbus Beijing's general manager Michael Van Tran described the agreement as focusing on "the development of new technologies in the field of aviation, and contribut[ing] to the development of aviation industry in China."[317] Yet this agreement also risks drawing Airbus further into China's defense innovation ecosystem. Domestically, Bright Laser reportedly manufactured components for a solid-fuel small satellite launcher, Jielong-1 (捷龙一号), the country's "first commercial carrier rocket." This product was developed and produced using a "pure commercialization" (纯商业化) method of social financing and competitive bidding.[318, 319, 320]

C919 Under Construction and Completed [310]

Bright Laser's relationships with other actors in China's defense economy and numerous other risk signals identified in this report should raise questions regarding foreign partners' exposure to the Chinese defense economy. Of the actor groups identified in Meet the Players, Bright Laser has significant relationships with all four. Bright Laser is a private dual-use manufacturer.[322] It is the commercial arm of a Key State Laboratory for military technology at one of the Seven Sons of National Defense.[323, 324, 325] It is the recipient of, and shares corporate officers with, an investment vehicle known to fund MCF projects.[326] It works with many of the top state-owned defense contractors[327] and has a research partnership with at least one of them.[328] In addition to its relationships with these four actor groups, Bright Laser also possesses a military production license[329] and is located in a high-tech demonstration zone with a MCF office.[330] Finally, Bright Laser advertised its presence at the 12th Zhuhai Air Show (2018),[331] a world-renowned defense exhibition held in China every two years. The abundance of risk signals in this case highlight the need for international companies to assess their tolerance for regulatory or reputation risk, as the results of joint R&D with international companies may bleed into Chinese national defense projects.

Bright Laser Technologies Announces their Partnership Agreement [321]

Notes 156-331

156 Minnie Chan, "China' s Aircraft Carrier Conundrum: Hi-Tech Launch System for Old, Heavy Fighter Jets," South China Morning Post, November 19, 2017, https://www.scmp.com/news/china/diplomacy-defence/article/2120391/chinas-aircraft-carrier-conundrum-hi-tech-launch-system (https://perma.cc/3LEF-WFJN); Garth Corfield, "Brit Semiconductor Tech Ended Up in Chinese Naval Railgun – Report," The Register, March 5, 2018, https://www.theregister.co.uk/2018/03/05/dynex_semiconductor_china_railgun/ (https://perma.cc/YAW3-QQPD).

157 National Enterprise Credit Information Publicity System 国家企业信用信息公示系统, http://gsxt.gdgs.gov.cn/; Canadian Corporate Registry, UK Companies House

158 China South Rail Locomotive & Rolling Stock Corp. merged with China North Rail Locomotive & Rolling Stock Corp. in 2016 to form CRRC Corporation Limited. Thus, all companies described above using the name "CSR" now use "CRRC." For example, Zhuzhou CSR Times Electric now does business as CRRC Zhuzhou Times Electric.

159 "轨道交通首例海外并购:时代电气鲸吞丹尼克斯" [Rail Transit' s First Overseas Acquisition: Times Electric Absorbs Dynex], 新浪财经 [Sina Finance], http://finance.sina.com.cn/stock/hkstock/ggscyd/20081219/03485657155.shtml (https://perma.cc/VM2W-M4KV); "Discloseable Transaction: Proposed Acquisition of Dynex Power, Inc. [by Zhuzhou CSR Times Electric Co., Ltd]," Times Electric Company, September 19, 2008, http://www.tec.crrczic.cc/Portals/2/pdf/LTN20080919017.pdf (https://perma.cc/SFX7-Y55J).

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162 Minnie Chan, "China' s Aircraft Carrier Conundrum: Hi-Tech Launch System for Old, Heavy Fighter Jets," South China Morning Post, November 19, 2017, https://www.scmp.com/news/china/diplomacy-defence/article/2120391/chinas-aircraft-carrier-conundrum-hi-tech-launch-system (https://perma.cc/3LEF-WFJN); "电磁弹射技术原理与主要应用" [Principle and Main Application of Electromagnetic Ejection Technology], 华夏幸福 [Huaxia Well-Being], May 28, 2019, http://www.cfldcn.com/research/industry-insight/2019/06/21/2380.html (https://perma.cc/6V7D-QBYZ); "中国航母为何必须用电磁弹射器?一个重要原因令人心酸" [Why do Chinese Aircraft Carriers Use Electromagnetic Catapults? An Important Reason is Heartbreaking], 每日头条 [KKNews], November 21, 2017, https://kknews.cc/zh-sg/military/4vlmbzq.amp (https://perma.cc/8KKZ-6Y3N).

163 "十一五"国家科技支撑计划重点项目"电力电子关键器件及重大装备研制"课题申请指南" [Application Guide for the "Eleventh Five-Year" National Science and Technology Support Program Key Project "Development of Key Components and Major Equipment for Power Electronics"], 中华人民共和国科学技术部 [Ministry of Science and Technology of the People' s Republic of China], July 31, 2007, http://www.most.gov.cn/tztg/200707/t20070731_51921.htm, via Google Cache, https://webcache.googleusercontent.com/search?q=cache:9gIOF8FSBrkJ:www.most.gov.cn/tztg/200707/t20070731_51921.htm+&cd=6&hl=en&ct=clnk&gl=us (https://perma.cc/N362-NFWF).

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166 "时代电气并购丹尼克斯" [Times Electric M&A with Dynex], 人民网 [Paper.people.cn], 2008, http://paper.people.com.cn/zgjjzk/html/2008-11/03/content_132253.htm (https://perma.cc/7USC-QAJF).

167 "轨道交通首例海外并购:时代电气鲸吞丹尼克斯" [Rail Transit' s First Overseas Acquisition: Times Electric Absorbs Dynex], 新浪财经 [Sina Finance], http://finance.sina.com.cn/stock/hkstock/ggscyd/20081219/03485657155.shtml (https://perma.cc/VM2W-M4KV).

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321 "From Supplier to Joint R&D Partners, Bright Laser Technologies Together with Airbus Enter a New Era of Aerospace Application with Metal Additive Manufacturing", 铂力特 [Bright Laser Technologies], December 27, 2017, https://perma.cc/T2JR-YWUN.

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325 "关于铂力特" [About Bright Laser], 铂力特 [Xi' an Bright Laser Technologies], http://www.xa-blt.com/home/about (https://perma.cc/EBR4-MAKX).

326 National Enterprise Credit Information Publicity System 国家企业信用信息公示系统, http://gsxt.gdgs.gov.cn/.

327 These include AECC, AVIC, CASC, CASIC, CSIC, CNNC, CETC, and CSSC. CRRC also makes an appearance. See: "About BLT," 铂力特 [Xi' an Bright Laser Technologies], http://e.xa-blt.com/home/about (https://perma.cc/UJ4D-TGU3).

328 Airbus (Beijing) Engineering Center Co. Ltd. 空客(北京)工程技术中心有限公司
According to an Airbus notice posted to the French Embassy in China' s website, ABEC is primarily a testing and analysis center used to evaluate Chinese norms and materials used in the construction of aircraft. Most of the tests concern the materials and the designs of parts for various Airbus programs. The document notes that ABEC' s objective is to develop and reinforce cooperation with their Chinese partner (AVIC) in the framework of developing Airbus in the Chinese market. According to the Chinese corporate registry, the joint venture' s ownership is split 70-30 in favor of Airbus China. Avic' s ownership is split between two subsidiaries and the group' s chief company, namely: 中航直升机股份有限公司 AVICOPTER PLC (18%), 江西洪都航空工业股份有限公司 Jiangxi Hongdu Aviation Industry Co. Ltd. (7%), and Aviation Industry Corporation of China 中国航空工业集团有限公司 (5%). See: Airbus (Beijing) Engineering Center Co. Ltd. 空客(北京)工程技术中心有限公司, Ambassade de France à Pékin [French Embassy in Beijing], https://cn.ambafrance.org/IMG/pdf/140227_annuaire_r_d_2014_part4.pdf (https://perma.cc/3FH7-GL78); National Enterprise Credit Information Publicity System 国家企业信用信息公示系统, http://gsxt.gdgs.gov.cn/.

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331 "Bright Laser Technologies went to the Air Show China the third time to show cost-effective metal 3D printing products," 铂力特 [Xi' an Bright Laser Technologies], December 27, 2018, http://e.xa-blt.com/home/news/detail?id=68 (https://perma.cc/P5FD-BAMG).

Risk Signals: An Assessment Tool

China's defense economy has opened its doors to participation by a much broader segment of the industrial base. In doing so, China has created the systems through which companies access the market. These systems are necessarily public facing, and companies that actively participate in them often leave observable traces. Unless Beijing decides to slow or stop its MCF strategy, there will always be a public-facing component. This transparency provides an opportunity to the international community of policymakers, regulators, and businesses to use PAI in assessing risk when evaluating a prospective Chinese-foreign business relationship. Fourteen of the most prominent risk signals identified in this study are categorized by severity and shown below.

Primary Risk Signals — These behaviors necessitate intense scrutiny when assessing counterparty risk. The presence of a single signal is cause for significant caution as it suggests the company is actively involved in China's defense-industrial economy.

Secondary Risk Signals — These behaviors suggest additional information should be collected when assessing counterparty risk. The presence of a single signal is not enough to determine whether a company is involved in China's defense-industrial economy, but suggests the company may intend to become involved in those supply chains.

Primary Risk Signals

SIGNAL	DESCRIPTION	EXAMPLE
Government-Listed Military Supplier	Counterparty appears on official PLA or state-run military equipment platforms or are lauded by official media as providing MCF services	Guizhou Space Appliance Co., Ltd. appears on a national procurement platform, offering 249 dual-use products to the PLA[332]
Military Production License	Counterparty has or claims to have any of the four licenses necessary for producing controlled technology for the PLA, including the "GJB" series licenses	CSR[333] (China South Rail and Rolling Stock Corporation) began publicly announcing its application for one such license at the same time it ramped up MCF activities[334, 335]
Declared MCF Business Strategy	Counterparty publicly or privately states that an avenue for revenue growth is supporting, implementing, or achieving MCF, whether independently or in collaboration with other actors	Beijing Highlander Digital Technology Co., Ltd. widely acknowledges its intent to pursue contracts with the PLA Navy and state-owned defense contractors[336]
Military Factory Representatives On-Site	Counterparty hosts military representatives on premises, whether permanently or sporadically, that inspect company activities and compliance with military standards	Wuhan Guide Infrared Co., Ltd. has military representatives from the PLA Army, Air Force, Navy, and Rocket Force embedded at its facilities[337]
Offices in MCF-Linked Industrial Zones	Counterparty is headquartered or has offices in a declared MCF industrial demonstration base or is listed as a member of a MCF commission within such an industrial zone	Beijing Highlander Digital Technology Co., Ltd. is headquartered in Zhongguancun Science Park and is Deputy Director of the MCF Industrial Alliance within the Park[338]
Defense Contractor Partnerships	Counterparty is a current, former, or prospective R&D or manufacturing partner for, or subcontractor of, a state-owned defense contractor	Xi'an Bright Laser Technologies Co., Ltd.'s clients include eight of China's state-owned defense contractors[339]
Defense R&D University Collaboration	Counterparty is a current, former, or prospective R&D or production partner or subcontractor of a state-owned university involved in defense projects (dependent on nature of the collaboration)	Xi'an Bright Laser Technologies Co., Ltd. is a research partner of Northwestern Polytechnical University, one of the Seven Sons of National Defense[340]
Defense Contractor or Defense University Subsidiary	Counterparty falls within the corporate network, at any level, of a state-owned defense contractor or a defense research university	Aerospace Hi-Tech Holding Group is a publicly-traded company whose controlling shareholder is China Aerospace Science and Industry Corporation (CASIC)[341]
MCF Funding Provider or Recipient	Counterparty is the provider or recipient of MCF funds	Xi'an Bright Laser Technologies Co., Ltd. is an investee of Xi'an Capitech, which is a lauded by MIIT as an MCF funder[342]

Secondary Risk Signals

SIGNAL	DESCRIPTION	EXAMPLE
Defense Conference Participant	Counterparty attends or presents at conferences, forums, or meetings on defense, security, or MCF (content of speeches given is significant)	Beijing Highlander Digital Technology Co., Ltd.'s chairman openly supports MCF and Chinese state policy at public defense conferences[343]
National, State, Provincial, or Enterprise Laboratory Host	Counterparty is home to one or more enterprise-based state-sanctioned S&T laboratories (focus of the laboratory should be taken into account)	Xi'an Bright Laser Technologies Co., Ltd. is the commercial arm of a Key State Laboratory at Northwestern Polytechnical University, one of China's Seven Sons of National Defense[344]
Military Trade Show Participant	Counterparty has, or is planning to, display products at military or security trade shows	National Defense Informatized Equipment and Technology Expo in 2018 attracted more than 500 companies from China and abroad[345]
Sensitive Technology Imports	Counterparty is an importer of potentially dual-use or sensitive technologies (can be assessed using HS codes and publicly available trade data)	CSR[346] (China South Rail and Rolling Stock Corporation) imports foreign expertise on sensitive technologies for commercial and allegedly military purposes[347]
Indirect Investment	Counterparty is investing in third parties to gain access to sensitive technologies held by the wholly-owned subsidiaries of its current or intended investees	Aerospace Hi-Tech Holding Group consolidated control over a French technology company through three investments in Luxembourg[348]

Notes 332-348

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333 Renamed CRRC in 2016.

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Conclusion

Military-Civil Fusion (MCF) is creating domestic pathways for Chinese companies to participate in their country's defense supply chains, even as its economy has enmeshed itself in the global trade in high-tech dual-use goods. At the same time, Beijing is keen to close the military technology gap between China and foreign powers by leveraging China's civilian resources. The confluence of MCF and innovation approaches such as IDAR, which encourages Chinese businesses to re-innovate foreign products for domestic uses, blurs the distinction between civilian and military knowledge, research, and production. Foreigners conducting licit business or research with Chinese civilian entities may be inadvertently contributing to PLA supply chains.

Sensitive foreign technologies have contributed to advanced PLA weapon systems in recent years, as shown in this report and elsewhere.[349] As a result, hawkish observers have claimed that all Chinese companies are beholden to the government and should therefore be categorically barred from deals involving sensitive technology.[350] Yet, this prescription is simplistic, detrimental to global development, and likely insufficient to protect strategic goods. It is detrimental because it disregards the valuable contributions of partnerships between Chinese and foreign companies and universities, especially in fields like medical research.[351] It is insufficient because simply banning trade and investment would not stop Chinese companies from conducting investment or trade through foreign subsidiaries, or buying the same product from a secondary supplier in another nation.

A more nuanced approach is needed, and this report offers a step toward better counterparty-risk assessment. The opening of China's defense industry to civilian companies, as well as attempts to make the defense economy more competitive and market-driven, has compelled the state to publicize the avenues through which civilian companies can participate in military procurement. Likewise, civilian companies are incentivized to signal to the government their intent and eligibility to do so. To the extent that these signals are publicly available, they create a trail of observable behaviors that speak to a Chinese company's connection to military supply chains. International trade and investment occurring in licit channels also leave a footprint in the public domain that can also be used to assess the exposure of international stakeholders to these supply chains. Relevant parties can use this public data to better scope the risks of transactions and control strategic goods.

Stakeholders can use public data to better understand China's innovation strategies, MCF, and the state of civilian participation in the defense economy. Such data empower governments to make informed decisions about protecting their strategic goods. For governments outside of China, the research and risk indicators presented in this report can be used to refine screening mechanisms for securing the various channels through which the PLA might procure sensitive technology. In the US, relevant positions and mechanisms include the Deputy Assistant Secretary of Defense for Industrial Policy, the Department of Commerce Bureau of Industry and Security, and the Committee on Foreign Investment in the United States, among others.

Governments should embrace an investigative solution that protects investment while keeping risky transactions at bay. They should strive to maximize transparency surrounding corporate ownership. Policymakers must ensure that this information is not only present across jurisdictions, but also readily accessible by the public, and not circumvented by subnational legislation.

International partners, particularly those comprising NATO and Five Eyes, should attempt to stimulate information sharing regarding corporate ownership and attempted investments in sensitive technologies to prevent obfuscated acquisitions through tertiary jurisdictions.

All parties, including government, private enterprise, and academic institutions, can use this research to inform due diligence processes that capture and mitigate the risk of unwitting participation in PLA supply chains. Regardless of their affiliations, these stakeholders need to begin by investing in the multi-lingual investigative capacity needed to conduct deep vetting of corporate structures and the risk signals of China's defense-industrial base. However, language alone is insufficient. Understanding that foreign corporate structures and political systems do not necessarily mirror the ones at home is critical to reducing counterparty risk and avoiding oversight of otherwise obvious signals. The marriage of language and contextual knowledge will also allow stakeholders to continuously adapt their risk models to an evolving threat landscape.

These solutions recognize that the onus is on those engaging Chinese firms to proactively prevent misappropriation of their technology. MCF's goal is to build a defense-industrial base much like that of other nations, especially that of the United States. Thus, China is unlikely to roll back MCF as a national strategy. Nor should it be expected to do so, as ensuring national security is the imperative of all governments. Instead, stakeholders must evaluate their own willingness to risk contributing to China's military growth and take necessary precautions to limit inadvertent participation in its defense economy. From artificial intelligence to autonomous drones, the applicability of commercial technology for military purposes is rapidly increasing. Civilian and military industries are converging. Thus, the determination to secure one's strategic goods and, by extension, the national strategic interests of one's country should be made now.

Notes 349-351

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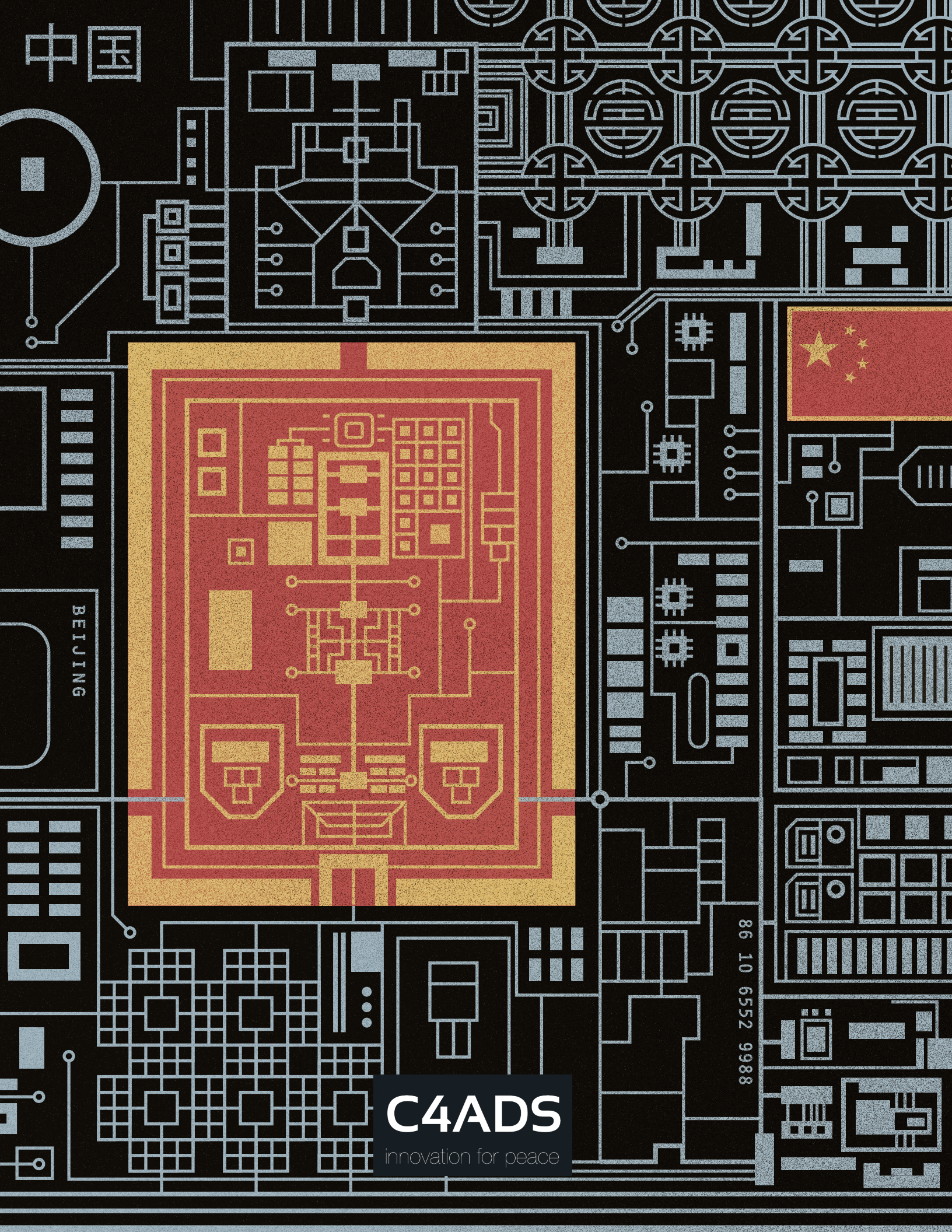
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