

#### ASSESSING SYSTEMIC STRENGTHS AND VULNERABILITIES OF

# **CHINA'S DEFENSE INDUSTRIAL BASE**

Researchers at the RAND Corporation created a repeatable methodology for assessing the strengths and weaknesses of any country's defense industrial base (DIB) across six topics:



ECONOMICS



GOVERNANCE AND REGULATIONS





WORKFORCE, LABOR, AND SKILLS

€ MANUFACTURING



RESEARCH, DEVELOPMENT, AND INNOVATION

They then applied this methodology to assess the DIB of the People's Republic of China (PRC). The study was required by Section 1260C of the Fiscal Year 2021 National Defense Authorization Act. (The methodology and more detailed findings are available in the full report at www.rand.org/t/RRA930-1.)

## THE SHEER SIZE OF CHINA'S DIB MAKES IT OPAQUE TO OUTSIDERS **AND UNWIELDY FOR THE CHINESE GOVERNMENT**



In 2021, China's gross domestic product (GDP) was **\$16.9 trillion**, second only to that of the United States, at **\$22.9 trillion**. China's overall economic size is a strength for supporting its DIB.<sup>[1]</sup>

Seven of the 15 Largest Defense-Related Firms in the World Are Chinese State-Owned Enterprises (SOEs).<sup>[2]</sup>





#### TOP CHINESE MILITARY EXPORTS IN 2019<sup>[4]</sup>



Chart shows the trend-indicator value (TIV) for each country, which is a measure used to compare weapon sales that accounts for different currencies and for discounted costs of refurbished used weapons, legacy weapons, and newer, more advanced weapons.

### TENSION BETWEEN DESIRE FOR ENTREPRENEURIAL INNOVATION WHILE SECURING PARTY CONTROL YIELDS UNCERTAINTY AND INEFFICIENCIES

## **ADVANTAGES**

The Chinese government's centralized power and decisionmaking help drive whole-of-government strategies.

President Xi Jinping and the Chinese Communist Party (CCP) have been working to increase their influence and even direct decisionmaking within defense firms.

By linking defense budget to GDP, China can reliably forecast and plan future defense spending.

China's military-civil fusion (MCF) allows the state to direct university-based research to prioritized science and technology areas.

## **DISADVANTAGES**



Topics not prioritized may falter without leadership's spotlight—a risk if the government bets on the wrong technology or businesses are afraid to innovate.

Confidence in intellectual property (IP) protections is low—China has been ranked 49th out of 129 in the world in IP protections.<sup>[5]</sup>

Lack of independent judicial, legislative, and media oversight requires the CCP to directly monitor, regulate, and control DIB cost or time overruns and quality deficiencies.

There is a lack of transparency about the true objectives in anti-corruption efforts.



## TREMENDOUS CAPACITY FOR MANUFACTURING AND DELIBERATE EFFORTS TO SECURE SUPPLY CHAIN INPUTS NECESSARY TO MANUFACTURE MILITARY CAPABILITIES





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#### DEFENSE-RELATED MINERALS CONCENTRATED OUTSIDE CHINA<sup>[11]</sup>

## CHINA'S DIB RELIES ON U.S. ALLIES AND PARTNERS FOR CRITICAL MILITARY TECHNOLOGY INPUTS

China relies on imports for weapon systems, particularly for aircraft and naval engines, despite efforts to develop them domestically.

#### Global weapon sales decreased during 2020 600 98 20 the pandemic. It would be premature to Russia consider this decrease as a trend. France Ukraine UK 2019 1,108 126 20 2018 1,696 121 20 Unit of measurement is TIV. FRAN UKRAINE

#### TOP WEAPON SYSTEM IMPORTS TO CHINA, BY COUNTRY, IN 2020<sup>[9]</sup>

In 2019, researchers at the Center for Advanced Defense Studies (C4ADS) found that the United States—not Russia—was the largest supplier to China's DIB, at **almost 20 percent of all of China's DIB imports**. C4ADS also found that: <sup>[12]</sup>



Eight of the top ten countries supplying China's DIB were U.S. allies.



Some products being imported were listed on the European Union's list of **export-controlled goods.** 



Many imported goods including U.S. goods were not export-controlled but have potential **dual-use applications**, **including aerospace and nuclear applications.** 

#### TOP FIVE AREAS OF PRC MANUFACTURING IMPORT RELIANCE IN 2019 [10]

			KEY SUPPLIERS
1	ELECTRICAL MACHINERY AND EQUIPMENT \$497 billion	<ul> <li>Integrated circuits</li> <li>Cellular and wireless network equipment</li> </ul>	Taiwan, South Korea, Vietnam
		<ul> <li>Diodes, transistors, semiconductor parts</li> </ul>	
2	MACHINERY, MECHANICAL APPLIANCES, NUCLEAR REACTORS, BOILERS \$190 billion	<ul> <li>Computers, data processors, optical mechanical readers</li> </ul>	Japan, Germany, South Korea
		<ul> <li>Semiconductor fabrication tools and equipment</li> </ul>	
		<ul> <li>Motherboards, microprocessors</li> </ul>	
3	OPTICAL, PHOTOGRAPHIC, Cinematographic, Measuring	Liquid crystal displays	Japan, Taiwan, USA
		instruments	
	\$99 billion	<ul> <li>Chemical analysis tools: polarimeters, refractometers</li> </ul>	
Л	VEHICLES OTHER THAN RAILWAY \$75 billion	Personal vehicles	Germany, Japan, USA
4		Tractors, mass transportation vehicles	
		Chassis, engine cabs	
5	PHARMACEUTICALS \$33 billion	<ul> <li>Medicine, therapeutic or prophylactic</li> </ul>	Germany, USA, Ireland
		Blood products	
		<ul> <li>Sterile surgical materials: sutures, adhesives</li> </ul>	
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## CHINA IS A GLOBAL S&T POWER AND IS CAPABLE OF WORLD-LEADING MILITARY TECHNOLOGY INNOVATION, **BUT INTER-RELATIONSHIPS WITHIN CHINA'S INNOVATION SYSTEM ARE INEFFICIENT**

China's quality-adjusted military patent output grew at an average annual rate of **16 percent** between 2015 and 2019. In contrast, the United States' average annual growth decreased by roughly **6 percent** per year over the same period.<sup>[6]</sup>



## Linkages among research institutions in China are weak

In 2020, China had only 1,946 university-firm co-authorships between firms and universities on scientific publications; the United States had 8,162.



## Linkages between the government and research institutions are weak

China had one government agency linked to 70 percent of government-funded scientific publications, whereas the United States' largest government agency was responsible for funding only 25 percent of scientific publications.



## CHINA WILL BE VULNERABLE TO SIGNIFICANT WORKFORCE UPHEAVAL OVER THE NEXT TEN YEARS

The DIB and other sectors will face labor shortages and lower profits because of wage hikes and other trends, including



China faces a low fertility rate and an aging workforce.



Chinese university classes generally lack academic rigor;<sup>[13]</sup> the system incentivizes professors to publish while slighting education outcomes.



China's STEM workforce is insufficient in both quantity and quality to meet demand.



Pervasive gender inequality might exacerbate potential labor shortages.



## CHINA RELIES ON U.S. AND ITS ALLIES AND PARTNERS FOR TRAINING, **BUT CHINA IS INVESTING IN "TALENT PROGRAMS" TO IMPROVE QUALITY AND QUANTITY OF THE S&T WORKFORCE**



### ADDITIONAL INTELLIGENCE CAN IMPROVE FUTURE ANALYSES



The RAND team was unable to assess the size of China's stockpiles and the rate at which China uses a material, preventing an assessment of how lack of access would affect the PRC.



There is a lack of information on companies that provide services to the People's Liberation Army, including ongoing support of major military systems, information systems, cyber services, and others.



#### SOFTWARE

The RAND team was unable to find data or analyses on the size and quality of the DIB software industry. A notable gap is an understanding of firms that provide software for command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems.



The RAND team found no systematic analysis of the flow of Chinese students and researchers back to China from foreign universities.

 International Institute for Strategic Studies, Military Balance+ (online database), 2021, "China (PRC) and United States Defence Economics." Amounts are reported in current-year dollars using market exchange rates.

[2] Defense News, "Top 100 for 2021," 2021.

- [3] U.S. Department of State, World Military Expenditures and Arms Transfers 2019, 2019, Table IIe.
- [4] Stockholm International Peace Research Institute (SIPRI), SIPRI Arms Transfers Database, 2020.
- [5] Property Rights Alliance, International Property Rights Index 2020, 2020.
- [6] RAND analysis of Web of Science: Derwent Innovation Index data (Clarivate, 2020).
- [7] United Nations Educational, Scientific and Cultural Organization (UNESCO), Institute for Statistics database, undated.
- [8] Fudan University, Tsinghua University, and J.P. Morgan, Skills Shortages in the Chinese Labor Market: Executive Summary, October 2016.
- [9] Stockholm International Peace Research Institute (SIPRI), SIPRI Arms Transfers Database, 2020.
- [10] International Trade Center, website, undated; United Nations, UN Comtrade Database, undated.
- [11] RAND analysis of World Mining Data 2020 (Christian Reichl and M. Schatz, World Mining Data 2020, Republic of Australia Federal Ministry of Agriculture, Regions and Tourism, 2020).
- [12] Center for Advanced Defense Studies, Open Arms: Evaluating Global Exposure to China's Defense-Industrial Base, 2019.
- [13] Javier C. Hernandez, "Study Finds Chinese Students Excel in Critical Thinking. Until College," New York Times, July 31, 2016a.



This research brief describes research conducted in the RAND National Security Research Division and documented in Assessing Systemic Strengths and Vulnerabilities of China's Defense Industrial Base: With a Repeatable Methodology for Other Countries, by Cortney Weinbaum, Caolionn O'Connell, Steven W. Popper, M. Scott Bond, Hannah Byrne, Christian Curriden, Gregory Weider Fauerbach, Sale Lilly, Jared Mondschein, and Jon Schmid, RR-A930-1, 2022 (available at www.rand.org/t/RRA930-1). To view this brief online, visit www.rand.org/t/RBA930-1. The RAND Corporation is a research organization that develops solutions to public policy challenges to help make communities throughout the world safer and more secure, healthier and more prosperous. RAND is nonprofit, nonpartisan, and committed to the public interest. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors. RAND<sup>®</sup> is a research trademark.

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