航空 航天

CHINA AEROSPACE STUDIES INSTITUTE

CHINA'S MILITARY-CIVIL FUSION STRATEGY

A VIEW FROM CHINESE STRATEGISTS

A BluePath Labs Report by

Alex Stone and Peter Wood

for the

China Aerospace Studies Institute

Printed in the United States of America
by the China Aerospace Studies Institute

ISBN 9798652603717

To request additional copies, please direct inquiries to
Director, China Aerospace Studies Institute,
Air University, 55 Lemay Plaza, Montgomery, AL 36112

Design by Heisey-Grove Design

E-mail: Director@CASI-Research.org
Web: http://www.airuniversity.af.mil/CASI
Twitter: https://twitter.com/CASI_Research | @CASI_Research
Facebook: https://www.facebook.com/CASI.Research.Org
LinkedIn: https://www.linkedin.com/company/11049011

CASI would like to thank the dedicated team at BluePath Labs for their work on this project. It took countless hours to read through scores of dense material, all written in Mandarin, to fully investigate the Military-Civil Fusion program in China. Without their tireless work and willingness to chase down rabbit holes, this report would not have been possible.

China Aerospace Studies Institute

CASI's mission is to advance understanding of the capabilities, development, operating concepts, strategy, doctrine, personnel, organization, and limitations of China's aerospace forces, which include: the PLA Air Force (PLAAF); PLA Naval Aviation (PLAN Aviation); PLA Rocket Force (PLARF); PLA Army (PLAA) Aviation; the PLA Strategic Support Force (PLASSF), primarily space and cyber; and the civilian and commercial infrastructure that supports the above.

CASI supports the Secretary, Chief of Staff of the Air Force, the Chief of Space operations, and other senior Air and Space leaders. CASI provides expert research and analysis supporting decision and policy makers in the Department of Defense and across the U.S. government. CASI can support the full range of units and organizations across the USAF, USSF, and the DoD. CASI accomplishes its mission through conducting the following activities:

- CASI primarily conducts open-source native-language research supporting its five main topic areas.
- CASI conducts conferences, workshops, roundtables, subject matter expert panels, and senior leader discussions to further its mission. CASI personnel attend such events, government, academic, and public, in support of its research and outreach efforts.
- CASI publishes research findings and papers, journal articles, monographs, and edited volumes for both public and government-only distribution as appropriate.
- CASI establishes and maintains institutional relationships with organizations and institutions in the PLA, the PRC writ large, and with partners and allies involved in the region.
- CASI maintains the ability to support senior leaders and policy decision makers across the full spectrum of topics and projects at all levels, related to Chinese aerospace.

CASI supports the U.S. Defense Department and the China research community writ large by providing high quality, unclassified research on Chinese aerospace developments in the context of U.S. strategic imperatives in the Asia-Pacific region. Primarily focused on China's Military Air, Space, and Missile Forces, CASI capitalizes on publicly available native language resources to gain insights as to how the Chinese speak to and among one another on these topics.

Preface

Military-Civil Fusion (MCF), this term seems like a counterpart to the American term civil-military integration (CMI), but in reality it is far deeper and more complex. Whereas, according to the U.S. Congressional Office of Technology Assessment, America's CMI is "cooperation between government and commercial facilities in research and development (R&D), manufacturing, and/or maintenance operations", China's Military-Civil Fusion strategy is a state-led, state-directed program and plan to leverage all levers of state and commercial power to strengthen and support the armed wing of the Communist Party of China, the People's Liberation Army (PLA).

China's Military-Civil Fusion program is not new. Every leader since Mao Zedong has had a program to compel the "commercial" and "civil" parts of Chinese society to support the PLA. It has gone by different terms, Military-Civil Integration, Military-Civil Fused Development, etc. General Secretary Xi Jinping has elevated the concept to Military-Civil Fusion. But is all cases, it is the "Military" that comes first. Whereas in the United States there is a partnership for spin-off and spin-on technologies, with a goal of assisting commercial companies as well as the military, this is simply a happy coincidence when, and if, it happens in China.

Since Xi Jinping's assumption of power, the role of the military, and the importance of MCF have markedly increased. General Secretary Xi has clearly switched the emphasis from Deng Xiaoping's famous statement. While most remember the first part of Deng's saying, "韬光养晦", which is generally translated to "bide your time, and hide your capabilities", most Americans, and westerners, seem to forget there was more in his dictum. The full quote is: "冷静观察, 稳住阵脚, 沉着应付, 韬光养晦, 善于守拙, 决不当头, 有所作为" It is the last four characters that now seem to have the emphasis, loosely translated- and achieve some goals/ get something done. This explains China's growing assertiveness and emphasis on the final piece of Deng Xiaoping's "Four Modernizations", the military.

To date, most surveys and analysis of MCF have focused on concrete examples, of how it is or is not working. These are important aspects to understand and study. However, what this report does is focus on how Military-Civil Fusion fits in to the CCP's and the PRC's overall national strategy; how it fits in with the other pieces which the CCP uses to guide the development path of the PRC; and rather than "looking down" to focus on the implementation of the program, but rather to "look up" to the strategies and policies that form the connective tissues within the greater system.

This report is intended for both policy makers and practitioners, to help them better understand how MCF is intrinsically linked to the other national strategic-level programs in China, and help them better compete in the long-term by understanding the nature of the system with which we are competing.

Dr. Brendan S. Mulvaney
Director, China Aerospace Studies Institute

Table of Contents

Abbreviations

Academy of Military Sciences	AMS
China Aviation Industry Corporation	AVIC
Belt and Road Initiative	BRI
Chinese Academy of Engineering	CAE
Chinese Academy of Sciences	CAS
China Aerospace Science & Technology Corporation	CASC
China Aerospace Science and Technology Corporation	CASIC
China Center for Information and Industry Development	CCID
Chinese Communist Party	CCP
Central Military Commission	CMC
China National Knowledge Infrastructure	CNKI
Commercial Technology & Industrial Base	CTIB
Defense Science, Technology, & Industrial	DSTI
Defense Technology & Industrial Base	DTIB
Equipment Development Department	EDD
Institutes of Higher Education	IHEs
Joint Logistic Support Force	JLSF
Logistics Support Department	LSD
Medium- to Long-term Plan	MLP
Military-Civil Fusion	MCF
Ministry of Industry & Information Technology	MIIT
Ministry of Science & Technology	MOST
National Development &Reform Commission	NDRC
National Defense Mobilization Committee	NDMC
National Defense Mobilization Department	NDMD
National Defense University	NDU
National Technology and Industrial Base	NTIB
National University of Defense Technology	NUDT
Northwestern Polytechnical University	NWPU
Office of Technology Assessment	OTA
People's Armed Forces Department	PAFD
State Administration for Science, Technology and Industry for National Defense	SASTIND
System of Systems	SoS
Strategic Support Force	SSF

Key Findings

MILITARY-CIVIL FUSION IS CHINA'S PATH TO VICTORY IN A GLOBAL CONFRONTATION OF SYSTEMS

- According to Chinese strategists, modern, informatized warfare is characterized by a systems confrontation that pits states' respective defense strategies, systems and degree of civil-military synergy against one another. The competition's outcome will be determined by a state's adaptability and ability to muster the will and strength of society as a whole to support security and development goals. Military-Civil Fusion (MCF), in their view, is regarded as a state governance approach that could directly support China's ability to prevail in a long-term strategic competition.

MCF STRATEGY CLEARLY ARTICULATES NEAR- AND LONG-TERM GOALS

- The near-term goal of the MCF strategy is achieving a state of "MCF deep development" characterized by streamlined processes and resource sharing to achieve interconnectivity, higher efficiency, and optimal allocation of resources.
- The long-term goal is to gradually unify all of the various military and civilian strategies in a way that creates a strategic capability for success in a systems confrontation. MCF is *not* simply another national plan, but rather a strategy whose components are to be woven into China's other national strategic priorities to advance the PRC's overarching security and development goals.

MCF REPRESENTS AN ACCELERATION OF PREVIOUS INITIATIVES

- Every PRC leader from Mao Zedong to Hu Jintao has pursued some form of civil-military integration (CMI). While the MCF strategy supersedes these, it is important to note that most components of the current MCF strategy evolved from initiatives started in the Jiang Zemin and Hu Jintao eras.
- Earlier efforts such as the reforms to ownership of state-owned defense conglomerates, failed to materialize despite clear policy directives, and prior to 2014, progress was largely confined to areas where there was little friction.

MCF OPERATIONALIZATION REQUIRES SMASHING BARRIERS AND DISRUPTING VESTED INTERESTS

- While Xi Jinping reaffirmed the overall direction of his predecessors' civil-military integration initiatives when he took office, he argued that there is a pressing need to transition from "early-state fusion" to "deep fusion," a process that, in his opinion, had been hindered by problematic mindsets, systemic barriers, and vested interests. To address these problems Xi directed involved parties to "break down ramparts, breakthrough solid ice, wade through dangerous shoals, and 'move (people's) cheese'" to achieve MCF's full potential.
- Xi's subsequent elevation of MCF development to a national strategy is seen by Chinese MCF researchers as a move to address deep-seated issues and drive concrete results. The Party's authority is seen as a force that can cut through the obstacles and barriers created by existing interest groups.

THE ROADMAP FOR THE MCF STRATEGY ENCOMPASSES TWELVE DOMAINS

- MCF development will occur in domains identified as having high levels of commonality between civilian and defense systems and great potential for further integration. Military-civil "deep fusion" is enabled by the formation of the six *Systems of Systems (SoS)*, which are dynamic ecosystems linking the defense and civilian sectors. Together, these domains and the six SoSs form the backbone of the MCF strategy.
- MCF has made notable progress toward enhancing interconnectivity and resource sharing in these domains during the 13th Five Year Plan period (2016-2020).

THE MCF STRATEGY PROMOTES CHINA'S GLOBAL AMBITIONS

- China has two national strategies, *Going Out* and the *Belt and Road Initiative*, that actively promote expansion of its presence and national economic interests abroad. Chinese strategists reason that the globalization of great powers' interests will inevitably require development of capabilities to protect overseas national interests. The MCF strategy complements and supports both strategies to advance China's economic and security interests abroad. Efforts include the "going out" of the national defense industry, the development of overseas logistics facilities, and international military exchange activities under the Belt and Road Initiative.

INTEGRATION OF DEFENSE AND CIVILIAN INDUSTRIAL AND INNOVATION BASES ARE TOP PRIORITIES

- While fully acknowledging the significant progress the industrial base and the innovation base have made in the past several decades, senior Chinese leaders, scholars, and experts appear concerned that the defense industrial base and the innovation base, in their current state, are insufficiently prepared to meet both defense and commercial needs.
- Of greatest concern is the innovation base's inability to produce original innovations and breakthrough technologies, and the defense industrial base's low self-sufficiency on "core, critical technologies."

THE UNITED STATES REMAINS THE PRIMARY MODEL OF INSPIRATION

- Acknowledging that all states must balance the competing twin goals of security and development, Chinese scholars and experts have closely studied MCF and CMI models used in other countries. Prominent scholars of MCF in China frequently reference American practices, and MCF-focused social media accounts run by government agencies or government-affiliated think tanks monitor the latest MCF-related developments in the U.S. on a regular basis.

BALANCING MARKET DEMANDS WITH PARTY CONTROL REMAINS A MAJOR CHALLENGE

- MCF initiatives need to be able to balance the interests of all involved parties and provide the right incentives. While MCF researchers often highlight the need to give market mechanisms a vital role in shaping the environment MCF actors operate in, clarifying the functional boundaries of the government and the market is not easy when the Party's leading role is repeatedly emphasized. Chinese decision-makers largely see Party and state leadership and its ability to institute and implement policies as the key to the strategy's success. Whether this perception correctly reflects reality is a question for debate. Finding the balance between the role of the government and the market is and will be one of the toughest challenges in the implementation of the MCF strategy.

Introduction

Every PRC leader from Mao to Xi has pursued some form of military-civil integration. While the concept was initially focused on the defense industrial base during the Mao Zedong and Deng Xiaoping eras, MCF gradually evolved under Jiang Zemin and Hu Jintao to include additional components such as military personnel education, logistics, and infrastructure planning and construction. In its current form under CCP General Secretary Xi Jinping, MCF has been elevated to a national strategy with a clear roadmap consisting of many moving parts and short- and long-term goals.[i] Xi Jinping has described the MCF strategy as a "major policy decision designed to balance security and development" and a "major measure in response to complex security threats and means of gaining strategic advantages."[1]

As the name suggests, the strategy hopes to achieve a state of "deep fusion" through the integration of the two essential building blocks: the "military" and the "civil." The "military" includes every aspect of the national defense and force building endeavor, including armed forces, national defense technology, industry, facilities, mobilization, education, resources, as well as the major operational domains. The "civil" refers to fields in the economic and social system that are closely related to national defense and force-building, such as the national science and technology and industrial system, the national talent education and training system, the national social services system, the national emergency management system, as well as emerging domains and nascent technological areas such as maritime, space, cyberspace, and artificial intelligence that are closely linked to the generation of "New Type Combat Capabilities."[2]

The optimization of national resource allocation and the generation of combat readiness and economic benefits are near-term, basic goals of the strategy. Its ultimate goal, according to Xi and Chinese experts, is the "gradual build-up of China's unified military-civil system of strategies and strategic capability" [军民一体化的战略体系和能力] (discussed in 1.2.2).[ii] From Chinese writings, it is clear that MCF is not a simple addition to China's other national strategic priorities, but rather a strategy whose components are to be woven into China's system of national strategies to form an organic, powerful, and comprehensive national strategic system that will advance the PRC's overarching security and development goals.

SCOPE NOTE

The goal of this study is to facilitate a better understanding of the theoretical framework and strategic goals of China's Military-Civil Fusion Strategy.

To provide a baseline of existing research on these topics, in early November 2019, a literature review of over 80 English-language news articles, studies, and multimedia reports published by academia, news agencies, think tanks, and U.S. government agencies on MCF-related topics was conducted. As of March 2020 there were a total of three long-form studies and book chapters on the MCF strategy in the public domain. The first one is the C4ADS's 2019 study "*Open Arms: Evaluating Global Exposure to China's Defense-Industrial Base*," which analyzed the implications of the confluence of the MCF strategy and China's "Introduce, Digest, Absorb, Re-Innovate" approach and identified "risk signals" that can aid in domain awareness.[3] The second study, *Blurred Lines:*

i Section 1 traces its historical evolution and provides details regarding its current iteration.

ii In this context, various authors make it clear that System of Strategies [战略体系], as in the set of strategies China is pursuing is different from "Strategic Systems" or capabilities that achieve strategic effects [战略能力]. While these represent our best understanding of the terms, there are inconsistencies in how the same concepts are referred to by different authors and at different times.

Military-Civil Fusion and the Going Out of China's Defense Industry by Greg Levesque and Mark Stokes examined MCF's development and the 'Going Out' of the Chinese aviation industry.[4] Lastly, a chapter by Brian Lafferty, in *Chairman Xi Remakes the PLA: Assessing Chinese Military Reforms* by the National Defense University, provides some important insights into how MCF contributes to the PLA's modernization drive.[5] The review found that other articles and news coverage focused heavily on China's pursuit of dual-use technology through both legal or illicit means, its implications for China's military rise, and the U.S. in general.[iii]

While the majority of these studies note the ambitions behind the MCF strategy and highlight it as a cause for concern for the United States, their discussions of the nature of MCF are fairly abstract. Most studies of MCF attempt to build a picture of the strategy by piecing together data on MCF developments. There is also a strong emphasis in these studies on specific projects or technologies such as AI, robotics, or 5G technology, and their implications for technology transfer, operational capabilities, etc. Although these studies provide valuable insight into specific aspects of the MCF strategy, they fail to capture the strategy's full agenda and ambitions.

Perhaps, as a result, much of the attention given the strategy by U.S. leaders have focused on tech transfer as the defining characteristic of MCF. Vice President Mike Pence, for example, has said that as part of MCF, "By law and presidential fiat, companies in China (whether private, state-owned, or foreign) must share their technologies with the Chinese military."[6] Defense Secretary Mark Esper has also focused on tech transfer, noting "President Xi Jinping's elevation of the 'Military-Civil Fusion Strategy' to a national level puts our exports for peaceful, civilian use at risk of transfer to the PLA."[7] Similarly, Secretary of State Mike Pompeo has stated that "Under Chinese law, Chinese companies and researchers must – I repeat, must – under penalty of law, share technology with the Chinese military."[8]

This interpretation appears to largely come from the *National Intelligence Law* [国家情报法] issued in 2017 which stipulates (Article 7), "any organization or citizen shall support, assist, and cooperate with state intelligence work according to law," and (Article 14) "state intelligence work organs, when legally carrying forth intelligence work, may demand that concerned organs, organizations, or citizens provide needed support, assistance, and cooperation."[9] This builds on Article 77 of the *National Security Law* passed in 2015, which also requires "citizens and organizations" to "provide necessary support and assistance to national security bodies, public security bodies, and relevant military bodies."[10]

It should be noted that China's overseas technology acquisition efforts, whether through state-directed overt, covert, or opportunistic[iv] means, long predates the MCF strategy or the *National Intelligence Law*. Certainly, given the sweeping powers the *National Intelligence Law* can exercise and the MCF strategy's focus on resource sharing and interoperability, China's dual-use technology acquisition efforts pose a greater threat than ever before.[v] However, there is also a danger that by focusing on this one aspect of MCF—as opposed to the strategy's broader strategic goals to make China a competitive, innovative country with world-dominating characteristics—we miss the forest for the trees.

---

iii For a more extensive review of these sources see: Addendum: Military-Civil Fusion English Literature Review by Quinn Rask.

iv Chinese private companies and state-backed funds have eagerly purchased intellectual property or entire U.S. companies through entirely legal means. A wide range of covert or semi-covert organizations from the Ministry of State Security (MSS), PLA Strategic Support Force, or agents affiliated with the United Front Work Department have all been involved in hacking or other forms of illicit tech transfer. It should also be noted that in many cases, Chinese citizens have opportunistically pursued access to sensitive technologies without direction from Party or state actors, with the intention of transferring the information for profit.

v This topic has been the subject of two recent studies. The first one is C4ADS's 2019 study "Open Arms: Evaluating Global Exposure to China's Defense-Industrial Base." See Marcel Angliviel de la Beaumelle et al. "Open Arms." C4ADS, October 7, 2019. https://www.c4reports.org/open-arms; The second, put out by the Ronald Reagan Institute in December 2019, examines the national security threats posed by China's dual-use technology acquisition efforts and provided policy recommendations for Strengthening the U.S. National Security Innovation Base. See Reagan Institute Task Force. "The Contest for Innovation: Strengthening America's National Security Innovation Base in an Era of Strategic Competition.," 3 December 2019, https://www.reaganfoundation.org/media/355297/the_contest_for_innovation_report.pdf

With this in mind, this study is meant to answer questions that have yet to be addressed in-depth by the existing literature. Specifically, this study attempts to explain, at a high level, the reasons for MCF's existence, what it is meant to achieve, and the powers and functions it may exercise to help achieve its goals. The study aims to provide a baseline reference and framework for ongoing monitoring and subsequent study of how the strategy is implemented. It hopes to give concrete meanings, grounded on authoritative publications, to the vague terms and convoluted descriptions that tend to accompany Chinese policy documents, especially with regard to national strategies.

Specific research questions include:

1) In Chinese policymakers' own words what are the strategy's core components?
2) What is the ultimate purpose of MCF as envisioned by senior Party and State leadership, as well as military and civilian strategists?
3) What are the high-level Party and State organizations charged with MCF policy formulation?
4) Who are the influential strategists articulating this vision within the Party, the PLA, and other civilian government organizations?
5) How does MCF relate to China's other macro-level national security, economic, and social development strategies?

To that end, this study adopts a different approach, using quantitative methods to first derive a set of authoritative institutions and scholars working on the topic in China's highest academic and military institutions, and attempting to build a conceptual framework of MCF based on MCF policy documents and the publications by these authors who have played a role in shaping the concept for CCP and PLA leadership. It presents a clear picture of the MCF strategy and its grand ambitions. As one of the hallmark policy initiatives of Xi's administration, we cannot risk failing to understand its full ambitions as articulated by Xi and his advisors.

SOURCES AND METHODOLOGY

This report attempts to expand beyond the scope of previous studies by drawing on a wider range of Chinese language sources. In particular, it expands upon a well-known set of official speeches, policies, white papers, and reports from official Chinese media outlets, and draws heavily upon authoritative books and journal articles from the Chinese Communist Party, State Ministries, and military strategists.

Although the central government has issued numerous plans and recommendations with regards to specific segments of the strategy in the 13th FYP (discussed in Section Three), the three most authoritative top-level guiding documents for the overall development of MCF include:

1. *The PRC Military-Civil Integration Development Law* [《中华人民共和国军民融合发展法》], which is still undergoing review and revision as of May 2020.
2. *The Military-Civil Fusion Strategy Outline* [《军民融合战略纲要》], which was adopted by the Central Commission for Military-Civil Fusion Development on March 2, 2018. The *Outline*, considered by some to be the doctrine of the MCF strategy, is only mentioned in the press release in passing, and the content of the outline itself is not publicly available.
3. The *Opinion on the Integrated Development of Economic Construction and National Defense Construction (2016 Opinion)* [《关于经济建设和国防建设融合发展的意见》], which was released by the CCP Central Committee, the State Council, and the Central Military Commission (CMC) on July 21, 2016. The *2016 Opinion* "clarified the general thinking, key tasks, policies, and measures of the development of military-civil fusion

under the new situation. It is a programmatic document [纲领性文件] for the overall promotion of economic and national defense construction."[11] The full text of the 2016 Opinion is not publicly available, but *Xinhua News* has published a synopsis of this document.

This study derives the basic framework of the MCF strategy based on the following information:

1. The Synopsis of the *2016 Opinion*
2. Press releases from the four meetings of the Central Commission for Military-Civil Fusion Development and Xi Jinping's discussions on military-civilian integration on various occasions
3. Publications by reputable and influential authors, whose authority on the subject is assessed below.

MCF RESEARCH LANDSCAPE IN CHINA

To assess the influence and authority of military and civilian scholars, experts, and strategists, we used two important datasets. The first, dataset no. 1, was built using publication data available on the China Book Publishing Database website, a comprehensive listing of books published in the PRC.[12] Dataset no. 2 is based on a 2018 study conducted by the Academy of Military Sciences and Wanfang Data[vi] that performed a bibliometric analysis of the body of MCF research works in China.[13] Cross-referencing the 2018 study with the China Book Publishing database provided valuable insights into the MCF theoretical research landscape in China.

Data set No.1: The China Book Publishing Database

A keyword search of the term "Military-Civil Fusion" [军民融合] was performed on the China Book Publishing Database. The search returned a total of 63 books published between 2014 and 2019, with one duplicated result. The next step was to examine the affiliation of authors from those books. Below is a table showing the top 10 organizations based on the authors' last known affiliations.[vii] Two of China's most influential military think tanks [军队高端智库], the National Defense University (NDU) and the Academy of Military Sciences (AMS) are clear leaders in the number of books published on MCF.[viii]

vi Wanfang Data [万方数据] is a leading journal and digital information database provider affiliated with the Chinese Ministry of Science & Technology, http://www.wanfangdata.com/index.asp

vii Note that these affiliations were determined based on the last known available information

viii The Academy of Military Science (AMS) and National Defense University (NDU) are TC Deputy Leader [副战区职] grade organizations directly subordinate to the Central Military Commission. AMS is regarded as the PLA's top think tank and developer of military theory (similar to western use of the term "doctrine") and publishes the PLA's primary military journal, Chinese Military Science [军事科学]. NDU serves primarily as an educational institution for senior officers. Both publish authoritative books referenced in this report.

Top Ten Organizations Publishing Books on MCF by Author Affiliation	
Organization	**Number of Authors by Affiliation**
National Defense University (NDU)	10
Academy of Military Sciences (AMS)	9
National University of Defense Technology (NUDT)	4
State Administration for Science, Technology, and Industry for National Defense (SASTIND)	3
National Development and Reform Commission (NDRC)	2
PLA Army Logistics University[ix]	2
Beijing Institute of Technology	2
Northwestern Polytechnical University (NWPU)	2
Weinan Normal University[x]	2
Central Party School	2

NDU and AMS have each created a research center dedicated to the study of military-civil fusion. AMS established its Military-Civil Fusion Research Center [军事科学院军民融合研究中心] in 2011.[14] According to a report by *PLA Daily*, this research center employs over 80 part-time consultants and research fellows whose affiliations range from CMC headquarters departments to private high-tech companies.[15] The same article demonstrated the influence of the Center by noting that it has established close working relationships with the (MIIT), SASTIND, the CMC Equipment Development Department, the CMC Logistics Support Department (LSD), the CMC Strategic Planning Office, the Chinese Academy of Sciences (CAS), and the Chinese Academy of Engineering (CAE). This research center was also responsible for the organization of a third-party assessment of the MCF strategy's level of implementation in 2015.

In July 2015, the National Defense University (NDU) [国防大学] unveiled its Research Center for Military-Civil Fusion Deep Development [军民融合深度发展研究中心] in Beijing.[16] This research center was tasked with assisting high-level decision-making through theoretical research. This center is responsible for compiling annual reports on MCF development in China and publishes the *Military-Civil Fusion Journal* [军民融合杂志], which has reportedly become an important platform for policy promotion, academic research, and exchange. A large number of policy advisory reports provided by this center have been favorably received by Party and state leadership.

ix One of the authors is affiliated with the Logistical Engineering University [后勤工程学院] and the other the Military Economics College [军事经济学院]. In August 2017, the Army Logistic University (also translated as the Army Service Academy was established on the foundation of the two schools. For more details, see Kenneth Allen, Mingzhi Chen, and Ringo Chan, "Overview of the People's Liberation Army's 37 Academic Institutions," China Aerospace Studies Institute, [forthcoming 2020].

x Weinan Normal University houses the West China Military-Civil Fusion Technology Industry Development Research Institute [西部军民融合技术产业发展研究院].

Screen capture from "National Defense University's Research Center for Military-Civil Fusion Deep Development Created in Beijing" [国防大学军民融合深度发展研究中心在京成立], TV.81.cn, 21 July 2015, http://tv.81.cn/jq360/2015-07/21/content_6594905.htm.

Publications from these two institutions represent the cornerstone of authoritative discussions on the overall content and goals of the MCF Strategy.

Dataset No.2: Bibliometric Analysis of Journal Articles on MCF

Released in 2018, *Research on Core Authors about Civil-Military Integration based on the Bibliometrics [Sic]* is a study commissioned by the Central Commission for Military-Civil Fusion Development (CCMCFD) [中央军民融合发展委员会], a commission with the highest authority on MCF-related decision-making personally chaired by Xi Jinping.[17] The study analyzed articles and conference proceedings published between 1974 and June 2017 in the Wanfang database (an academic database similar to SCOPUS or China National Knowledge Infrastructure [CNKI]) and employed key term query searches to identify emerging trends in MCF-related research.

The report found that a total of 2,448 journals have published at least one article on the topic of MCF. A total of 14,432 articles collected from these journals formed the basis of their analysis. Of the 14,432 articles, 7,712 titles included author affiliation information. Based on the first author's affiliation, the researchers identified 4,429 research institutions and found that the top 20 institutions generated 27.14% of the total content (when organizations that have published only one article are subtracted this rises to 59.29%), indicating that these institutions form the core of the MCF research field.

Whether in terms of academic influence or decision-making influence, two groups of researchers dominate MCF research. The first group includes authors affiliated with military-affiliated academic and research institutions such as the Military Economics College,[xi] National University of Defense Technology [NUDT], NDU, PLA Equipment College,[xii] PLA Nanjing Political College, and AMS. The second group consists almost entirely of researchers from China's major defense conglomerates, led by the China Aerospace Science and Technology Corporation (CASIC), China Aviation Industry Corporation (AVIC), and Norinco. Naturally, this group's research is heavily focused on the defense technology R&D aspect of MCF.

xi Now the Army Logistic University.
xii Now the PLA Strategic Support Force's Space Engineering University.

The table below shows the top 20 institutions based on the number of articles published on MCF.

Rank	Organization (English)	Organization (Chinese)	No. of Articles
1	Military Economics College	军事经济学院	325
2	China Aerospace Science and Technology Corporation	中国航天科技集团公司	292
3	National University of Defense Technology	国防科技大学	179
4	National Defense University	国防大学	151
5	China North Industries Group Corporation Limited (Norinco)	中国兵器工业集团公司	134
6	China Aviation Industry Corporation (AVIC)	中国航空工业集团公司	120
7	China Shipbuilding Industry Corporation	中国船舶重工集团公司	107
8	PLA Equipment College	装备学院	100
9	China Aerospace Science and Industry Corporation	中国航天科工集团公司	96
10	Nanjing Political College	南京政治学院	95
11	China National Nuclear Corporation	中国核工业集团公司	89
12	Military Transportation College	军事交通学院	77
13	Academy of Military Sciences	军事科学院	73
14	China Electronics Technology Group Corporation	中国电子科技集团公司	67
15	Beijing Institute of Technology	北京理工大学	43
16	Northwestern Polytechnical University	西北工业大学	34
17	Xi'an Political College	西安政治学院	30
17	Nanjing Army Command College	南京陆军指挥学院	30
19	Renmin University of China	中国人民大学	27
20	Beijing Institute of System Engineering	北京系统工程研究所	24

The study also revealed the top individual researchers in the field and offered ranking variations based on the bibliometrics selected.

Researcher ranking based on the number of first authorship articles:

1	38	Du Renhuai [杜人淮]	PLA Nanjing Political College [解放军南京政治学院]
2	27	Shu Benyao [舒本耀]	PLA Equipment College [装备学院] (Now SSF Space Engineering University)
3	22	Jiang Luming [姜鲁鸣]	National Defense University [国防大学]
4	21	Yu Chuanxin [于川信]	AMS Military-Civil Fusion Research Center [军事科学院军民融合研究中心]
5	20	Fan Zhaozhen [范肇臻]	Defense Economics and Management Research Institute, Central University of Finance and Economics [中央财经大学国防经济与管理研究院]

Researcher ranking based on article count normalized for degree of authorship:

1	38.90	Du Renhuai [杜人淮]	PLA Nanjing Political College [解放军南京政治学院]
2	29.00	Shu Benyao [舒本耀]	PLA Equipment College [装备学院] (Now SSF Space Engineering University)
3	24.00	Zeng Li [曾立]	National University of Defense Technology [国防科学技术大学]
4	22.57	Jiang Luming [姜鲁鸣]	National Defense University [国防大学]
5	22.12	An Mengzhang[安孟长]	China Aerospace Academy of System Science and Engineering [中国航天科学与工程研究院]

In the writing of this report, many points of view of various scholars were referenced, but out of the list above, special attention was paid to scholars who met the following criteria:

1) They have published books, systematic studies, or reports based on the current iteration of the Military-Civil Fusion strategy between 2015 and the present, and their publications offer a comprehensive overview of the MCF strategy rather than being focused on a particular domain or technology (such as defense technology R&D or space).
2) Their work conveys concrete, evidence-driven, and meaningful information that adds to our understanding of the strategy. As pointed out by Zheng Bo [郑波] of the Military-Civil Integration Research Institute at the China Center for Information and Industry Development (CCID) [赛迪智库军民结合研究所], a think tank directly subordinate to MIIT, China's current research on MCF is rapidly increasing in volume and subject matter, but there are many problems.[18] For example, in order to maintain the Party line and not cross politically sensitive lines, researchers like to choose topics on matters that have been clearly settled by the central government, such as the significance of developing MCF. Research into areas that may be controversial, but which deal with pressing issues such as the much-needed institutional reform, is limited or superficial. Researchers, especially those working on a specific area of the strategy, often put the interests of their own organizations or industries first. They frequently talk around a subject, content with "barely scratching the surface" ["蜻蜓点水"], lest they "draw fire on themselves" ["引火烧身"].[19]

   Overall, Chinese experts on this subject fall into two camps: advisors to the central government who conduct studies and inform decision-makers, and those who publicize [宣传] the information after the fact. Some experts fall into both camps, but the work of the former tends to be more informative.[xiii]
3) Their publications match the narrative of the two most authoritative MCF policy documents to date. Several key documents on MCF, including the *Outline of the MCF Strategy* [军民融合战略纲要], one of the two most authoritative documents issued by the Chinese Central Government, are not public but are frequently referenced by top MCF strategists. Therefore, to piece together the full picture of what these documents detail, researchers whose work indicates that it is fully in sync with central policies are considered a more reliable source.

For the reasons outlined above, the books and articles by the following three authors and their frequent collaborators are referenced extensively throughout this report.

xiii An example of this type of dichotomy can be seen in Chinese military commentators, some of whom are clearly focused on external messaging vs those involved in strategy formulation. See: Andrew Chubb, "Propaganda, Not Policy: Explaining the PLA's 'Hawkish Faction' (Part One)," *China Brief*, 25 July 2013. https://jamestown.org/program/propaganda-not-policy-explaining-the-plas-hawkish-faction-part-one/

"81.cn Interviews Jiang Luming: Here's Why Even the Americans are won over by China's Military-Civil Fusion Technologies" [军网专访姜鲁鸣: 我国军民融合技术为何能令美国人都服气], 81.cn, 18 March 2018. http://www.81.cn/2018zt/2018-03/18/content_7992498.htm.

Jiang Luming [姜鲁鸣]

One of the top-ranked authors identified using the datasets is NDU professor, Major General, military CPPCC member [军队政协委员] Dr. Jiang Luming. Jiang has been a pioneer in the field of defense economics for over 30 years.[20] He serves as deputy director of the National Defense Economics Expert Panel [国防经济专家委员会] under the CMC Science and Technology Committee and acts as a consultant for the CMC Strategic Planning Committee [战略规划委]. In 2009 he was one of two NDU professors who were invited to lecture the CCP Central Committee Politburo's study session on MCF, and his body of public work indicates close familiarity with the unpublished government policies on MCF. His 2017 book, *Initial Discussion on the Military-Civil Fusion Strategy* [军民融合发展战略探论], which he co-authored with NDU researchers Wang Weihai [王伟海] (pictured below) and Liu Zuchen [刘祖辰], is one of the few books published in the last five years that specifically discusses the MCF *strategy*, rather than MCF as a broad topic. The language in the book closely mirrors that of the *2016 Opinion*, making it possible—even probable—that he played a significant role in writing the classified *2016 Opinion* or *MCF Strategy Outline* itself.

"China Aviation High-Tech Innovation Forum held in Xi'an Aviation Base" [中国航空高科技创新论坛在西安航空基地召开], Sina, 8 November 2017, https://sx.sina.com.cn/news/b/2017-11-08/detail-ifynnnsc9770563.shtml.

Yu Chuanxin [于川信]

Another key scholar who ranked high in our second dataset is Dr. Yu Chuanxin. A leading thinker on MCF, he serves as the Secretary General [秘书长] of the AMS Military-Civil Fusion Research Center. In addition to that role, he also likely serves as director of the AMS Defense Comprehensive Research Office of the Force Construction Research Department [军队建设研究部国防综合研究室主任]. Yu is the author and chief editor of many AMS teaching materials.

"Zeng Li: Military-Civil Fusion is a National Strategy and a National Policy" [曾立:军民融合是国家战略也是基本国策], Hunan Think Tank, 15 December 2015, https://www.hnzk.gov.cn/zhikuyanjiu/1602.html#.

Zeng Li [曾立]

Zeng Li is the executive deputy director [常务副主任] of NUDT's Military-Civil Fusion Research Center [国防科技大学军民融合研究中心] and led the NUDT's research effort on defense resource allocation and management systems, a project funded by the National Social Science Fund of China. The project led to the publication of a volume edited by Zeng, *National Defense Resource Allocation and Management System with Chinese Characteristics under Military Fusion: National Strategy and Policies* [中国特色军民融合国防资源配置与管理探索: 国家战略与基本国策].

ORGANIZATION OF THIS REPORT

Section 1 provides an introductory overview of the Military-Civil Fusion Strategy. Section 1.1 traces the evolution of MCF as a concept across five generations of leaders whose policies and efforts collectively formed the basis of Xi Jinping's MCF strategy. Section 1.2 breaks down the strategy into its core components, outlines its basic and ultimate goals, and explains how it connects to China's other national strategic priorities. Section 1.3 provides a brief analysis of the similarities and differences between the MCF strategy and other countries' approaches to national defense and economic resource allocation in the eyes of Chinese strategists.

Section 2 examines the MCF strategy's management structure as proposed by Xi Jinping, which consists of three components: the MCF organization and management system, operational system, and policy system.

Section 3 analyzes each component of the "6+3+n+1" roadmap and discusses their operationalization during the 13th FYP.

The Conclusion provides a brief analysis of the outlook for the strategy.

NOTE ON TERMS

Chinese political writings have their own vocabulary that is important to understand when interpreting theory and policy. These terms include: *xitong* [系统], *tixi* [体系], *zhidu* [制度], *jizhi* [机制], and *tizhi* [体制]. This section attempts to explain the specificity of meaning behind each term that is hard to capture and render through translation, and how this study approaches these terms.

XITONG AND *TIXI*

The definitions of *xitong* and *tixi* offered in *Cihai* [辞海],[21] a comprehensive and authoritative dictionary and encyclopedia of contemporary Mandarin Chinese, are fairly similar.

- *Xitong: an organic whole with a certain structure and functions composed of several interrelated and interacting elements.*
- *Tixi: a (unified) whole formed by a group of interacting mutually-constraining entities*

In practice, *xitong* is often used to describe simpler systems and tixi more complex systems, but the distinction is subtle and ill-defined, and some authors use both terms interchangeably. Throughout this study, *xitong* and *tixi* are both translated as "system." The English translation "System of Systems" [SoS] for *tixi* is reserved for the six major ecosystems the MCF strategy strives to build, to emphasize the creation of a new, more complex system which offers more functionality and performance than simply the sum of the constituent systems. This idea is favored by Chinese MCF researchers who frequently write about MCF achieving the so-called "the whole is greater than the sum of its parts" effect (frequently given as 1+1>2).

JIZHI

The translation for *jizhi* [机制] is less contested. It is most often translated as "mechanism," as the term refers to the process and manner of interaction between the organizations or parts of a working system.

ZHIDU

The *Cihai* definition perfectly captures the broad meaning of the term:

- *Zhidu: In social sciences, it refers to the social structure that regulates individual actions with rules or operating models. In general, it also refers to the sum of a series of habits, morals, laws, regulations, etc. that are unified and regulate social relations within a specific social scope in a certain historical period. There are both unwritten norms and written mandatory norms.*

Unlike *tizhi*, which is often restricted to discussions involving the government, *zhidu* can be used in many settings, such as a company's leave policy [休假制度]. Translation provided the Chinese Ministry of Commerce of Chinese Premier Li Keqiang's work report illustrates how the translation of this term varies based on the context:[22]

- the "system of regional ethnic autonomy" [民族区域自治制度]
- "tighten institutional constraints" [扎紧制度笼子]
- "The fundamental principle and institution of the Party having absolute leadership over the armed forces" [党对军队绝对领导的根本原则和制度]
- "policies and institutions" [政策制度]

It is difficult to convey the full meaning of the term with a word-for-word translation. Throughout this study, *zhidu* is translated as policies, institutions, institutional norms, or systems, depending on the context.

TIZHI

Tizhi is a term most often reserved for discussions when government entities are involved.

- *Tizhi: A general term for the systems, institutions, methods, forms, etc. involved in matters related to the institutional setup, leadership affiliation, and management authority of state organs, political party organizations, enterprises, and public institutions.*[23]

Similar to the term *zhidu*, the true meaning of *tizhi* is often lost in translation. One of Xi Jinping's catchphrases, for example, is often translated as "new whole-of-nation system" *xinxing juguo tizhi* [新型举国体制],[24] but the term *tizhi* here is more akin to a form of governance, a system of social management that includes elements such as institutions, institutional norms, management structure and processes, bureaucratic approaches, rather than simply a system.

Arguably, understanding the term *tizhi* is key to understanding China's political system and culture. For this reason, throughout this study, it is not translated but kept in its pinyin form.

In summary:

Xitong	系统	System(s)
Tixi	体系	System(s) of Systems [SoS(s)] for the six MCF ecosystems, otherwise System(s)
Jizhi	机制	Mechanism
Zhidu	制度	Context-specific (policies, institutions, institutional norms, or systems, etc.)
Tizhi	体制	Tizhi

Section 1: MCF: An Overview

This section provides an introductory overview of the Military-Civil Fusion Strategy.

Section 1.1 traces the evolution of MCF as a concept across five generations of leaders whose policies and efforts collectively formed the basis of Xi Jinping's MCF strategy. A significant portion of Xi's MCF blueprint can be traced back to initiatives launched in the Jiang Zemin era. Therefore, understanding the historical evolution of the concept is important when assessing the current state of strategy.

Section 1.2 first breaks down the MCF strategy into its core components, namely the "6+3+n+1" blueprint (examined in detail in Section Three), then its basic and ultimate goals and explains how it interacts with China's other national strategic priorities.

Section 1.3 provides a brief analysis of the similarities and differences between the MCF strategy and other countries' approaches to national defense and economic resource allocation in the eyes of Chinese strategists.

1.1 MCF: From Mao to Xi

Chinese strategists acknowledge that all states must seek to balance the competing twin goals of security and development. Examples in Chinese history can be found as early as the Western Han dynasty (206 BCE – 9 CE) with the Tuntian System [屯田制], which used farmers, soldiers and merchants to settle border areas while providing logistical support to the military.[25]

Since the founding of the People's Republic of China, each generation of leaders of the Chinese Communist Party (CCP) has promoted a version of this idea, giving rise to a group of often confusing associated terms.[xiv] Instead of focusing on translating each term in MCF's evolutionary arc, it is more helpful to understand MCF in terms of how each generation of Chinese leaders viewed the relationship between security and economic development.

In PRC's early history, the development of one was perceived as to preclude the other. But with the advent of advanced technologies, this binary view of security and development slowly evolved into a more holistic approach. By officially elevating MCF development to a national strategy, Chinese leaders are signaling that neither should come at the expense of the other and that with careful planning and guidance, a kind of synergy will result, providing fuel for both China's sustained economic growth and defense readiness.

THE MAO ERA: FROM EMPHASIZING DUAL PRODUCTION CAPABILITY TO "DEFENSE PRODUCTION SHALL PREVAIL"

After the end of the Korean War, a consensus emerged among CCP Central leaders that another world war was not imminent, and that China's defense expenditures, which accounted for 30% of the total budget between 1953 and 1958, should be reduced to 20% to divert more resources to economic development.[26] Mao encouraged the defense industries "to build dual-use production lines, to master two sets of production skills on two sets of equipment" to make the transition between defense and civilian production easier.[27] In August 1964, Mao vividly compared the relationship between national defense construction and economic construction to the relationship between "fist" and "bottom," in martial arts, pointing out that only when the "bottom" is "sat tight" (when one's position is steady and aligned, and the core engaged) can the fist deliver a powerful punch ["屁股"坐稳了,打出去的"拳头"才有力量].[28]

Between 1958 and 1965, production of civilian products made up 60.8% of the defense industry's total output value, reaching as high as 74.5% in 1960.[29] But this period was short-lived. With the worsening of the Sino-Soviet relations and withdrawal of aid to both civilian and defense development programs, China's leaders refocused efforts on defense production. The defense industry, which was previously encouraged to produce civilian goods, was criticized for "not attending to its proper duties" [不务正业] and the civilian production lines were promptly removed.[30]

THE DENG ERA: "THE MILITARY SHOULD EXERCISE PATIENCE."

In the early 1980s, Deng Xiaoping and his strategists made the judgment that "peace and development are the themes of today's era, and large-scale wars cannot be waged in a short time."[31] Based on this judgment, the Party refocused its attention on economic development. On June 4, 1985, at an expanded meeting of the Central Military Commission Deng pointed out: "The four modernizations require prioritization. Military equipment modernization is only possible in earnest if the national economy has established a relatively good foundation. Therefore, we (the military) must stay patient for a few years."[32] This was often referred to as the "The military should exercise patience" quote. Following Deng's guidance, national defense and force building took a back seat.

xiv The language used to describe MCF has evolved significantly between different Chinese administrations. The following terms have been used: "military and civilian dual use" [军民两用], "military-civilian integration" [军民结合], combining peacetime and wartime preparations [平战结合], "nestling the military within the civilian" [寓军于民], "military-civilian fusion-style develop path" [军民融合式发展路子], among others.

With regard to the defense industry, in August 1978, Deng underscored the need to liberate its defense industrial base from the Soviet system it copied, which was "a wasteful application of resources and a system that restricts technological development."[33] The prominent problem of the Soviet system, according to Deng, was that the defense industry is "leading a race where it is the only competitor" [孤立地一马当先], therefore unable to drive civilian industries or overall technological development.[34] Of course, this sort of competition was only made possible in the environment created by the subsequent beginnings of a market economy in China.

THE JIANG ERA: BALANCE ECONOMIC AND MILITARY DEVELOPMENT, WITH ECONOMICS IN THE LEAD

The imposition of an embargo on military equipment sales to China in the wake of the Tiananmen Massacre in 1989 after more than a decade of access to new technologies brought home China's need for self-reliance in advanced technology. The United States' decisive victory in the Gulf War, the arrival of the revolution in military affairs, air campaigns against Bosnia (1995), and Kosovo (1999) acted as a wake-up call for Chinese leaders that China must prepare for an entirely new form of warfare.

While continuing to prioritize economic development, Deng's successor Jiang Zemin, who took office in 1993, began tipping the balance back toward defense by highlighting the need to continuously strengthen the defense forces. In January 1993 Jiang also set out a new strategic guideline [战略方针] directing the PLA to "place the basis of preparations for military struggle on winning local wars that might occur under modern especially high-technology conditions."[35] Winning wars under these conditions would require significant modernization while not sacrificing continuing economic development. Accordingly, beginning with Jiang, the scope of civil-military integration expanded beyond the defense industrial base to include infrastructure, logistics, education, and others. Several core components of Xi Jinping's MCF blueprint can be traced back to the Jiang era. For example, Jiang proposed:[36]

- Improving military-civilian compatibility
- Combining military facilities and civilian infrastructure
- Relying on national education system to train military officers
- Establishing a military-civilian compatible logistics support system
- Improving the efficiency of the use of funds and materials
- Promoting dual-use technologies
- Constructing a *civil-military integrated national defense technological and industrial SoS* that nestles the military within the civilian, cooperates vigorously, and innovates independently[37]

THE HU ERA: MILITARY-CIVIL FUSION-STYLE DEVELOPMENT

Hu Jintao, who assumed office in 2003, refined Jiang's vision for CMI and proposed to pursue *a military-civil fusion-style development path with Chinese characteristics* [走出一条中国特色的军民融合式发展路子], marking a shift in terminology from *integration* [结合] to *fusion-style* [融合式].[38] Hu called for the expansion of CMI into new areas and highlighted the need to bring together defense modernization and economic and social development from a higher standpoint, with a wider scope, and achieve a deeper level integration.

Hu's blueprint consisted of four Systems of Systems (SoS), all of which are included (in original or slightly altered form) in Xi's roadmap for MCF:[39]

- *The weaponry research and production SoS*
- *The military personnel training SoS*

- *The military support and sustainment SoS*
- *The national defense mobilization SoS*

Military-Civil Fusion was mentioned in Hu's 17th Party Congress report in 2007 and became an integral part of national strategic planning with its inclusion in the 12th FYP.[40] A key State Council policy document that paved the way for the private industry's entry into the defense industrial base was released early in Hu's term in 2005.[41] In 2012, Hu's 18th Party Congress report called for formulating strategies to guide MCF development, along with the management structure and legal framework."[xv] Hu also proposed to align the design and formulation of China's national defense strategies with its national development strategies.

THE XI ERA: FROM "EARLY-STATE FUSION" TO "DEEP FUSION"

In December 2012, Xi Jinping, the then newly-appointed General Secretary of the Central Committee of the CCP and Chairman of the CMC, acknowledged Hu's military-civil fusion-style development path with Chinese characteristics as an important lesson from the PLA's force building history.[42] Speaking at an expanded meeting of the CMC [中央军委扩大会议] that month, Xi offered his assessment of existing efforts and achievements, noting "we have only just emerged from an initial phase of MCF-style development" [我们初步走出一条军民融合式发展路子].

Although commentators generally regard 2015 as the watershed moment for MCF's elevation to a national strategy, Xi spoke of MCF development as a national strategy [军民融合发展作为一项国家战略] as early as the plenary meeting of the PLA delegation at the 2nd Session of the Twelfth National People's Congress held in March 2014, explaining that MCF development concerns both national security and China's overall development and is a "move to rejuvenate the nation and a strategy to strengthen the armed forces" [关乎国家安全和发展全局, 既是兴国之举, 又是强军之策].[43]

At the plenary meeting of the PLA delegation at the 3rd Session of the Twelfth National People's Congress held in March 2015, Xi Jinping remarked that a question he ponders frequently is how to balance development and security in the [formulation] of the overall national strategy, and stated that the elevation of MCF development into a national strategy represents an answer to that very question.[44] Xi offered his assessment of the current status of MCF development in China and called for its transition from "*early-state fusion*" [初步融合] to "*deep fusion*" [深度融合].

On July 21, 2016, the *Opinion on the Integrated Development of Economic Construction and National Defense Construction (2016 Opinion)* [关于经济建设和国防建设融合发展的意见] was released by the CCP Central Committee, the State Council, and the Central Military Commission (CMC). As of writing, the *2016 Opinion* is believed to be the only public (partial summary) authoritative document on MCF development to date. Since then, MCF has come to the forefront and entered a stage of rapid development.

A NOTE ON TIMING

While Xi fully reaffirmed the overall direction of MCF set out by his predecessors, he was not satisfied with its slow progress and critical of its weak operationalization.[45] In December 2014, at the All-Army Equipment Work Conference [全军装备工作会议], Xi articulated his concerns:[46]

> *"We have made great efforts in promoting military-civil fusion in the fields of defense technology and weapons and equipment development, but the (problematic) mindsets [思想观念], tizhi barriers [体制障碍],*[xvi] *and vested*

xv The original text is: "加强军民融合式发展战略规划, 体制机制建设, 法规建设. 已经为军民融合提升为国家战略打下了伏笔."

xvi As explained in the Introduction Section, *Tizhi* includes elements such as institutions, institutional norms, management structure and processes, bureaucratic approaches.

interests [利益藩篱][xvii] *that have been restricting the development of military-civil fusion still exist. Integration is a problem that has yet to be resolved."*

Xi's comments spotlighted the crux of the problem and explained, at least partially, the timing for elevating MCF development to a national strategy. Prior to 2014, the notable developments under the MCF initiative have largely been confined to areas where there was little friction or vested interests.[47] The further development of MCF will inevitably involve the consolidation of resources and interests, as well as readjustment of mindsets and work styles, which had previously led to clashes and conflicts.[48]

Chinese scholars also noted that the general public, or even actors in the traditional domains involved in CMI, have collectively displayed a lack of recognition of the importance and nature of MCF. In a study exploring the intricacies between China's defense modernization and the MCF strategy, Brian Lafferty examined the "mindset" issue Xi highlighted, which Chinese researchers have been cataloging for years:[49]

- *A persistent superficial understanding of CMI, relating to what it entails, why it is important, and how it should guide behavior;*
- *A widespread persistence of "no action, no initiative, no self-reliance" [deng, kao, yao, 等, 靠, 要] behavior among lower-level officials;*
- *A lingering … lack of buy-in from actors impacted by the reform."*

Bi Jingjing [毕京京], deputy commandant [副校长] of NDU between 2012 and 2017, noted the following outward expression of these problems:[50]

- "I'm willing to 'fuse' others but not willing to 'be fused' by others."
- "It is okay for others to share resources with me, but I will not share my own resources."
- "My game, my turf, my rules."

In short, tizhi impediments, problematic mindsets, and vested interests together contribute to the "deep-seated structural issues" that has held back progress. PLA NDU's *Report on the Development of Military-Civil Fusion in China (2016)* noted that an evaluation of economic and defense construction at the end of the 12th FYP concluded that progress had been unsatisfactory.[51] To effect change and drive results, at the first meeting of the Central Commission for Military-Civil Fusion Development on June 20, 2017, Xi Jinping used a long list of emphatic phrases to highlight the urgency of the task. He urged officials to "break down ramparts, break through solid ice, remove barriers…wade through dangerous shoals, 'move (people's) cheese,'[xviii] resolve difficult problems, overcome obstacles, try out new ideas, and open new paths."[52]

xvii This problem is most severe with the defense industrial base, which is discussed in more detail in section 3.1.2.

xviii This phrase likely comes from a self-help book published in the United States in 1998 called "*Who Moved My Cheese? An Amazing Way to Deal with Change in Your Work and in Your Life*," which was translated into Chinese and became a big hit in China in the early 2000s. Xi Jinping is using "cheese" to refer to vested interests. He also used the term in his interview with the *Wall Street Journal* (WSJ) on September 22, 2015, but WSJ left the term out in its translated version. In the Chinese original, Xi said "This round of reforms has truly 'moved cheese'; it is a serious move. Any reform will inevitably upset someone's vested interests and change how they work and live." "改革是真动了奶酪, 动了真格, 改革必然会触及一些人的既得利益, 改变一些人的工作和生活状态." See Li Shiquan [李仕权], "12 Quotes from Xi Jinping Will Help You Understand His *Wall Street Journal* Interview" [12大金句, 带你快速读懂习近平接受《华尔街日报》采访], *People's Daily Online*, 23 September 2015. http://politics.people.com.cn/n/2015/0923/c1001-27625702.html.

1.2 Military-Civil Fusion as a Grand Strategy

On June 20, 2017, Xi Jinping, speaking to the Central Commission for Military-Civil Fusion Development [中央军民融合发展委员会/CCMCFD], articulated his vision for the Military-Civil Fusion strategy:[53]

> *"We must accelerate the formation of a full-element, multi-domain, and high-return military-civil fusion deep development pattern, and gradually build up China's unified military-civil system of strategies and strategic capability."*[xix]

Four months later, Xi reiterated this vision to the national audience, referencing "military-civil fusion" three times in his 19th Party Congress speech delivered on October 18, 2017.

This seemingly simple statement was carefully crafted. According to PLA National Defense University researchers Jiang Luming, Wang Weihai, and Liu Zuchen, the first and latter halves of Xi's statement respectively represent the basic (near-term) and ultimate (long-term) goals of the strategy.[54]

According to Jiang et al., the "military-civil fusion deep development pattern," characterized by its inclusion of key elements and multiple domains while delivering high returns, serves as the basic, near-term goal of the strategy [基本目标].[xx, 55] Jiang et al. further argue that once this "pattern" is achieved, China can work toward achieving the ultimate goal [终极目标] of the strategy, which is the gradual build-up of its "unified military-civil system of strategies and strategic capability" [军民一体化的战略体系和能力].[xxi, 56]

This interpretation is supported by a Guangming Daily article published on November 16, 2017, one month after Xi's Party Congress speech that called for "in-depth implementation of the military-civil fusion strategy."[xxii] The article argues that in order to implement the strategy, it is necessary to gain an in-depth understanding of its goals. It notes:[57]

---

xix The original text is "加快形成全要素, 多领域, 高效益的军民融合深度发展格局, 逐步构建军民一体化的国家战略体系和能力." The Chinese term "Geju" [格局] is translated as "pattern" to retain the literal meaning of the word, but note that here the term implies a dynamic state of development.

xx This rendition is supported by the 2016 Opinion, which identified the "state of military-civil deep fusion" as the primary goal of the integrated development of economic and national defense construction [经济建设和国防建设融合发展的主要目标]. See "CCP Central, State Council, CMC release Opinion on the Integrated Development of Economic Construction and National Defense Construction" [中共中央国务院中央军委印发《关于经济建设和国防建设融合发展的意见》], *Xinhua*, 21 July 2016, http://www.xinhuanet.com//politics/2016-07/21/c_1119259282.htm.

xxi While the literal translation is used throughout the report, this idea is perhaps better understood as a "unified and coordinated system of military and civilian development strategies and strategic capability."

xxii The author is given as Zhong Xin [钟新], likely a pseudonym chosen since it is a homophone for Central [中心]. For other examples of the Chinese government's use of homophones for pen names see: David Gitter and Leah Fang, "The Chinese Communist Party's Use of Homophonous Pen Names - An Open-Source Open Secret," in *Asia Policy* 13.1, 31 January 2018. https://www.nbr.org/publication/the-chinese-communist-partys-use-of-homophonous-pen-names-an-open-source-open-secret/

The 19th Party Congress report put forward clearly the requirement to form a military-civil fusion deep development pattern and gradually build up China's unified military-civil system of strategies and strategic capability. Presently and for some time to come, we must focus on this goal, adhere to the holistic national security concept, implement Xi Jinping's strong military thought, uphold Party leadership, strengthen state leadership, focus on integration and sharing, give market a role to play, deepen reform and innovation, promote the transition from military-civil early-state fusion to deep fusion to achieves leapfrog development. Overall, we should strive to form a full-element, multi-domain, and high-return military-civil fusion deep development pattern by 2020.

The end goal of the military-civil fusion deep development is to build up China's unified military-civil system of strategies and strategic capability, that is, to achieve a balance between national development and national security, to unify building a prosperous nation and a strong military, to integrate economic construction and national defense construction, to simultaneously enhance economic strength and national defense strength, to achieve unity and fusion in the strategic planning of various domains, to integrate resources of various aspects, to form a strategic posture that enables the integrated deployment of forces of politics, economy, military, science and technology, diplomacy, and culture, to enhance the country's overall strength and strategic competitiveness, and safeguard national sovereignty, security, and development interests.

It should be noted that both the *2016 Opinion* and writings from various groups of MCF strategists used the term *mubiao* [目标] (translated here as "goal") to denote a navigational point toward which effort should be directed, rather than the effect expected to be derived from MCF development. In other words, Xi Jinping's statement represents a roadmap for MCF development, explaining what the strategy entails and how to reach the goal. However, when it comes to the intended effect of MCF or the question of why the pursuit of MCF deep development is crucial, Xi has only made a few minor remarks reported in official media. At the CCP Central Politburo meeting held on March 26, 2016 that reviewed and passed the *2016 Opinion*, Xi called the MCF strategy "a grand strategy that benefits the nation, the military, and the people" [一项利国利军利民的大战略], but the exact meaning of this statement has been left open to interpretation.[58]

One interpretation argues that MCF development can contribute to four major positive outcomes:[59]

First, MCF can support China's transformation into a powerful nation [由大到强]. China is currently at a critical stage of this transformation. Faced with internal and external challenges to development and security challenges, there is an urgent need for major improvements China's national defense capabilities. At the same time, its economic development has entered a stage of slowed growth, prompting the need for defense construction to play a bigger role in driving economic growth (see 1.2.1.3 for detail).

Second, MCF can help China gain advantages in international technological and military competitions. As major powers continue to increase investment in the development of disruptive technologies, there is an urgent need for China to close the gap and even surpass these nations in terms of S&T development. The MCF strategy includes measures to integrate the nation's military and civilian S&T resources and enhance the military-civil coordinated innovation capability (see 3.1.2 for detail), which will contribute to a strong military and the dream of building a Scientific Great Power.

Third, MCF provides an excellent opportunity for the improvement of China's governance system. Despite previous efforts at integration, the military and the civilian sectors are still largely separate, leading to wasteful use of national resources and low efficiency. The implementation of MCF enables the creation of a governing system across sectors, government bodies, and domains (see Section 2 for detail).

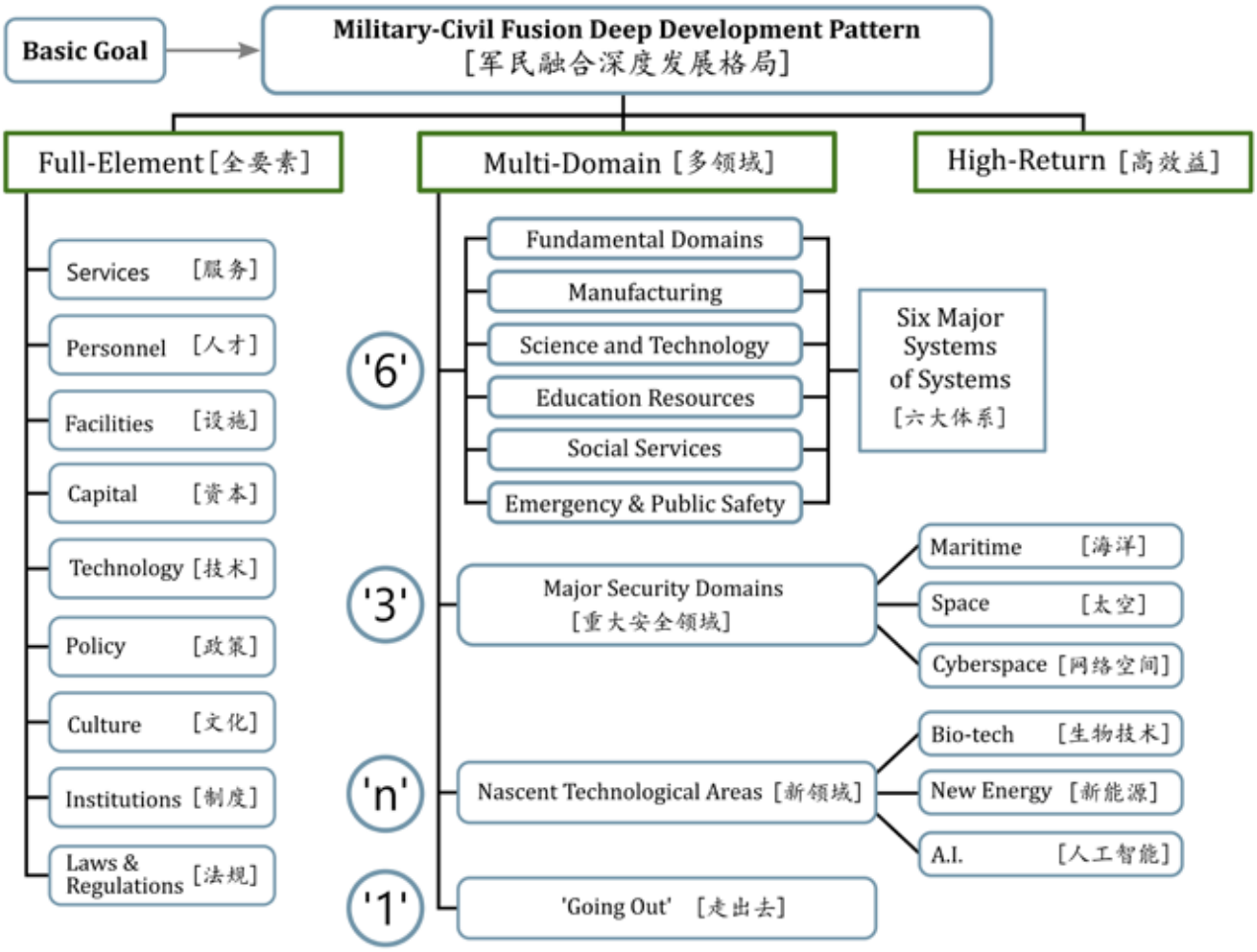
Fourth, MCF supports the construction of a world-class military. The Party's goal of building a strong, world-class military in the new era rests on China's strong economic strength, scientific and technological strength, and comprehensive national strength. The MCF strategy is meant to work in coordination with China's other great power strategies in the manufacturing, maritime, space, cyberspace domains to leverage high-quality resources to support defense construction (see 1.2.2 and 3.2 for detail).

1.2.1 "Basic Goal"

The near-term goal of the strategy is to form the "military-civil fusion deep development pattern." Understanding the "pattern" requires an examination of its three core characteristics, which are described as "full-element," "multi-domain," and "high-return."

The "full-element" attribute defines the types of resources shared between the military and civilian sectors; the "multi-domain" attribute identifies the domains prioritized for MCF development.[60] Taken together, they provide a roadmap for MCF development, explaining how China plans to achieve the deep fusion pattern. While subject to modifications, these areas, outlined in the chart below, serve as the "backbone" of the MCF strategy. The last attribute—"high return"—describes the effects Chinese leaders and MCF strategists hope to derive from MCF development.

The graphic below illustrates the core components of the "military-civil fusion deep development pattern" based on the literature examined for this study.[61]



1.2.1.1 "Full-Element"

The "full-element" attribute was the least-well defined and was given the least amount of attention in the research works analyzed in this study. The *2016 Opinion* failed to give a specific definition. However, NDU strategists offered a description in their 2017 book, noting that the "full element" attribute calls for the fluid movement of a whole host of assets (elements), tangible or intangible, between the national defense [国防系统] and economic systems [经济系统] to ensure the optimal use of resources in achieving economic or military development. These elements include:

> *Technology, personnel, services, capital, facilities, information, management systems and practices, standards, policy, governing norms, laws and regulations, and culture* [62]

The essential argument is that without the promotion of MCF, resources allocated to these two systems stay with their respective system. As a result, they are not fully utilized, and idle resources go to waste. If the initial allocation of defense and economic resources is not optimal, a course correction can be achieved through the free flow and interaction of the above elements to alleviate the imbalance resulting from resource allocation planning.[63]

These factors form a useful matrix to evaluate the effectiveness of the MCF strategy in future studies. Namely, for a given area, the more elements that are observed to be shared amongst the entities, the deeper the level of integration. For example, as mentioned earlier, China's defense industrial base utilized dual-use production lines and produced a large number of civilian products as early as the 1950s, but the elements involved were too limited to meet the requirements of "deep fusion." China's current, more complex, and interconnected economy offers many more opportunities for the "all element"-level efficiencies hoped for by MCF theorists. While speculative, it appears that the ultimate goal is to achieve a "frictionless" economic system where the boundaries between the two systems are blurred, and resource sharing is highly efficient.

1.2.1.2 "Multi-domain"

Based on the examined literature, the domains[xxiii] that have been identified for prioritized MCF development are listed in the table below, along with the time and occasion for each domain's inclusion into the MCF blueprint (the specific content of each domain is discussed in section 3). Given that the domains selected for MCF development will continue to evolve, the analytical framework provided by Jiang et al. that mapped the "multi-domain" aspect of the strategy as consisting of four segments (6+3+n+1), proves useful.[64] It should be noted that the nascent technological areas presently include biotech, new energy, and artificial intelligence, but the list is deliberately left open-ended as new technologies are expected to be added.

MCF Priority Domains:

Category	Domain	Time of Inclusion
"6" Traditional Domains	Fundamental Domains [基础领域]	*2016 Opinion*[65]
	Manufacturing Domain [产业领域]	
	Science and Technology [科技领域]	
	Education Resources [教育资源]	
	Social Services [社会服务]	
	Emergency and Public Safety [应急和公共安全]	
"3" Major Security Domains	Maritime [海洋]	
	Space [太空]	First CCMCFD meeting[66] (June 20, 2017)
	Cyberspace Security and Informatization [网络安全和信息化/网信]	
"n" Nascent Technological Areas	Biotechnology [生物科技]	
	New Energy [新能源]	
	Artificial Intelligence [人工智能]	Likely July, 2018[67]
"1"	"Going Out" of MCF ["融合"走出去]	Jiang et al.[68] (December 2017)

Related to the "6" traditional domains are the *six Systems of Systems (SoS)* meant to gradually take shape through the promotion of MCF in these domains.[69]

	Domain	System of Systems (SoS)
"6" Traditional Domains	Fundamental Domains [基础领域]	Fundamental Domain Resource Sharing SoS [基础领域资源共享体系]
	Manufacturing Domain [产业领域]	Advanced Defense STI SoS with Chinese characteristics [中国特色先进国防科技工业体系]
	Science and Technology [科技领域]	Military-Civil Coordinated Technology Innovation SoS [军民科技协同创新体系]
	Education Resources [教育资源]	Military Personnel Training SoS [军事人才培养体系]
	Social Services [社会服务]	Socialized Support and Sustainment for the PLA SoS [军队保障社会化体系]
	Emergency and Public Safety [应急和公共安全]	National Defense Mobilization SoS [国防动员体系]

xxiii Multiple components use the term "领域" which can mean area, field or domain. In this report it is translated according to the given context.

The six SoSs are formed by fusing civilian and defense ecosystems that possess high levels of commonality but which have previously been separated into distinct silos.[70] While the domains prioritized for MCF development and the six systems of systems (SoS) are clearly linked, it is useful to think of the "domains" as relatively static, and the SoSs as dynamic ecosystems that operate across domains to achieve operational effects—to enable MCF "deep fusion" to take place.

Whether China can successfully shape up the six SoSs and drive operational effects in domains of interest should be considered a key indicator in the evaluation of the MCF strategy. Of these, the six SoSs (covered in detail in section 3) merit the most attention in this report as their development is crucial to the overall success of the strategy.

The Six Systems of Systems (SoS)

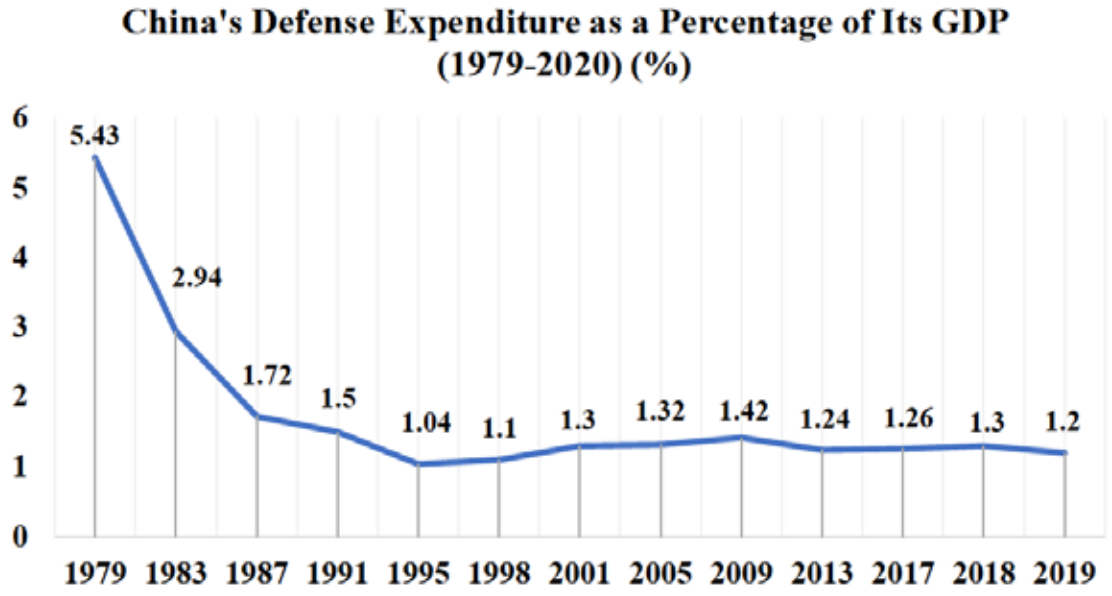
Defense Infrastructure	+	Civilian Infrastructure	=	Fundamental Domain Resource Sharing SoS [基础领域资源共享体系]
Defense Technology Industrial Base	+	Civilian Technology Industrial Base	=	Advanced Defense Technology Industrial SoS [中国特色先进国防科技工业体系]
Defense Innovation System	+	Civilian Innovation System	=	Military-Civil Coordinated Technology Innovation SoS [军民科技协同创新体系]
Military Personnel Cultivation System	+	National Education System	=	Military Personnel Cultivation SoS [军事人才培养体系]
Military Logistics System	+	State Social Service System	=	Socialized Support and Sustainment for the PLA SoS [军队保障社会化体系]
National Defense Mobilization System	+	State Emergency Management System	=	National Defense Mobilization SoS [国防动员体系]

1.2.1.3 "High-Return"

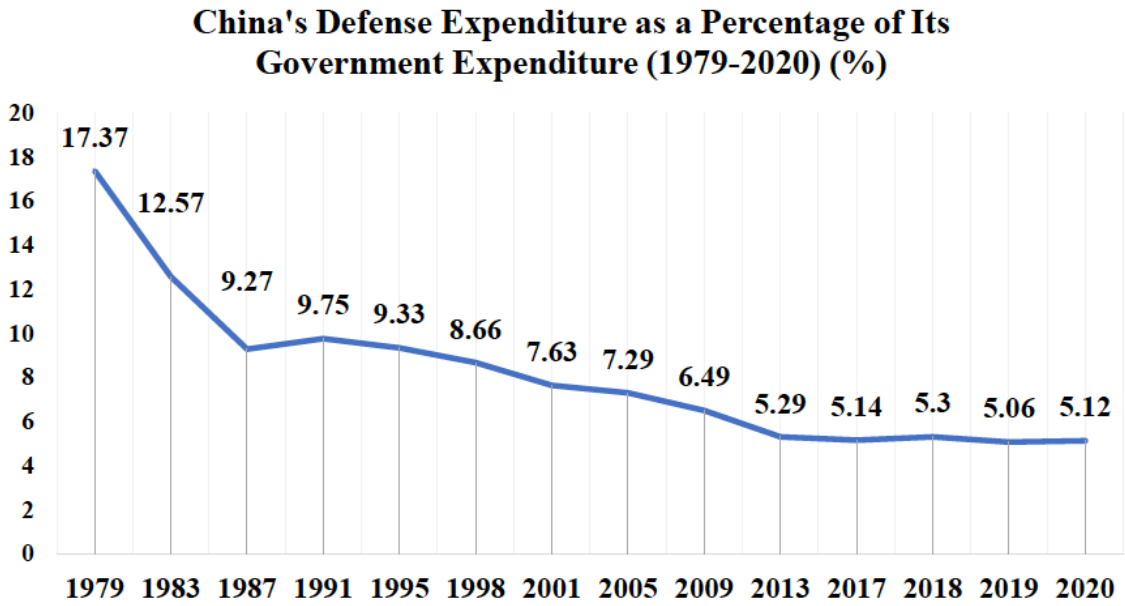
Chinese strategists often underscore the point that the MCF strategy is as much an economic issue as it is a defense issue. In the opinion of NUDT professors He Kun [贺坤] and Zeng Li [曾立], at the core of the "MCF deep fusion" strategy lies the need to continuously enhance the efficiency of military-civilian resource allocation, which, they argue, is essentially an economic issue.[71] Military-civil fusion, they note, asks for "one portion of investment and two portions of return" [一份投入, 两份产出], a saying commonly found in writings on the subject. This argument stems primarily from concerns about the sustainability of defense spending and the slowed state of China's sluggish economic growth. This tension between the competing demands is likely to be even stronger in the near future, given that China's armed forces "are moving towards informatization and shouldering arduous tasks in following the trends of worldwide Revolution in Military affairs" and "there is still a wide gap between China's defense expenditure and the requirements for safeguarding national sovereignty, security and development interests."[72]

While China's annual defense budgets remain substantial ($178 billion for 2020), the rate of growth has slowed in recent years, from 10.1% in 2015 to 6.6% in 2020.[73] This trend can be expected to continue. According to a report by the U.S. Office of the Secretary of Defense, "Over the next few years, China's official defense budget will likely increase by an annual average of 6 percent, growing to $260 billion by 2022."[74]

Official statistics from the 2019 Defense White Paper indicate an overall plateauing of defense spending as a percentage of GDP.[75] The following shows official Chinese estimates presented in the 2019 Defense White Paper, updated to 2019 with the latest official budget estimates.[76] Other estimates, such as those from the Stockholm International Peace Research Institute (SIPRI), include defense R&D budgets, the People's Armed Police and other factors, and arrive at a number higher than that provided by China.[77] By SIPRI's estimate, for example, between 2009–2018, the average defense expenditure as a percentage of GDP was 1.9%.[78]



According to official statistics, defense expenditures as a percentage of overall government expenditures also appear to be declining.[79]



A report published by the Investment Promotion Agency of the Ministry of Commerce (MOFCOM) noted that, over the past decade, China's defense expenditures have accounted for an average of 5.66% of the national fiscal budget, while education, medical care, science, and technology budgets accounted for 14.91%, 5.70%, and 3.93%, respectively.[80] At present, China is in a period of economic transformation, and the growth rate of total fiscal expenditure has slowed down. However, the report notes that a significant reduction in budgets in education, medical care, and other fields is highly unlikely in the near term. Given the data above, the decline in China's defense as a percentage of government expenditures will likely continue, while the Chinese armed forces are still undergoing intense (and expensive) modernization. Under such conditions, it is difficult for defense expenditures to grow in a sustainable manner, making the efficiencies derived from MCF that much more important.

Lafferty's study of MCF and PLA modernization noted that China's resource commitment challenges include declining increases to the defense budget, the increasing cost of next-generation weapons platforms (often by orders of magnitude), and the rapidly rising cost of military operations. He concludes:

> *"As a result, there are no expectations that China can achieve its defense modernization goals solely by increases in the defense budget. Chinese leaders have been clear that the solution to this problem will not be guns-versus-butter budgetary tradeoffs that prioritize short-term military needs at the expense of economic imperatives. Their reluctance to raise defense spending more dramatically stems in part from the belief that it would harm economic growth (and thus the foundation for long-term military strength), as well as from the common perception that one of the major causes for the fall of the Soviet Union was its ruinous attempts to match U.S. military spending."* [81]

The problem of sustainability with its defense expenditure is exacerbated by the growing economic challenges the country faces. After experiencing double-digit GDP growth for much of the past few decades, China's economy has slowed over the past ten years, from above 10% in 2010 to 6.1% in 2019.[82] Growth was projected

to continue to gradually fall for the foreseeable future,[83] with forecasts of under 6% for 2020, even before the COVID-19 pandemic.[84]

Slower growth was caused by a variety of factors, including the aftermath of the global financial crisis, slowing exports, rising labor costs, aging population and declining labor supply, and decreased productivity.[85, 86] In 2014, Xi Jinping began using the term "new normal" to refer to the slower state of the economy and urged for measures to shift the growth model from an economy driven by inputs and investment to one increasingly driven by innovation.[87] Supply-side structural reforms [供给侧结构性改革], which "target the structure of production to make it more efficient at the macro and firm level," were announced in late 2015 and have evolved into a core component of China's economic policy agenda.[88]

Debt represents another major concern. Both firms and local governments have had high levels of debt in recent years, with China's overall debt hitting over 300% of GDP in Q1 2019 by one measure,[89] creating systemic risk that could lead to a financial crisis. The government has been trying to reduce debt through deleveraging and even allowing some defaults, which hurts growth in the short term but helps limit risks in the long term. However, in 2018 and 2019, Beijing shifted back to some easing and stimulus policies, raising concern about its balancing of growth vs. reforms and commitment to deleveraging. The trade war with the U.S. has also weighed on the Chinese economy.[90] Though a "phase one" trade deal was signed in January 2020, the trade conflict appears far from settled.[91]

The annual Central Economic Work Conference [中央经济工作会议], which is attended by China's highest officials and sets the economic agenda for the year, provides a window into the Party's priorities. At the 2019 meeting, a key takeaway was the emphasis on "stability," as in "stability first" [稳字当头].[92] In particular, there are the "Six Stabilities" [六稳]: employment [就业], finance [金融], trade [外贸], attracting foreign investment [外资], investment [投资], and expectations [预期], with employment as the most important [位列"六稳"首位].[93] In addition to "stability" and moving forward with the economic restructuring and transition, other CCP priorities laid out include the "three tough battles" [三大攻坚战] of reducing (financial) risks, poverty alleviation, and combating pollution. 2020 is also the deadline for a major CCP goal: achieving a "comprehensive moderately prosperous society" [全面建成小康社会], defined by reaching $10,000 per capita GDP. At the time of writing, these already weighty challenges are growing even more formidable as China and the whole world continues to assess and deal with the fallout from the COVID-19 pandemic.

Faced with these challenges and constraints, Beijing regards the successful integration and implementation of the Military-Civil Fusion strategy with the Innovation-Driven Development Strategy and the Supply Side Structural Reform as vital to coming through this transition unscathed. By delivering returns on investment for both sectors, MCF development could offer a solution, or at the least helping offset future declines in defense spending.

Jiang et al. outlined the economic benefits expected from the strategy in its early implementation stage as follows:[94]

- Unleash pent-up demand: Military-Civil Fusion helps unleash pent-up demand by opening business opportunities that were previously solely under the military or the defense industrial base's purview to the broader economy. The civilian economy's participation in the PLA's mechanization and informatization drive will also act as a driving force for economic growth.
- Stimulate technological innovation: The accelerated transfer of high-quality innovation resources and technologies from the military and defense industrial base to the civilian sector is expected to stimulate innovation and enhance vitality, giving birth to new technologies, new products, and new industries, and accelerate the structural transformation of the economy. In his discussion of China's 14th Five Year Plan and the MCF strategy, Tan Yungang [谭云刚], a military acquisition expert, urged the formation of "national teams" made up of state-owned defense conglomerates and influential private enterprises in strategic

emerging domains.[95] Tan asked, "If Huawei, Tencent, Alibaba, Baidu are deeply integrated with Datang Telecom, Ziguang Group, Tsinghua Tongfang, and Tongxin Software, will Intel, Google, Microsoft, and Apple still be so full of swagger [牛]?"

- Create employment opportunities: The industries and sectors identified for MCF develop involve many high-end manufacturing and service industries, and the jobs created are generally a good match with the skill sets of college graduates, whose employment prospect has become a major issue in the country.
- Use Resources Efficiently: Breaking down systemic barriers between the military and the civilian sectors and dismantling the "high walls" of vested interests and introducing market forces will help eradicate the persistent problems of duplicated efforts, inefficiency, inadequate resource sharing, and reduce serious waste in civil and military sectors, ensuring that limited national resources are used efficiently for security and economic development.

1.2.2 "Ultimate Goal"

Although boosting demand, saving resources, and creating jobs are important near-term goals for the MCF development, the end goal of the MCF strategy is to *gradually* build up China's "unified military-civil system of strategies and strategic capability."

Jiang et al. argue that, at the most fundamental level, MCF embodies a state governance approach.[96] According to them, informatized warfare is essentially a systemic confrontation between states, manifested in the competition and confrontation of their respective national strength, national defense strategies, the degree of civil-military integration and the synergy of the national defense tizhi and mechanisms [主要表现为国家综合国力, 国防发展理念, 军民融合程度, 国防体制机制整体合力之间的较量和对抗].[97] As a result, they conclude that:[98]

> *Ultimately, the active promotion of civil-military integration by the world's major countries is not intended to solve the problem of resource conservation or the "generational gap" in technology and equipment, but rather to bridge the "institutional deficit" in ability to unify the country's overall security and development and build up a military-civil system of strategies and strategic capability.*[99]
>
> *This extraordinary international competition is directly related to contention for national security and development dominance in the Information Age; behind the curtain lies a confrontation of ideas and concepts in modern national governance, the competition of institutions and systems, and the competition to see whose system is more adaptable and capable of change, and which is more capable of gathering national will and the strength of society as a whole to support national security and development through deep integration.*

As the term suggests, a unified military-civil system of strategies and strategic capability consists of two interrelated components: 1) a set of well-coordinated national strategies and 2) the strategic capability this set of strategies generates. Writing in *China National Defense News* in September 2017, AMS professors Yu Chuanxin and Liu Zhiwei explained that "national strategic capability" is the ability to use strategic resources and means to achieve strategic ends.[100] It follows that the success of the latter hinges on the former.

HOW MCF MIGHT INTERACT WITH OTHER NATIONAL STRATEGIES

The "unified military-civil system of strategies" calls for weaving the components of the MCF strategy into other national strategic priorities to achieve an organic, powerful, and comprehensive national system of strategies.[101] AMS professor Yu Chuanxin spoke highly of the MCF strategy's far-sightedness, calling it a "multi-dimensional comprehensive blueprint" [多维度布局的总体规划]. However, perhaps due to the fact that this is a longer-term goal, neither country leaders nor strategists have clearly articulated how the various pieces of the MCF strategy will fit into the larger picture to form the system of strategies.[xxiv, 102]

Xi's 19th Party Congress report merely listed the MCF strategy along with six other strategies to be 'resolutely' implemented.

- The strategy of "rejuvenating the nation through science and education" [科教兴国战略]
- The strategy of "rejuvenating the nation through talents" [人才强国战略]
- Innovation-driven development strategy [创新驱动发展战略]
- Rural revitalization strategy [乡村振兴战略]

xxiv One can reasonably expect that MCF tasks will be incorporated into the Five-Year Plans going forward. The various CCP Central Commissions and Leading Small Groups (discussed in Section Two) in charge of each area of development will probably remain an effective communication channel for the coordination of these strategies. The fourteenth FYP, once released, will also shed light on this issue.

- Regional coordinated development strategy [区域协调发展战略]
- Sustainable development strategy [可持续发展战略].

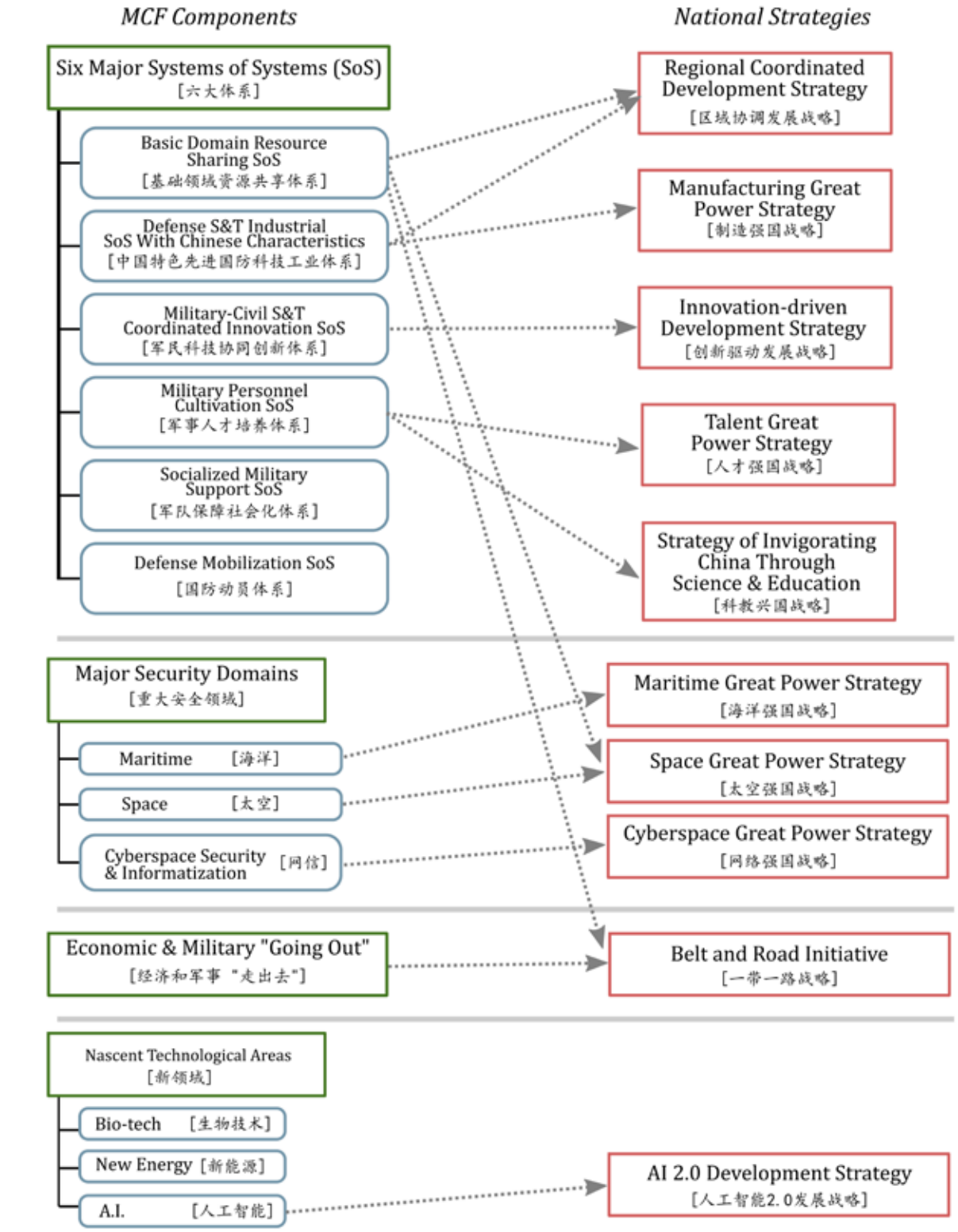
Xi's list appears incomplete and a far cry from a "multi-dimensional comprehensive blueprint." Besides the aforementioned strategic priorities, the MCF strategy has been discussed in the same breath as other national strategic priorities such as the Belt and Road Initiative [BRI/一带一路倡议] and the "Great Power strategy" series [强国战略] covering domains from manufacturing, maritime, to space, and cyberspace.[xxv]

Jiang et al. provided a useful framework that puts Chinese strategic priorities into perspective, dividing them into three tiers. The first tier consists of strategies at the most macro level, which under the Xi administration include only two strategies: the BRI and the innovation-driven development strategy. The second tier concerns national strategies for critical domains, and the third tier is comprised of the various regional development strategies.

The graphic on the next page illustrates how each core component of the MCF strategy might interact with the national strategic priorities described above. Section Three provides more details as to the interactions.

xxv While the various "power nation" strategic priorities might not be explicitly stated as a "strategy," government officials and researchers generally treat this series as de-facto national strategies. For example, when the 18th Party Congress report proposed to "build a Maritime Great Power," an official from the State Oceanic Administration explained that the proposal to "build a Maritime Great Power" signifies that China's development plan for the maritime domain has officially risen to the national strategic level. He also notes that to have an effective national strategy planning at the industrial or departmental levels must take those higher-level goals into account. See Zhang Yue [张月], "China's Grand Chessboard Strategy for Achieving Maritime Great Power Status" [海洋强国大棋局], *Xinhua*, 23 March 2018, http://www.xinhuanet.com/globe/2018-03/23/c_137059316.htm.

China's Unified Military-Civil System of Strategies*



***: Chart represents the author's interpretation of reviewed materials**

1.3 MCF with Chinese Characteristics?

Chinese scholars and experts have closely studied the various MCF/CMI models of other nations, most notably, of the United States, Japan, Israel, and the Soviet Union. Chinese MCF analysts have adapted or rejected various aspects of each model. They found in the Soviet Union's model, where the defense system is prioritized over the civilian system [先军后民], a lesson to be learned and an approach to be avoided. The Israeli model, which they termed "Driving the Civilian with the Military" [以军带民], and the Japanese model which the Chinese call, "Concealing the Military among the Civilian" [以民掩军], both included elements that China could borrow from. But it is the United States model that they have unquestionably looked to for inspiration.[xxvi]

International Models of Military-Civil Interaction According to Chinese Analysts[103]

United States	"Civil-Military Integration"	"军民一体化模式"
Russia	"Military-Over-Civilian"	"先军后民"
Japan	"Concealing the Military among the Civilian"	"以民掩军"
Israel	"Driving the Civilian with the Military"	"以军带民"

The influence of the U.S. model can be seen in the influence of a report from 1994 titled "Assessing the Potential for Civil-Military Integration" and published by the former Office of Technology Assessment's (OTA), which is frequently cited by Chinese scholars studying MCF.[xxvii] The report also gave rise to the Chinese term "*Junmin Yitihua*" [军民一体化], which in Chinese language discussions is mostly associated with the U.S. model of civil-military integration (CMI).[xxviii] This term is so much preferred that it is used in the description of the ultimate goal of the MCF strategy—the unified military-civil system of strategies and strategic capability.

The United States [美国] is frequently referenced in authoritative writings on MCF. As Elsa Kania has noted, "China's initiatives in military-civil fusion are informed by a close study of and learning from, the U.S. defense industry and American defense innovation ecosystem to an extent that can be striking."[104] Jiang et al.'s book on the MCF strategy referenced "United States" 131 times. Based on Jiang et al.'s assessment, with respect to weapons and equipment R&D, the United States has completed the integration of the defense technological and industrial base with the commercial technological and industrial base as early as in 2000. But according to Jiang et al.'s data, as of 2017, China's level of integration was only 36-40%.[xxix, 105]

A two-volume collection of essays written for the MCF Development Forum by AMS's Military-Civil Fusion Research Center mentioned "United States" 373 times. NUDT's researchers' book on defense resource allocation includes 486 references. Additionally, AMS's Yu Chuanxin and Liu Zhiwei devoted a whole book to the study of the Defense Advanced Research Projects Agency (DARPA).[106] In discussing China's defense acquisition reform, NUDT researchers went into painstaking detail to explain how such a process works in the United States, demonstrating great familiarity with core components of the DOD's defense acquisition system such as the Planning, Programming, Budgeting, and Execution (PPBE) process and the Joint Capabilities Integration and Development System (JCIDS).[107] Zeng reasoned that as the largest developing nation in the world, it is only natural for China to borrow the Joint Capabilities Integration and Development System—a clear success—from the United States, the world's largest developed nation.[108]

---

xxvi It should be noted that the characterizations of these models reflect the Chinese analysts' own understanding of each country's military-civil interaction. These countries' military-civil interaction may be quite different in reality. These nations do not use these terms to refer to their civil-military interactions this way.

xxvii The OTA was an advisory office under U.S. Congress that operated between 1972 and 1995.

xxviii Baidu Baike's explanation of the term Junmin Yitihua states that there is not a clear definition of the term and again borrows OTA's definition of CMI. See https://baike.baidu.com/item/%E5%86%9B%E6%B0%91%E4%B8%80%E4%BD%93%E5%8C%96.

xxix The authors did not offer further details regarding these figures.

It is also worth noting that Chinese researchers are continuing to derive inspiration from the latest developments in the United States. Official MCF-themed social media accounts run by government agencies or government-affiliated think tanks publish articles about the latest developments in this arena in the United States on a fairly regular basis. And as noted in section 3.1.3, the CMC Science and Technology Committee has commissioned long-term, routinized information collection, translation, and analysis of defense technology developments abroad.

While some may argue that the U.S. model only bears some similarities to a subcomponent of China's MCF strategy, namely, the *defense industrial SoS*, Chinese researchers have certainly received inspiration from other nations' models when considering other components as well.

These scholars note that developed nations promote military-civil fusion in the following ways:[109]

- They adopt a whole-of-society approach to promote the informatization of their military forces (i.e., use of private firms and technological platforms for defense purposes).
- Lockheed Martin, Boeing, and other large military-industrial groups have always maintained a high proportion of outside contractors, many of which later themselves became major enterprises in military research fields. This means that there are "onramps" to encourage new entrants into the field, which promotes innovation.
- In recent conflicts, more than 80% of the U.S. Military's logistical and technical support personnel were provided by contractors and reservists, "essentially realizing socialized (meaning civilian) support for the military."
- Military cadets are largely trained by the national education system. In developed countries, upward of 70-80% of cadets come from local universities. In recent years, the PLA's proportion of cadets trained by our national education system is less than 30%.
- Developed countries already effectively utilize their civilian infrastructure for defense purposes, designing expressways, service stations, and tunnels to accommodate or enhance military use.

Section 2: MCF Management Structure

This section will assess the powers and functions exercised by the MCF strategy to achieve its goals. It will first describe the key nodes (chiefly, Party, State, military organizations) and pathways that make up the national infrastructure for the design and implementation of the MCF strategy, then examine the operational and policy systems.

The major obstacles hindering the progression of military-civil fusion from its "early-state" to "deep fusion" are characterized by the *2016 Opinion* and senior Party leaders as:[110]

- *Tizhi* barriers [体制性障碍]
  As explained in the Introduction Section, *tizhi* is a general term for the systems, institutions, methods, forms, etc. involved in matters related to the institutional setup, leadership affiliation, and management authority of state organs, political party organizations, enterprises, and public institutions. Here Chinese leaders and MCF researchers are using the term to describe all forms of current structures and systemic barriers across the bureaucracy that prevent communication, cooperation, and coordination and hinder increases in performance.

- Structural issues [结构性矛盾]
  While this term is frequently used in MCF writings, few authors go into great detail. Jiang et al. explain that simultaneous with the growing need for greater security and development, there is a "relatively insufficient" supply capacity of highly advanced weapons and equipment and an excessive supply of lower-end products.[111]

- Policy issues [政策性问题] and incomplete legal framework [法治还不健全]
  Chinese leaders believe that the numerous regulatory documents in the field of MCF have not achieved desired results and are pushing for the passing of a national MCF law that can have a strong binding force on both military and civilian actors (discussed in Section 2.3).

In essence, Chinese leaders believe that MCF "deep fusion" cannot be achieved until these issues are resolved. To address these issues, Xi prescribed the construction of the "three systems" [三个体系][112] which consist of the following:

- An organization and management system [组织管理体系] that features unified leadership, coordination between the military and the civilian sectors, and unobstructed and highly effective pathways of communication [统一领导, 军地协调, 顺畅高效].
- An operational system [工作运行体系] that unifies Party/state leadership, defense requirements, and market operations [国家主导, 需求牵引, 市场运作相统一].
- A comprehensive and systematic legal, regulatory, and policy system [政策制度体系] that is intricately linked and incentivizes effectively [系统完备, 衔接配套, 有效激励].

Arguably, the "protocol order" in which they were listed reveals the mindset of China's decision-makers. Even though "supply and demand" and "market operations" are emphasized here, Party and state leadership's ability to institute and implement policies remain key to the strategy's success. Whether this perception correctly reflects reality is a question for debate.

2.1 MCF Organization and Management System

Xi's first "system" is described as an organization and management system that features unified leadership, coordination between the military and the civilian sectors, and unobstructed and highly effective pathways of communication. This essentially means the creation of an organizational structure responsible for overseeing, implementing, and coordinating the MCF strategy.

China had previously relied on the Department of CMI Promotion [军民结合推进司] of the Ministry of Industry and Information Technology to act as the administrative body over CMI work. This mechanism has proved ineffective and ill-adapted at advancing MCF development. As Lafferty observes, this department lacked the authority to oversee much of the day-to-day operations that concern various civil and military institutions whose actual management was in the hands of other higher-ranking agencies, such as MOST, NDRC, and SASTIND.[113] NUDT researchers noted that a major policy document issued by this department in 2010 required the close coordination of over 20 military and state organs, making it difficult to implement effectively.[114]

In January 2017, Xi unified leadership for MCF development by establishing the CCP Central Commission for Military-Civil Fusion Development (CCMCFD) [中央军民融合发展委员会], which he personally chairs. The CCMCFD reports to the CCP Politburo and the Standing Committee of the Politburo and acts as the highest-level decision-making and deliberative coordination mechanism for major issues in MCF development. Compared to Hu Jintao, Xi has taken a much more active role in Central Leading Small Groups (LSGs) [中央领导小组] and Central Commissions.[115] As noted in an analysis performed by the Mercator Institute for China Studies (MERICS), Xi Jinping has "redirected authority over crucial issues back to the inner circle of the Party" through the reorganization and remodeling of LSGs and Central Commissions [中央委员会] that constituted "the political core executive" with "significant influence over strategic policymaking."[116]

The influence and wide reach of the CCMCFD was evident at the first plenum of the 18th CCMCFD held on June 20, 2017, with the presence of Central Politburo Standing Committee members, State Councilors, CMC members, CMC department directors, CCP internal division directors, as well as directors from various state ministries including NDRC, MOE, MIIT, MOF, among others.[117]

"Twelve Central Leaders Assume Position in a New Organization—What Exactly is the Central Commission for Military-Civil Fusion Development?" [12名中央领导在新机构任职,中央军民融合发展委员会究竟是做什么的?], Junmin.org [军民网], 21 June 2017, https://web.archive.org/web/20170918154202/http://news.junmin.org/2017/xinwen_shehui_0621/230461.html.

The CCMCFD has held four plenum meetings since its inception. As of March 2020, there is no public information suggesting whether any meetings took place in 2019 or 2020. While some issues were emphasized during all four meetings, such as the need to further break down barriers and to advance institutional reforms, each meeting also had a slightly different focal point, which signaled the major challenge areas faced by the CCMCFD. Chief among them is the persistent lack of buy-in from local officials, slow progress of the legislative process, and the lack of tangible outcomes, especially in the area of technological innovation. A summary of the most recent meetings is included below.

Date	CCMCFD Core Agenda
June 20, 2017[118]	• Clarifies workflow, central tasks, and the establishment of MCF managing organizations at the provincial and prefecture levels • Emphasizes the role of reform and innovation • Calls for the cleaning up of MCF legal documents • Clarifies key domains for MCF development • Urges all regions and departments to be willing to "wade through dangerous shoals and move (people's) cheese" to promote MCF
September 22, 2017[119]	• Emphasizes the "system engineering" nature of MCF development • Discussed and instituted policies regarding the defense industrial base and military logistics • Discussed infrastructure construction and resource sharing needs
March 2, 2018[120]	• Approves "Military-Civil Fusion Development Strategy Outline" • Announces the first group of Innovation Demonstration Zones • Reemphasizes the scope of the MCF strategy, the Party's authority and leadership, and the need to break down barriers • Highlights the need to overcome difficulties and achieve tangible outcomes • Urges local Party Committees and governments to play proactive roles
October 5, 2018[121]	• Emphasizes the need to strengthen the legal framework for MCF; to make sure to "think about issues, make decisions, and do things within the law" • Points to strategic major research and engineering projects [战略性重大工程] as an effective means to promote technological innovation • Calls for breakthroughs in key core technologies and the tackling of the most complex and most difficult issues

MCF researchers argue that with the creation of the CCMCFD, the "top-level design of MCF" [军民融合顶层设计] is complete. CCMCFD clearly represents a communication mechanism for the coordination between the military and the civilian sectors, but whether it has achieved "unobstructed and highly effective pathways of communication" is hard to derive based on publicly available information.

Given the MCF strategy's wide purview and the fact that the success of the strategy rests on its ability to coordinate and balance defense and economic resources and activities, members of the CCMCFD likely consult with members of other Central Commissions and LSGs. While the full list of involved organizations is not known, the following, all of which are led by Xi Jinping, are *likely* involved:[122]

- Central National Security Commission [中央国家安全委员会]
- Central Military Commission [中央军事委员会]
  - CMC Strategic Planning Office Military-Civil Fusion Bureau [中央军委战略规划办军民融合局], which works jointly with NDRC and other relevant ministries and commissions to promote the in-depth development of MCF according to the *2016 Opinion* [123]
- Central Commission for Comprehensively Deepening Reform [中央全面深化改革委员会]
- Central Commission for Finance and Economy [中央财经委员会]
- Central Commission for Cybersecurity and Informatization [中央网络安全和信息化委员会]
- Central Commission for Foreign Affairs [中央外事工作委员会]
- CMC Leading Small Group for Military Reform [中央军委深化国防和军队改革领导小组]

The specifics for how these various Central Commissions and LSGs interact were not detailed in the literature examined for this report. But it appears that the following senior leaders *likely* sat on both the CCMCFD and the Central National Security Commission in early 2017, which could indicate a high level of coordination.[124]

Senior Party and State Leaders Likely Sat on Both CCMCFD and Central NSC (June 2017)*

Xi Jinping [习近平]	CCP General Secretary, CMC Chairman, Chinese President [中共中央总书记, 国家主席, 中央军委主席]
Li Keqiang [李克强]	CCP Politburo Standing Committee member, Premier of the State Council [中共中央政治局常委, 国务院总理]
Wang Huning [王沪宁]	CCP Politburo member, head of the Central Policy Research Office [中共中央政治局委员, 中央政策研究室主任]
Fan Changlong [范长龙]	CCP Politburo member, CMC Vice Chairman [中共中央政治局委员, 中央军委副主席]
Meng Jianzhu [孟建柱]	CCP Politburo member, Secretary of the CCP Central Political and Legal Affairs Commission [中共中央政治局委员, 中央政法委员会书记]
Li Zhanshu [栗战书]	CCP Politburo member, Central Secretariat secretary, Director of the CCP Central General Office [中共中央政治局委员, 中央书记处书记, 中央办公厅主任]
Yang Jing [杨晶]	Central Secretariat secretary, State Councilor, State Council Party Group member, Secretary-General of the State Council [中央书记处书记, 国务委员, 国务院党组成员兼国务院秘书长]
Guo Shengkun [郭声琨]	State Councilor, State Council Party Group member, Party Secretary and Minister of Public Security, Deputy Secretary of the Central Political and Legal Affairs Commission [国务委员, 国务院党组成员兼公安部部长, 党委书记, 中央政法委员会副书记]
Zhang Yesui [张业遂]	Party Secretary and Vice Minister of the Ministry of Foreign Affairs [外交部党委书记, 副部长]
Zhao Keshi [赵克石]	CMC member, Director of the CMC Logistics Support Department [中央军委委员, 中央军委后勤保障部部长]
Zhang Youxia [张又侠]	CMC member, Director of the CMC Equipment Development Department [中央军委委员, 中央军委装备发展部部长]

*Titles reflect their roles in June 2017.

While the Central Party organizations clearly have the leading role, a number of state ministries and pre-existing State Council bodies also have important roles in MCF-related policymaking:

- SASTIND. As the administrative agency in charge of national defense science and technology industry in China, SASTIND serves national defense and armed force building needs, as well as national economic development needs, particularly in the field of advanced manufacturing. SASTIND is responsible for the formulation and implementation of national defense science and technology industrial plans, policies, standards, and regulations.[125]
- MIIT's Department of CMI Promotion issues development plans regarding dual-use technology transfer, military-civilian common standard system construction, etc.; promotes relevant system reforms;[126]
- NDRC's Economic and Defense Coordinated Development Department [发改委经济与国防协调发展司] works closely with the CMC Strategic Planning Office's Military-Civil Fusion Bureau to study and formulate plans and policies to coordinate military and economic activities;[127]
- State LSG for State S&T System Reform and Innovation System Construction [国家科技体制改革和创新体系建设领导小组] (discussed in 3.1.3);
- National Defense Mobilization Commission [国家国防动员委员会] (explained in greater detail 3.1.6).

Active promotion of the plans and policies by local governments will be important to the MCF strategy's success. According to data from MIIT affiliated think tank CCID, as of the end of 2018, CCP-led MCF management

organizations, called the *CCP Provincial Party Committee Military-Civil Fusion Development Committee* [省委军民融合发展委员会], have been set up in 31 provincial-level divisions[xxx] under the provincial Party Committees.[128] In some provinces, such as Hubei, the office of the *Hubei Provincial Party Committee Military-Civil Fusion Development Committee* shares staff with the *Provincial People's Government's National Defense Science and Technology Industry Office* [省人民政府国防科技工业办公室], a practice commonly known as "two names, one office" [两块牌子, 一套班子], a practice which is seen throughout China's Party/State/Military organization. In some prefecture-level cities [地级市], MCF Development Committees have been established at the municipal Party Committee or even the District Party Committee level.[129]

In summary, notable progress has been made with regard to the MCF organization and management system with the creation and subsequent staffing of the managing organizations at the central and local levels. What remains to be seen is whether these organizations are effectively exercising their assigned functions. This remains a work in progress, as seen in CCID's 2018 MCF work summary report, which noted that the division of responsibilities and coordination mechanisms still needed to be established or further clarified.[130]

xxx China has 33 provincial-level divisions, including 22 provinces (and claims a 23rd, Taiwan), five Autonomous Regions (Tibet, Xinjiang etc), four Municipalities (Beijing, Shanghai, Tianjin and Chongqing) and two Special Autonomous Regions: Hong Kong and Macau

2.2 MCF Operational System

The second of Xi's Three Systems, the MCF Operational System, is meant to unify Party and State leadership, defense requirements, and market operations, allowing for effective control over the entire MCF enterprise. While called a *tixi* (system) in the Chinese name, in many ways, these are better understood as a set of guiding principles. Foremost among them is that the Party is "in the lead," while at the same time remaining responsive to defense requirements and market forces.

PARTY/STATE LEADERSHIP [国家主导]

The first principle is meant to make the respective demands of defense, and the market subject to the Party's and States' control. While the term for "state" is used, according to Jiang et al., the intended meaning of the phrase is to "realize the ruling Party's leadership over all MCF domains and processes, guiding and regulating the correct direction of MCF development."[131] "The strong willpower and enforcement power of the Party and the state" [党和国家坚强的意志力和贯彻力] is seen as the only strong force that can cut through the obstacles and barriers created by existing interest groups [利益集团].[132] Party leadership is realized through three functions:[133]

- Formulate and promulgate strategies, plans, policies;
- Deliberate on and make decisions regarding the major issues concerning the long-term and overall direction of the strategy;
- Strengthen leadership of and provide guidance to local Party Committees and governments

GUIDED BY DEFENSE REQUIREMENTS [需求牵引]

The second principle is meant to address the PLA's lack of a mechanism to coordinate service-specific requirements with the overall national strategy.

Efforts under this are two-fold: 1. The creation of mechanisms for military and civilian entities to exchange demand information; 2. The incorporation of defense requirements into the strategic decision-making process. The former is an easier task as it can be solved through the creation of public service and bidding platforms, but the latter requires reforming the existing defense requirement generation mechanism.

NUDT researchers point out that although China has its own national security strategies, national defense security strategies, military strategies, and military construction guidelines, due to the way they are formulated, there is often a lack of consistency in their message.[134] They contrast this with the United States, noting that there is a chain of linked and overlapping documents issued by the White House, DOD, and service-specific strategies.[xxxi]

These problems prevent China's strategic planning from forming a systematic and complete planning system, they argue.[135] Rather than the higher levels providing a unified set of capabilities that lower levels must then develop, services and arms instead make their own assessments and pursue what they assess as their own requirements. This prevents objective assessment of future defense requirements, and the fragmented processes also severely hamper the implementation of a national defense acquisition auditing process [国防需求监审工作], which NUDT researchers argue is necessary for China to efficiently allocate its defense budget.

---

xxxi However, Tai Ming Cheung has noted that "The People's Liberation Army (PLA) has had a long-term Weapons and Equipment Development Strategy (WEDS [武器装备发展战略])…the WEDS provides planning stability for 20 years. Its integrated approach involves input from across the entire defense establishment, which lessens the effects of parochial bureaucratic interests and political intervention. The WEDS is closely coordinated with other key development strategies, including economic development, national security, military, and national science and technology development." Tai Ming Cheung, "U.S.–China Military Technological Competition and the Making of Chinese Weapons Development Strategies and Plans," UC San Diego, 2017, https://escholarship.org/uc/item/43m5m3gp.

These researchers proposed establishing China's own "strategic chain" [战略链条] of linked strategic guidance documents, each developed by its corresponding leading organization:[136]

Type of Strategy	Responsible organizations
National Security Strategy [国家安全战略]	Central National Security Commission
National Defense Strategy [国防安全战略]	Central Military Commission
Army Construction Guide [军队建设指南]	CMC Joint Command Center [军委联指]
Theater Command Development Plans and Joint Operations Capability Construction Plan [各战区的发展规划及联合作战能力建设规划]	Each Theater Command's Joint Command Structure [各战区联合机构]

MARKET OPERATIONS [市场运作]

The final principle is meant to clarify the functional boundary between the government and the market.

At the meeting with the PLA delegation at the 2nd Session of the Twelfth National People's Congress held in March 2014, Xi remarked that the successful implementation of the MCF strategy relies on both the leading role played by the state as well as the role played by the market.[137] MCF researchers have also highlighted the need to give market mechanisms an important role in shaping the environment MCF actors operate in and hinted that the Party and the state's leading role often overshadows that of the market.[138]

In the last chapter of their book, Jiang et al. insightfully note that to successfully advance the MCF strategy, five relationships must be managed successfully: between the government and the market, the central government and local governments, the military and the civilian government, state-owned defense conglomerates and competitive private companies, and domestic and overseas interests.[139] MCF initiatives need to be able to balance the interests of all involved parties and provide the right amount of incentives. Chinese researchers tend not to elaborate on negatives, but there is evidence to suggest that the interests of civilian entities involved in MCF activities were not properly protected in the past. For example, there have been instances where compensation promised to local governments for taking on the additional cost of incorporating military requirements into infrastructure construction was not delivered. In other cases, civilian equipment was requisitioned during military training without compensation, or the intellectual property rights of high-tech companies were not properly protected.

China's political system makes addressing this problem even more difficult, and MCF guiding policies continue to place heavy emphasis on the role of the Party and the state. The *2016 Opinion* only vaguely directed attention be paid to "the use of market methods to optimize the allocation of military and land resources."[140] In the same paragraph, the Opinion then went on to highlight the need to "actively guide" private capital, technologies, and other forces into the national defense construction endeavor, but the wording left it unclear whether the market or the government will assume this role. Writing in CCP journal Seeking Truth in July 2018, Standing Deputy Director of the CCMCFD General Office Jin Zhuanglong [金壮龙] referenced "Xi Jinping" 18 times while calling for the "opening up of a new era of in-depth MCF development," yet making no mention of the "market."[141]

Finding the balance between the role of the government and the market is and will continue to be one of the toughest challenges facing the implementation of the MCF strategy. With such vague guidance from the central government, local governments are left to themselves to find the most cost-efficient way to promote the free flow of elements such as technologies, talent, services, capital, and information. Based on the size of the MCF budgets and the policy tools at their disposal, which can include land leasing, business loans, labor market regulations, infrastructure construction, financial and tax support among others, local governments must leverage market forces efficiently while demonstrating that they have upheld Party leadership in the process. This balancing act is difficult

to perform well in all manner of government business, as evidenced by a message from the General Office of the CCP Central Committee to grassroots cadres in the form of a notice issued in April 2020, telling them to "never do a stupid thing that you think will satisfy the supervising cadres but will disappoint the masses."[142]

2.3 MCF Legal, Regulatory, and Policy System

The third prong of Xi's MCF management structure is a comprehensive and systematic legal, regulatory, and policy system that is intricately linked and incentivizes effectively. This includes laws that regulate individual actions, regulatory documents issued by Party, state, and military agencies, as well as policy initiatives such as the Five-Year social and economic development plans.

This system remains a work in progress. Between 2015 and 2020, the CCMCFD has issued a relatively complete set of policy initiatives to promote MCF development, but the legal framework is in dire need of development.

CCMCFD APPROVED POLICIES

The CCMCFD has issued a set of policies to guide MCF development during the 13th FYP (2016-2020). The table below gives a selection of relevant CCMCFD approved policies divided by their respective domains.

MCF Domains	CCMCFD Approved Policies
MCF Overall	Military Civil Strategy Development Outline [军民融合发展战略纲要] Opinion on Strengthening the Legal Framework for MCF Development [关于加强军民融合发展法治建设的意见]
Fundamental Domains [基础领域]	Management Measures for Implementing National Defense Requirements into Construction Programs Closely Related to National Defense and Economic Development—Trial Version [经济建设与国防建设密切相关的建设项目贯彻国防要求管理办法 (试行)]
Manufacturing [产业领域]	13th Five-Year Plan for National Defense Science, Technology, and Industry Development ["十三五"国防科技工业发展规划] Opinion Regarding the Promotion of National Defense Science and Technology Industry's Deep Development of Military-Civil Fusion [关于推动国防科技工业军民融合深度发展的意见] (Document No. 91 [2017])
Science and Technology [科技领域]	Science and Technology Military-Civil Fusion Development Plan for the 13th FYP ["十三五"科技军民融合发展专项规划] (S&T MCF Plan) Implementation Plan for Building National Military-Civil Fusion Innovation Demonstration Zones [国家军民融合创新示范区建设实施方案]
Social Services [社会服务]	Opinion on Advancing Implementation of Military Logistics in Deep Development of Military-Civil Fusion during the Period of the 13th Five Year Plan ["十三五"期间推进军事后勤军民融合深度发展的实施意见]
Emergency and Public Safety [应急和公共安全]	CCMCFD has reportedly passed development plans for civil air defense, transportation readiness, and economic mobilization, but no clear details were offered.

LEGAL FRAMEWORK

PLA NDU's *Report on the Development of Military-Civil Fusion in China (2016)* noted that the existing legislative norms for MCF consist of mostly administrative regulations, lacking higher-level laws promulgated by the National People's Congress and the Standing Committee that can have a strong binding force on both military and civilian actors.[143] One piece of important legislation that could make substantial headway in developing this system is the *PRC Military-Civil Fusion Development Law* [中华人民共和国军民融合发展法]. The Law, which has been on the legislative agenda since early 2011, is understood to act as a baseline for regulations on the topic, avoiding problems created by overlapping or contradictory regulations implemented at lower levels of government. This piece of legislation is supposedly in its final stages of completion. In September 2018 for example, the 13th NPC Standing Committee identified the proposed legislation as "a draft law with relatively mature conditions and to be submitted for review during its tenure" [条件比较成熟, 任期内拟提请审议的法律草案].[144] Analysts at MIIT-affiliated think tank CCID expected the law to be passed in 2019, but it appears to have been delayed again. The

2020 Two Sessions [两会], typically set for March, were pushed back to May due to the COVID-19 outbreak, and as of writing appears to have declined to take up the issue, leaving it unclear whether the *MCF Development Law* will be enacted before the end of 2020.

In addition to enacting the new law, existing Party and state regulatory documents since 1978 that touch upon MCF development will also need to be addressed. In February 2018, the General Offices of CCP Central Committee, State Council, and CMC jointly issued a notice requesting the cleaning-up of Party regulations, state laws, and regulations, other regulatory documents released since 1978 in all areas of great potential for MCF development.[145] The notice specified that these documents should be screened and properly categorized to be either abolished, invalidated, modified, integrated, declassified, decrypted and continue to be effective, based on the fourteen criteria outlined by the Notice. The notice did not offer a specific number, but according to a *PLA Daily* article from October 2013, on the military side alone, the number of military laws, regulations, and rules (including normative documents) formulated by military agencies has reached more than 4,000 and is in dire need of cleaning up and organizing.[146]

Section 3: Roadmap [6+3+n+1]

Having examined the Military-Civil Fusion strategy's near- and long-term goals and management structures, this section examines each component of the "6+3+n+1" roadmap and discusses their operationalization during the 13th FYP.

Based on the availability of information for each component, it provides answers to these questions:

- What is the current status of each of the six SoSs?
- What do near-term efforts in each priority domain look like during the 13th FYP?
- Why do they consider these efforts necessary or important?
- What are the main challenges?

While the '6' and '3' components are discussed separately, the authors acknowledge that their responsibilities overlap and are interactive, each enabling the others. This can clearly be seen in the overlap between the transportation infrastructure component (3.1.1) and military logistics (covered in section 3.1.5) and defense mobilization (3.1.6).

3.1 The Six Systems of Systems

The *2006 Opinion* called for the "basic formation" of the six systems-of-systems by 2020. As explained in section 1.2.1.2, the six SoSs are formed by fusing civilian and defense ecosystems that possess high levels of commonality but which have previously been separated into distinct silos.[147]

The Six Systems of Systems

Fundamental Domain Resource Sharing SoS	[基础领域资源共享体系]
Advanced Defense Technology Industrial SoS	[中国特色先进国防科技工业体系]
Military-Civil Coordinated Technology Innovation SoS	[军民科技协同创新体系]
Military Personnel Cultivation SoS	[军事人才培养体系]
Socialized Support and Sustainment for the PLA SoS	[军队保障社会化体系]
National Defense Mobilization SoS	[国防动员体系]

While the six SoSs represent a clear priority for MCF development, the materials reviewed in this report failed to provide clear analyses of these SoSs, including the form they will take to concretely achieve their goals, the actors involved, and the nature of their interaction. The descriptions in subsequent sections attempt to recreate that information by synthesizing information from available sources.

Each section will begin with an overview, then outline developments during the 13th FYP.

3.1.1 Fundamental Domain Resource Sharing SoS

OVERVIEW

Although MCF efforts in this area can be traced back to the Jiang administration, Xi's *Fundamental Domain Resource Sharing SoS* [基础领域资源共享体系] went beyond infrastructure construction in the traditional sense [传统基础设施] to include technology-driven space and information network assets. According to the *2016 Opinion*, the *Fundamental Domain Resource Sharing SoS* connects the following elements: transportation, space and information infrastructure, surveying, mapping, meteorology, and standard metrology.[148] It is a massive undertaking and will require effective leadership and coordinated management mechanisms between the military and the civilian sectors to achieve desired results.

The *Fundamental Domain Resource Sharing SoS* has not been the subject of as many publications by MCF researchers previously as the defense *industrial SoS* or the *innovation SoS*. However, the "*new infrastructure construction*" [新型基础设施建设] initiative, which rose to prominence in early 2020, may spur growing interest in this area. The term "*new infrastructure construction*" was coined at the Central Economic Work Conference held at the end of 2018. The initiative includes the promotion of "commercial use of 5G, data centers, and further development of artificial intelligence technology, industrial internet, and Internet of Things."[149] Party Central leaders publicly discussed the subject five times between February 3rd and March 4th, sending a strong signal that the initiative will serve as an important means to combat the economic impact of the COVID-19 outbreak.

Writing in July 2018, Standing Deputy Director of the CCMCFD General Office Jin Zhuanglong stated that the types of infrastructure in question should be jointly constructed and shared by the military and the civilian sectors [坚持共建共用共享].[150] Jiang et al. noted that establishing a national infrastructure planning and management system involving organizations from both sectors with a clear division of responsibilities is crucial.[151] Together, these organizations, under the guidance of the CCMCFD, can take into full consideration the mission requirements of the armed forces and the overall construction capacity of the nation to enable scientific, data-driven decision-making.

The following table shows the main components of the *Fundamental Domain Resource Sharing SoS* and central tasks under each component, as outlined by government policy documents and other authoritative writings. Due to its scope, the remainder of this section focuses on transportation infrastructure. A brief overview of current initiatives in the space and cyber domains is provided in section 3.2.2 and 3.2.3.

Components	Central Tasks
Transportation Infrastructure [交通基础设施]	**Airways:** - Enhance airport compatibility; build military-civilian airports[152] - Optimize airspace structure; promote airspace classification and management reform and low-altitude airspace management reform; establish dynamic airspace management and flexible use mechanisms[153] **Railways:** - Strengthen the construction of major railway corridors in strategic directions, implement national defense requirements in railway construction and transformation[154] **Highways:** - When building highways, create sections that can be used as auxiliary runways for aircraft[155] - Strengthen infrastructure construction in southwest and northeast China to enhance weapons and equipment mobilization capacity and the mobility of armed forces[156] **Sea lanes and Waterways:** - Repurpose civilian vessels for military use[157] - Plan the layout of the ocean and ocean resupply transportation system, and build corresponding waterway combat readiness facilities and support facilities[158]
Space Infrastructure [空间基础设施] [159] (See 3.2.2 for more information)	- MCF Space-Based Real-Time Information Service System [positioning, navigation, timing, remote sensing, communication, PNTRC] - Space-Earth Integrated Information Network Mega Project [国家天地一体化信息网络重大工程], which includes the MCF Space-based Communication System [军民融合天基通信系统]. - Promote the sharing of satellite resources between military and civilian entities - Build a shared military-civil navigation system and integrated remote sensing comprehensive application system
Information Infrastructure [信息基础设施][160]	- Connect mobile communication systems - Optimize the layout of satellite communication system - Accelerate the construction of geographic surveying and mapping information system - Coordinate Military Electromagnetic Spectrum Management System [161] - Expand and pre-position overseas information infrastructure [拓展海外信息基础设施] - Independently research and develop a network information security protection system [自主研发网络信息安全防护系统]
Topographic Infrastructure [测绘基础设施][162]	- Establish a regular mechanism for cross-departmental and cross-domain geographic information data transfer and location service station network sharing[163]
Weather Infrastructure [气象基础设施]	- Optimize Military-Civil organizational layout and data-sharing mechanisms [164]
Standardization Infrastructure [标准计量基础设施]	- Resolve incompatibilities between military and civilian standards [165,166]

TRANSPORTATION INFRASTRUCTURE:

The *Law of the People's Republic of China on National Defense Transportation* [国防交通法], which went into effect on January 1, 2017, is the first national defense legislation enacted since the 18th Party Congress and is regarded as the most significant legislation for implementing the MCF strategy. The law regulates national defense transportation activities, enhances strategic delivery capabilities, and safeguards national security and development interests.

The *Law* consists of nine chapters and 60 articles.[167] It calls for a national defense transportation system that can provide service in peacetime, but also facilitate fast response during emergencies (e.g., national disasters) and enhance capabilities during wartime. It gives county-level and above governments the authorization to requisite civil transportation resources such as vehicles, facilities, and materials, based on national defense needs. The law outlines plans for the state to rely on large and medium-sized transportation enterprises to organize and build strategic delivery support forces, enhance strategic delivery capabilities, and provide effective support for the rapid organization of long-distance and large-scale defense transportation. National agencies abroad and China's

enterprises engaged in the international transportation business and their overseas agencies are required to support ships, aircraft, vehicles, personnel that carry out international rescue, maritime escort, and military operations to safeguard the country's overseas interests.

The following is an overview of China's progress in these sectors:

AIRWAYS:

Airport sharing between the PLAAF and the Civil Aviation Administration of China (CAAC) dates to 1985. According to the information provided by CAAC, as of 2017, China has a total of 64 military-civilian airports [军民两用机场] in operation, accounting for over 28% of all transport airports. Among them, there are 59 airports shared by civil aviation and the PLAAF, accounting for more than 92%.[168] The remaining five are believed to be shared with other services.[169] PLA Daily reported in August of 2019 that these 59 airports have jointly completed over 1 million flights and transported 92.21 million passengers since 2018, accounting for 7.3 percent of the national total.[170]

With the elevation of MCF to a national strategy, CAAC has reportedly established a joint working mechanism with the PLA Army, Navy, and Air Force headquarters.[171] CAAC and the Air Force has held a number of MCF-themed conferences, attended by Zheng Xuexiang [郑学祥], director of the Air Force Logistics Support Department. The two sides have reportedly established a three-tier communication mechanism (see chart) and signed an agreement to jointly manage dual-use airports.[172]

Notably, Lhasa Gongga Airport [拉萨贡嘎机场] and Wuxi Shuofang Airport [无锡硕放机场] were selected in 2015 as pilot projects for "deep MCF development." Its main goal is to gradually achieve the ability to "guarantee flight safety in peacetime and meet operational needs in wartime" ["平时保障飞行安全, 战时满足作战需要"].[173] The Lhasa Gonggar Airport is an important entry point for new recruits into Tibet and a critical strategic supplies transport hub. It also regularly hosts J-10 and J-11 aircraft.[174] Wuxi Shuofang Airport serves as a regional hub for civilian air traffic but is also home to the 26th Special Mission Division's 76th Airborne Command and Control Regiment.[175] Wuxi itself is a major logistics center, hosting one of four PLA Joint Logistic Support Force Joint Logistics Support Centers [联勤保障中心].

HIGHWAYS:

Hao Maojin [郝茂金], Yang Cun [杨存], "Air Force Third-Generation Jet Takes off and Lands on Highway for First Time" [空军首次在高速公路上起降三代战机], *China Youth Daily* [中国青年报], 30 May 2014, http://zqb.cyol.com/html/2014-05/30/nw.D110000zgqnb_20140530_2-10.htm.

Chinese researchers note that highway infrastructure should be built with defense needs in mind to facilitate the fast movement of military equipment. A prime example of other applications highlighted as part of MCF includes their use as emergency operating strips for combat aircraft. Researchers with the PAP Logistics College [武警后勤学院] noted that as of 2011, the total length of China's highways has reached 85,000 kilometers, but only had less than 20 sections reserved for use as emergency airstrips nationwide, far below the 500 mark which planners deemed necessary.[176] By the end of 2018, China's total highways reached 143,000 kilometers, but it is unclear how many of the new emergency runways have been added.[177]

In May 2014, the former Jinan Military Region Air Force (now under the Northern Theater Command) successfully tested highway airstrip takeoffs and landings on a number of aircraft types, including the 3rd generation J-16D (see photo).[178]

RAILWAYS:

China Railway Network

NUDT researchers highlighted the need to coordinate infrastructure building efforts with China's regional development strategies, especially for the national Western Opening, and Northeast Old Industrial Base Revitalization projects, to enhance production capacity and ensure the prompt delivery of weapons and equipment to the potential war fronts.[179,xxxii]

Railways play an important role in Chinese strategic goals through the Belt and Road Initiative, linking Chinese producers with markets through the trans-Eurasian Silk Road Economic Belt [丝绸之路经济带]. The first China-Europe line opened in 2011. The longest, from Yiwu on China's east coast province Zhejiang, to Madrid, began service in 2014. At 13,000km it is the longest rail line in the world.[180]

xxxii While initially concentrated in the northeast, in the 1960s much of China's defense industrial base was moved inland away from coastal areas as part of the "Third Front" movement in the 1960s to protect them from Soviet attacks. As a result, many key production areas are not conveniently located for the broader economy, which is focused along the southern and eastern coasts.

SEA LANES AND WATERWAYS

China has more than 120,000 kilometers of navigable inland waterways, which have formed an important transportation network for centuries.[181] Enhancing these already essential networks will help connect defense production centers such as Wuhan (a logistics hub also home to important defense production sites) with the rest of the country.

China also operates a massive fleet of commercial cargo vessels and tankers. The PLA Navy has signed agreements with some of the giants in this field, including COSCO, and experimented with modular equipment that can be used to allow these ships to perform underway operations for the PLAN vessels (see Section 3.2.1 for more detail).[182]

3.1.2 Advanced Defense Science, Technology, and Industrial SoS with Chinese Characteristics

OVERVIEW

Labeled a "top priority" [重中之重] by MCF researchers and government officials, the *Advanced Defense Science, Technology, and Industrial SoS* with Chinese characteristics [中国特色先进国防科技工业体系] endeavors to achieve "deep fusion" of the defense industrial base and the civilian industrial manufacturing base. This goal closely matches the definition of Civil-Military Integration (CMI) offered in a 1994 report by the Office of Technology Assessment (OTA) that is frequently cited by Chinese scholars:

> *Civil–Military Integration [CMI] is defined as the process of uniting the Defense Technology and Industrial Base [DTIB] and the larger Commercial Technology and Industrial Base [CTIB] into a unified National Technology and Industrial Base [NTIB]. Under CMI, common technologies, processes, labor, equipment, material, and/or facilities would be used to meet both defense and commercial needs.*[183]

Despite its clear importance to Chinese leaders, key aspects of this SoS have not been clearly defined. For example, Chinese researchers have failed to explain what particular characteristics of this SoS are "Chinese" or what makes this SoS "advanced." In fact, an article published by a group of researchers from NUDT in the August 2019 issue of the *Science & Technology Progress and Policy* highlighted this very issue. Based on their research, as of April 2018, there were only two articles in the entire Chinese CNKI academic database that included some form of discussion as to the exact meaning of this SoS. This group researchers then argued that in its fully-realized state, the *Industrial SoS* with Chinese characteristics should embody the characteristics of openness and effectiveness, with a well-designed industrial layout, optimized production capacity, and be dynamically adjustable.[184] They further note that the essence of "Chinese characteristics" in the *industrial SoS* is simply Party leadership [党的领导]. This vague interpretation suggests that theoretical research into the long term development of the *industrial SoS* remains incomplete.

In the near term, clearly identified priorities include the restructuring of the defense industrial base and the further opening up of the defense industrial market to civilian actors.

China's defense industrial base has been the focus of various reform policies over decades; however, progress has been slow in many areas.[xxxiii] As of 2019, about 2% (3,000 out of 150,000) of China's private high-tech companies are involved in the defense supply chain, primarily providing parts or material supplies.[185] Between 2009 and 2019, 68% of the private companies that entered this field specialize in information technology.[186] While that represents significant progress for the PLA's informatization drive, information technology alone is not enough to address the problem of low self-sufficiency of "core key technologies" [关键核心技术] needed by both the DTIB and CTIB. The group of state-owned defense conglomerates and its hundreds of subsidiaries have continued to dominate China's defense technology R&D and manufacturing scene. The outcome of their ownership structure reform has been regarded as slow and incomplete at best. The massive investment in the state-owned defense groups, mostly through government funding, has not resulted in corresponding economic gains. The lack of genuine competition and the solidification of interests also severely hindered technological innovation.[187]

Whether China can effectively root out these existing issues is a good measure of its success at constructing the *industrial SoS* of its dreams. The most authoritative guiding document for the development of the *industrial SoS*

xxxiii The ownership structure reform of the defense conglomerates [军工企业股份制改革], another core component of the MCF strategy, was initiated in May of 2007.

during the 13th FYP—*Document No. 91 [2017]*—was released by the State Council in November 2017.[xxxiv] *Document No. 91 [2017]* clarified that efforts in this space should be directed toward addressing existing problems [问题导向], be pragmatic in its approach and stay result-oriented [务实求效].[188] It outlined 29 measures in seven broad areas and called for the formation of a "'small' core, 'large' collaboration, 'specialized,' and open weaponry equipment scientific research and production system to "realize the mutual sharing and mutual support and effective transformation of military and civilian resources, and promote the in-depth development of military-civil fusion."[189]

The four attributes— "'small' core, 'large' collaboration, 'specialized,' and 'open"—and the set of measures proposed by *Document No. 91 [2017]* require a significant amount of contextualization, which is the focus of the following section. As the AMS bibliometric analysis study outlined earlier found, MCF development in the defense industrial base has been the primary focus of the existing body of research on MCF in China.[190] MCF researchers have cataloged a myriad of problems plaguing China's DTIB and CTIB at large that taken collectively, delivered a picture of the current state of integration that stands in perfect contrast to the 13th FYP goal. Of greatest concern are the *industrial SoS*'s low self-sufficiency, sectorization, de-facto monopolization, and barriers created by vested interests.

Current State of the Industrial SoS	13th FYP Goal for the weaponry equipment scientific research and production system
•'large' core •'small' collaboration •'sectorized' •'closed-off'	•'small' core [小核心] •'large' collaboration [大协作] •'specialized' [专业化] •openness [开放型]

Before delving into a more detailed analysis of these problems and outlining policy measures and notable developments during the 13th FYP, it should be noted that while the Advanced Defense Science, Technology, and Industrial SoS and the Military-Civil Coordinated Technology Innovation SoS (see Section 3.1.3) partially overlap, especially with regards to the roles played by military academic institutions and defense research institutions, the two SoSs have different areas of focus and were designed to address different sets of issues.[xxxv]

For clarity purposes, the former is referred to as the *industrial SoS* and the latter the *innovation SoS*. The *industrial SoS* generally involves the manufacturing sector, emphasizing product development, and the improvement of technologies and manufacturing processes. The *innovation SoS*, on the other hand, has a strong basic and applied research focus. In other words, the *industrial SoS* involves more effort on what would be described in the U.S. as the mid-to-high levels of the Technology Readiness Levels (TRL) measurement system, while the *innovation SoS* promotes scientific breakthroughs that are lower on the TRL system, but the two SoSs meet somewhere in the middle.[191]

---

xxxiv The full name of the document is the "Opinion Regarding the Promotion of National Defense Science and Technology Industry's Deep Development of Military-Civil Fusion" [国务院办公厅关于推动国防科技工业军民融合深度发展的意见国办发(2017)91号].

xxxv The *Military-Civil Coordinated Technology Innovation SoS* is similar in definition to what the United States' National Security and National Defense Strategies referred to as the National Security Innovation Base (NSIB), defined by the Reagan Institute's report as comprising "the ecosystem of capital, research, knowledge, capabilities, policies, incentives, and people that turns ideas into innovations and transforms discoveries into useful technology and products to protect our national security." See Reagan Institute Task Force. "The Contest for Innovation: Strengthening America's National Security Innovation Base in an Era of Strategic Competition," 3 December 2019. https://www.reaganfoundation.org/media/355297/the_contest_for_innovation_report.pdf.

The chart below divides the key actors involved in MCF development into each of the two SoSs, based on the authors' assessment of their respective roles. These entities are not clearly delineated by their status as either one of the "ten defense companies," a government research institution, or even a private company. The Chinese terms "military sector" [军口] and "civilian sector" [民口] have much more to do with their historical status. The former generally consists of traditional defense partners and the latter more recent entries into the defense industry. To improve upon the current research, development, and industrial system and achieve "military-civil deep fusion," MCF thinkers argue that there must be greater cohesion and fusion both between military and civilian sectors and among the components of the *Industrial SoS* and *Innovation SoS*.

Domain	Type	"Military Sector" [军口]	"Civilian Sector" [民口]
Industrial SoS (Manufacturing Domain)	Enterprises	- State-owned defense conglomerates	- Private companies involved in the defense supply chain
Innovation SoS (S&T Domain)	Research Institutions	- Military research institutes - Research institutes affiliated with defense conglomerates[xxxvi]	- Government research institutions, such as CAS - "New-Type" Research Institutions
	IHEs	- Military Institutes of Higher Education (IHEs) - MIIT-affiliated IHEs - SASTIND "Joint Construct [共建]" IHEs	- Civilian IHEs

Prominent Problems in the DTIB

PROBLEM I: LOW SELF-SUFFICIENCY

China's own DTIB and CTIB have made tremendous progress over the past three decades with such achievements as new generation fighter jets and transport aircraft or high-speed bullet trains. While fully recognizing the significant progress China has made, senior Chinese leaders, scholars, and experts appear concerned that the DTIB and the CITB, in their current state, are insufficiently prepared to meet both defense and commercial needs. One of the most prominent expressions of this deficiency, as noted by multiple authors and reports, is the DTIB and CTIB's reliance on imports for critical technologies, materials, and equipment.

Reducing the dependence of the industrial base on imports of critical components and sophisticated technologies was one of the principal aims of the Made in China 2025 [中国制造2025] strategy announced in 2015. As part of transforming China into a Manufacturing Great Power, the plan sought to achieve self-sufficiency in critical parts, components, and basic and critical materials [核心基础零部件, 关键基础材料], and set targets of 40% and 70% self-sufficiency by 2020 and 2025, respectively. The plan specifically targeted high-tech industries including aerospace equipment, communication equipment, power generation, and transmission equipment, engineering machinery, rail transportation equipment, and household appliances as areas where achieving self-sufficiency was important.[192] The plan projected that by 2020, the situation of "being controlled by others" [受制于人] would begin to be alleviated.

When Chinese Premier Li Keqiang failed to mention the strategy in his 2019 annual work report, outside observers speculated whether the strategy was a dead letter or not. While there is evidence to suggest that China is still aggressively pursuing the strategy, it is doing so in a manner that attracts less attention abroad, and it is increasingly clear that the industrial base is struggling to meet the 2020 and 2025 targets.[193]

xxxvi China's industrial base has traditionally been divided among R&D institutions and manufacturers, as in the aviation industry, where design bureaus such as Chengdu Aircraft Research & Design Institute (CADI) conceptualize, model and provide guidance and manufacturers like Chengdu Aircraft handle production.

Notably, in 2018 Zhang Kejian [张克俭], deputy director of SASTIND, wrote that:

> *China's DTIB has achieved a relatively large leap forward, but much work remains to be done to achieve these goals, namely: safeguard national security; protect our evolving national interests; consolidate our status as a great power; achieve the 'strong military goal' of "able to fight, able to win fights"; bring our defense industry up to global standards. There remains a generational gap between the technological levels of our weapons and internationally. There is a significant gap between (our) DTIB's ability to indigenously research and produce core and critical technologies and basic products. In particular, there are "five bottlenecks" that have yet to be resolved: military-use electronics, critical materials, advanced propulsion technology, high-end manufacturing equipment, and essential software (including operating systems).*[194]

Other Chinese Military experts and government reports have raised similar concerns. Jiang et al. note that there is a "relatively insufficient" supply capacity of highly advanced weapons and equipment, and an excessive supply of lower-end products.[195] In the field of weaponry equipment R&D, "supply is not based on demand, but on what is available" [有什么供什么].[196] They point out that China continues to rely on imports for a large number of critical equipment, high-end manufacturing equipment, and core technologies, and that breakthroughs are needed in many areas such as propulsion technology, critical materials, and basic computer software. A 2018 MOFCOM report noted that about 20% of China's military electronic devices must be imported, and some high-end products are difficult to purchase through "special channels" [特殊渠道].[197] The report goes on to note that China's R&D of radar equipment has suffered due to its subpar research and production of critical materials such as silicon carbides [碳化硅], citing its inability to lower production cost and improve material performance. It concludes that if the United States imposes more stringent sanctions on key devices, materials and equipment such as high-speed high-precision analog-to-digital converters/digital-to-analog converters (ADCs/DACs) or high-end digital signal processors (DSPs), China's development, manufacturing, and application of defense products will suffer greatly.

This inability to "crack" critical technologies extends to the CTIB as well. In early 2018, China's *S&T Daily* newspaper launched a special feature consisting of a series of 35 separate reports about "*Chokehold Technologies*" [卡脖子技术], areas where breakthroughs are urgently needed.[xxxvii,198] On July 13, 2018, Xin Guobin [辛国斌], a deputy minister of MIIT and director of the LSG for Manufacturing Great Power Construction [国家制造强国建设领导小组], delivered a speech at the "2018 Symposium on the Construction of a Manufacturing Great Power."[199] Xin told the audience that for a long time, domestic and foreign assessment of China's manufacturing capabilities has been exaggerated and one-sided, focusing heavily on achievements instead of weaknesses. In fact, according to Xin, the manufacturing industry in China is still severely lacking in innovation capacity and is failing to fully internalize the capacity to produce core technologies.

According to a survey of 30 large enterprises examining 130 critical materials conducted by MIIT concluded that China relies on imports for 52% of these materials; among them, 32% are 100 percent import-dependent.[200] In the field of information technology, 95% of high-end chips used in general-purpose processors for computers and servers and more than 70% of intelligent terminal processors and most storage chips [70%以上智能终端处理器以及绝大多数存储芯片] are imported. In the field of equipment manufacturing, more than 95% of manufacturing and

xxxvii This came 12 years after the MLP warned that "core technologies cannot be purchased." In 2006, the State Council issued the 2006 Medium to Long-term Plan for the Development of Science and Technology [2006-2020] (MLP) [国家中长期科学和技术发展规划纲要(2006-2020年)], a milestone document that has been guiding China's science, technology, and innovation [STI] policies since its release. The MLP laid out a blueprint for China to become an innovative nation [创新型国家] by 2020 and a global scientific power [世界科技强国] by 2050. Besides enhancing indigenous innovation capacity, the MLP delineated three lines of efforts between 2006 and 2020 to achieve breakthroughs in 1) generic technology urgently needed in most industrial sectors, 2) core technology critical to economic and national security, and 3) cutting-edge technology that can bring strategic advantages to China in the long run.

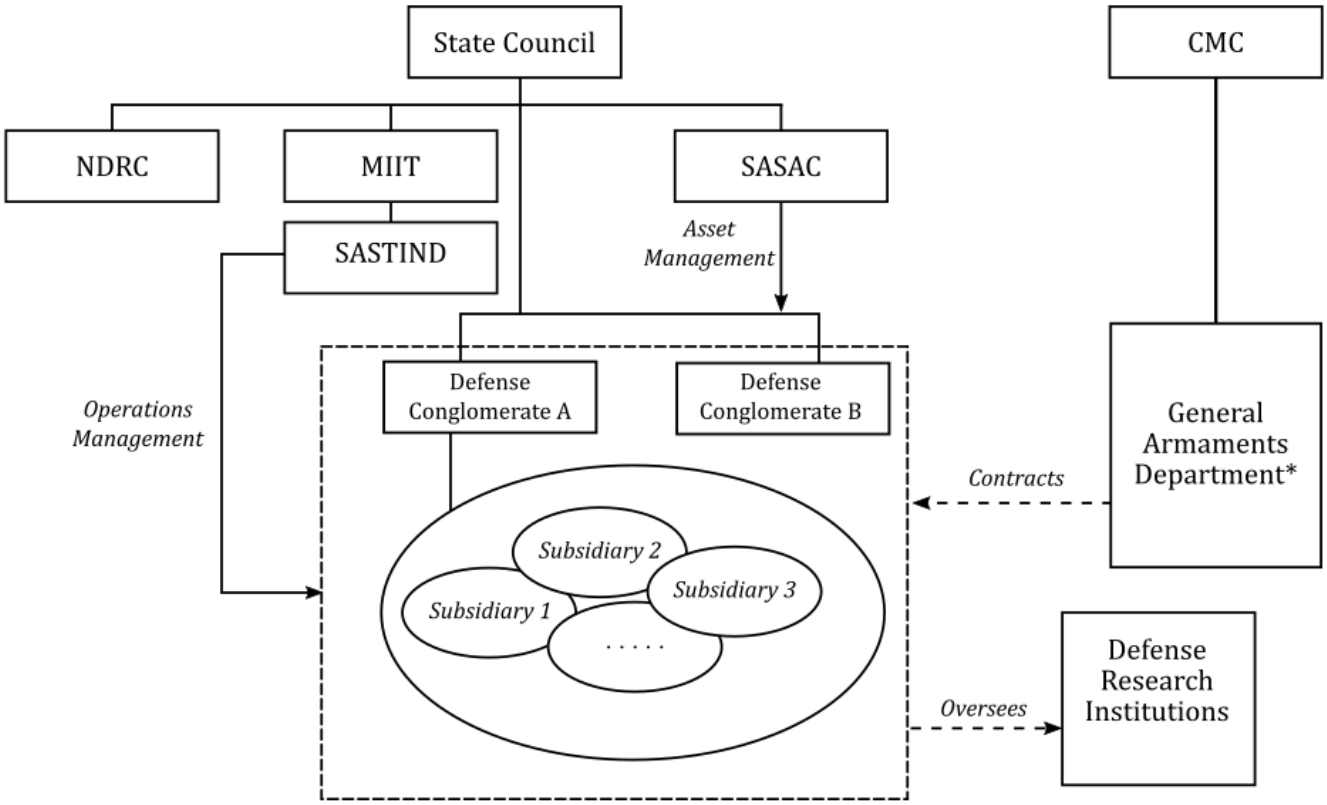
testing equipment involved with the precision production lines for core components for high-end CNC machine tools, high-end equipment, launch vehicles, large aircraft, aeroengines, automobiles, etc., are imported.

Although data shows that as of 2019 the number of China's private high-tech companies has grown to over 150,000 and many have surpassed the defense conglomerates in terms of their R&D capabilities, it is clear that China is still suffering from a myriad of technical difficulties in the development of core technologies in fields including intelligent manufacturing, aerospace, electronics, materials.[201] In light of the situation, Xi Jinping has repeatedly stressed that "core, critical technologies cannot be requested, purchased, or begged for" [核心关键技术是要不来, 买不来, 讨不来的].[202] During his visit to the NUDT in November 2013, Xi bluntly told the audience that "Real 'core technologies' cannot be bought; dependence on imported weaponry is itself unreliable; imitation will not get you far."[203, 204]

PROBLEM II: "SECTORIZATION"

Self-sufficiency is not the only problem; structural issues within the defense industry are major impediments to industrial capacity in China.

Since the establishment of the First Ministry of Machine Building [第一机械工业部] and the Second Ministry of Machine Building in 1952, China's defense industrial base has undergone rounds of reforms stretching over six decades. In the 1980s, the rough landscape of China's current defense industry was formed, with a total of seven ministries of machine building, responsible for the fields of civil machinery, nuclear industry, aviation, electronics, weapons, shipbuilding, and aerospace. Each defense group controls a host of subsidiaries, research institutes, and factories. These groups are owned by the 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], but SASTIND (under MIIT) is in charge of overseeing their business operations. These defense groups also maintain military procurement relationships with the CMC Equipment Development Department and service equipment procurement bureaus.



Zeng Li [曾立], ed., *Research on the Military-Civil Fusion National Defense Resource Allocation and Management with Chinese Characteristics (Part 1)* [中国特色军民融合国防资源配置与管理探索] (上), (Beijing: Economic and Management Publishing House, 2016), 199.

An important characteristic of China's state-owned defense conglomerates is what Chinese experts term "sectorization" [行业化], that is, each conglomerate is largely focused on a particular industrial sector such as shipbuilding, aviation, or electronics. By contrast, prominent western defense contractors such as Lockheed Martin and Raytheon, are specialized [专业化]—they may retain a focus area, but they tend to operate across a number of inter-related sectors.[205] Chinese experts argue that the latter model is superior as specialized development allows for real competition in the market space, giving rise to companies with advantages of scale and technology, while "sectorization" results in a de-facto monopoly, creating a chain of vested interests in a particular trade [行业利益链条].[206]

The following table shows a list of the state-owned defense conglomerates broken down by sector:

Sector	State-Owned Defense Conglomerates
Aviation	Aviation Industry Corporation of China Limited (AVIC) [中国航空工业集团有限公司] Aero Engine Corporation of China Limited (AECC) [中国航空发动机集团有限公司]
Space	China Aerospace Science and Technology Corporation Limited (CASIC) [中国航天科工集团有限公司] China Aerospace and Industry Corporation (CASC) [中国航天科技集团有限公司]
Shipbuilding	China State Shipbuilding Corporation Limited (CSSC) [中国船舶集团有限公司][xxxviii]
Armaments and Ordnance	China North Industries Group Corporation Limited (NORINCO) [中国兵器工业集团有限公司] China South Industries Group Corporation Limited (CSGC) [中国兵器装备集团有限公司]
Electronics and Information Technology	China Electronics Technology Group Corporation (CETC) [中国电子科技集团有限公司] China Electronics Corporation (CEC) [中国电子信息产业集团有限公司]
Nuclear Technology	China National Nuclear Corporation Limited[xxxix] (CNNC) [中国核工业集团有限公司]

While the composition of these industries has been changed, with repeated cycles of breakups and consolidation, the overall contours of the industries themselves have remained largely unchanged. It is therefore unlikely that sectorization will disappear in the near-term.

PROBLEM III: LACK OF CIVILIAN PARTICIPATION

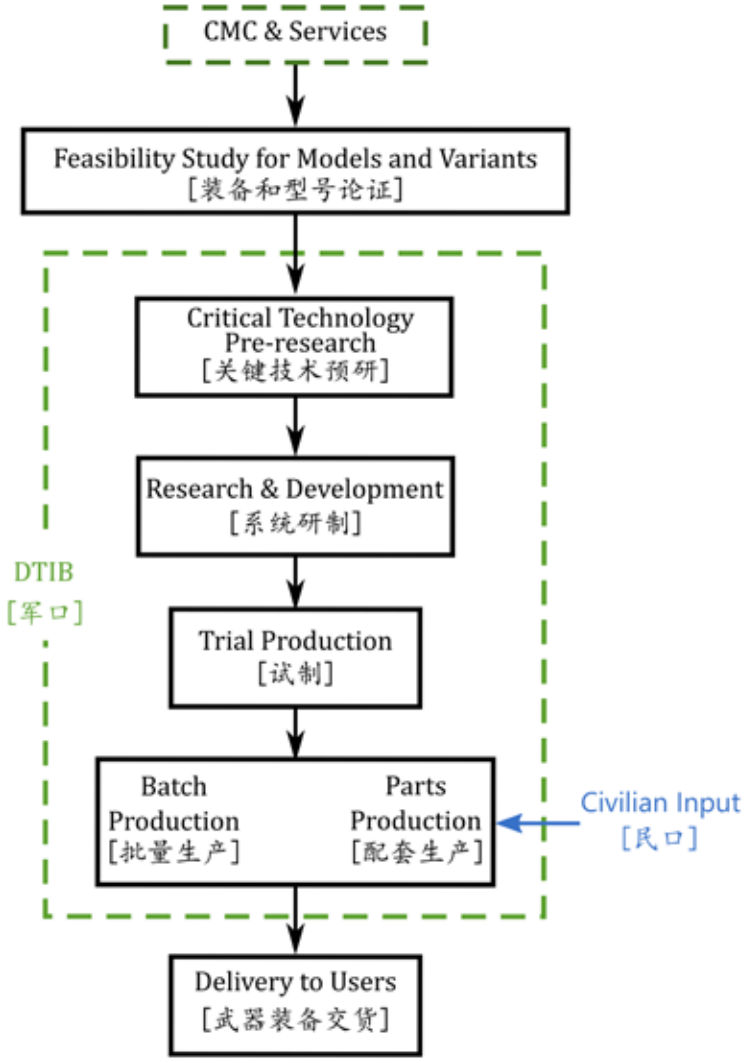
Despite years of effort to introduce competition from the outside, private enterprises are mainly involved in parts or auxiliary products manufacturing and are having trouble moving up the supply chain, a space largely dominated by state-owned defense conglomerates and their subsidiaries.[xl] In fact, data from 2019 suggests that about 2% (3,000 out of 150,000) of China's private high-tech companies are involved in the defense supply chain, primarily providing parts or material supplies.[xli, 207] Civilian input only happens at a much later stage, and then often reluctantly if at all. NUDT researchers further illustrated this point with the graphic reproduced below:

xxxviii The (new) CSSC Limited was created in October 2019 through the merger of the former China State Shipbuilding Corporation [中国船舶工业集团有限公司/南船] and the former China Shipbuilding Industry Corporation [中国船舶重工集团有限公司/北船]. See "About Us" [关于我们], CSSC, accessed May, 2020. http://www.cssc.net.cn/n4/index.html.

xxxix The (new) CNNC Limited was created in January 2018 through the merger of the former China National Nuclear Corporation and the China Nuclear Engineering and Construction Group Corporation [中核建设集团]. See "Group Introduction," [集团介绍], CNNC, accessed May 2020. http://www.cnnc.com.cn/cnnc/300545/jtjs/index.html.

xl Some media reports have speculated that the military-civilian integration rate of China 's first domestic aircraft carrier is close to 80%, but AMS researcher Yu Chuanxin admitted in an interview that he is skeptical of the figure. See "Roughly 3,000 Private Chinese Enterprises Have Entered the Front Line of Military Industrial Procurement [我国大约3000家民企已进入军工采购一线], *Xinhua*, 14 March 2018, http://m.xinhuanet.com/mil/2018-03/14/c_129829001.htm.

xli Due to the high level of private industry participation in the U.S. defense supply chain there is not an exact equivalent for this number. However, there are measures of the level of competition between private companies within the defense industry. A 2020 assessment of the health and readiness of the U.S. defense industrial base concluded that rather than being dominated by a few firms, it fact enjoys a high degree of competition, noting "...total contract obligation dollars remain widely allocated among contractors despite the large combined market share held by the 'Big 6' defense contractors (36%)." See: "Vital Signs 2020: The Health and Readiness of the Defense Industrial Base," National Defense Industrial Association, 2020, https://www.ndia.org/policy/vital-signs-2020, 12.



[Zeng Li [曾立], ed., *Research on the Military-Civil Fusion National Defense Resource Allocation and Management with Chinese Characteristics (Part 1)* [中国特色军民融合国防资源配置与管理探索] (上), (Beijing: Economic and Management Publishing House, 2016), 200]

Additionally, there are also limited "advantaged enterprises" [优势企业] or industry giants in the space. Writing in 2018, NDRC researchers noted that the DTIB is occupied by small to mid-size enterprises [SMEs]. Among them, fewer than ten companies have a net profit of more than 100 million yuan ($15 million USD); the average net profit is less than 30 million yuan ($4.2 million USD).[208]

Many scholars and experts pointed to the "invisible psychological barriers" erected by the military and have identified the DTIB as the main culprit. Researchers from the former PLA Logistics College [后勤学院] called for strengthening "mutual trust" between military and civilian entities. They point out that the military tends to consider private companies "incapable of maintaining confidentiality" [保密难], the quality of their products "unreliable" [靠不住], their ability to continue production during wartime is "not guaranteed" [不保险], and that SMEs generally "don't last long" [活不长].[209] Additionally, they noted state-owned defense companies have often proclaimed themselves as the "rightfully dominant players" [老大] and deliberately set up obstacles to exclude participation of private enterprises in terms of funding, technologies, and products, on the grounds that private companies are unreliable and untrustworthy.

PROBLEM IV: LACK OF COMPETITION

In 2002 the CMC released the PLA Armament Procurement Regulations [中国人民解放军装备采购条例] which delineated five procurement categories: public bidding procurement, invitational bidding procurement, competitive negotiation procurement, single-source procurement, and inquiry procurement. According to researchers from China National Defense S&T Information Center [中国国防科技信息中心], PLA's largest digital information center under the CMC S&T Committee, competitive procurement projects account for 25% of all procurement projects as of the early 2010s.[210] According to Tai Ming Cheung, competitive bidding and tendering only apply to "noncombat, support equipment, such as logistics supplies," and that the defense conglomerates overwhelmingly rely on single-source procurement.[211]

Single-sourcing has multiple downsides. For one, this mechanism allowed the defense conglomerates to become the sole provider of many major weapons and equipment systems, amass technical information, equipment, production processes, and technical personnel, and creating huge barriers to entry barriers for the new entrants from the civilian sector. The armament pricing system for single-source procurement tenders also has a fixed 5 percent profit margin on top of actual costs.[xlii] As noted by Chinese scholars and Cheung, particularly since there are unlikely to be competitors, this low-profit margin creates a perverse incentive for defense contractors to drive up costs while discouraging innovative approaches or investments in new technological capabilities.[212] Even if competitive bidding does take place, these defense conglomerates often operate under the mentality that a pre-determined rotation system [轮流坐庄] (where each gets a contract in turn) is much preferable to a "fratricidal war" [同室竞争], reducing the competitive bidding process to a mere formality.[213]

There have also been cases where the exact opposite mindset took hold, and multiple companies pursued the same contract without regard to cost. For example, between 2014 and 2015, China State Shipbuilding Corporation [CSSC] and China Shipbuilding Industry Corporation [CSIC] fought each other tooth and nail for an LNG ship contract. While both made huge investments in the required infrastructure to complete the contract, a CSIC subsidiary won the bid but was ultimately unable to fulfill the contract, resulting in the CSSC subsidiary receiving the contract. The fact that both sides undertook massive investments to go after this contract was seen as a wasteful duplication of effort. Chinese experts highlight this problem as "excessive competition" [过度竞争]. To reduce this sort of competition and improve efficiency in the already-struggling shipbuilding industry, the two groups were forced to merge to form the new China State Shipbuilding Corporation Limited [CSSC]. Notably, the process, which was completed in November 2019, was overseen by an outsider, Lei Fanpei [雷凡培], an aerospace engineer who served as Chairman of the board of CASC.[214]

Many scholars highlighted "disorderly competitions" [无序竞争] that took place during and after competitive bidding processes as problematic. NUDT researchers noted that both the military and defense groups have a tendency to protect their own subsidiaries and factories in the bidding process. As an example, they noted that during a competitive procurement process for an oil tanker, the military deliberately disrupted the bidding process by excluding outside bidders who were much more qualified.[215] The NDU scholars also gave instances where the bidding process for a key model [重点型号] was fiercely competitive, but once the contract was signed, the winner's performance deviated significantly from what was clearly mandated in the contract.[216]

NUDT researchers have argued that the root of the problem is the lack of a modern enterprise management system within the defense conglomerates. Several incomplete rounds of ownership structure reforms over the past decade have given rise to a "semi-administrative, semi-market-oriented" [半行政, 半市场化] administrative system at the heart of these defense groups, continuing to hinder competitions and erode military procurement processes.[217]

xlii Some sources suggest that this rate has been raised to 10%, but this information has not been verified.

Together, these unresolved issues have led to a military equipment scientific research and production system characterized by a "large core" that is a de-facto monopoly, exhibits little collaboration between entities, is "sectorized" and relatively closed off from the CTIB.

Development of the Industrial SoS During the 13th FYP:

To root out these deep-seated issues in the *industrial SoS* and pave the way for in-depth MCF development, the State Council laid out its plan to reform the *industrial SoS* during the 13th FYP in *Document No. 91 [2017]*, which outlined 29 measures in seven broad areas, but in essence, its main goal is to further open up the DTIB to civilian elements. It proposed:

- Breaking the boundaries between the "military sector" [军口] and "civilian sector" [民口];
- Formulating a plan to make structural adjustments to the defense product R&D ecosystem nationwide, regardless of the nature of ownership;
- Forming a "'small' core, 'large' collaboration, 'specialized,' and open weaponry equipment scientific research and production system.

According to the document, '*Small*' core refers to state-led efforts in the production of defense products that reflect *core strategic capabilities* [核心能力]. This part of the business is likely to remain in the hands of state-owned defense conglomerates.

'Large' collaboration and openness are achieved through the production of defense products that reflect *essential capabilities* [重要能力] and *general capabilities* [一般能力]. The former will be jointly developed by government and market forces with an emphasis on bolstering competition and supporting private "advantaged enterprises" [优势企业], while the latter is to be fully left open to market competition.

The measures outlined in *Document No.91 [2017]* can be synthesized into five lines of effort designed to further open up the DTIB and enhance interoperability between the DTIB and the CTIB.

1. OWNERSHIP REFORM

Chinese leaders see ownership reform of state-owned defense conglomerates [军工企业股份制改革] as the cornerstone of its push to open up the defense industrial base.

The first step in the SOE corporate structure reform—the transition of all defense conglomerates from "people-owned" [全民所有制] to "wholly state-owned" [国有独资], were completed in January 2018.[218] While these defense conglomerates were known as "state-owned enterprises" [SOEs], they had been operating under the ambiguously termed "people-owned enterprise" ownership structure for many decades. In essence, "people-owned" SOEs operated in a similar manner as government agencies or state entities—financial goals were not a chief concern, and employees were entitled to guaranteed lifetime employment and welfare support, known as the "iron rice bowl" [铁饭碗]. However, "wholly state-owned" enterprises require the establishment of clear corporate governance structures and employment contracts.[xliii]

In May of 2007, COSTIND, NDRC, and SASAC jointly issued a guiding opinion to officially initiate the structural reform of ownership of the defense conglomerates.[219] However, this push failed to materialize under Hu Jintao and only advanced in earnest until a decade later in July 2017, when the State Council issued an ultimatum ordering a complete transition of centrally-owned enterprises [央企] from "people-owned" to "wholly state-owned"

xliii Limited company or Joint-stock limited company [有限责任公司或股份有限公司]. For example, Aviation Industry Corporation of China is now Aviation Industry Corporation of China, Ltd.

[国有独资] to be completed by the end of 2017.[220] The purpose of this transition, according to SASAC officials, is to turn state-owned enterprises into "truly independent market entities that operate independently according to law, that bear their own profits, losses, and risks, that can exercise self-discipline, and develop themselves."[221] The fact that the Xi administration was able to push through reform measures that were initiated and failed is a testament to its ability to "'move (people's) cheese' and resolve difficult problems."

This transition is the prerequisite for subsequent reforms aimed at introducing private capital into the system through a variety of channels, often referred to as "market(-based) diversified financing" [市场多元化融资]. According to *Document No.91 [2017]* and SASTIND's 2017 MCF Action Plan, mixed ownership reform [混合所有制改革] will be a central task in the near term. With the exception of industries engaged in specialized projects such as strategic weapons development, defense conglomerates, and their subsidiaries will carry out shareholding system reforms in accordance with control categories such as wholly state-owned, state-owned absolute control, state-owned relative control, and state-owned equity participation, etc. [国有独资, 国有绝对控股, 国有相对控股, 国有参股等控制类别]. The defense industry landscape, at both the parent company and subsidiary levels is expected to shift considerably through a host of activities, including reorganization, restructuring, privatization, asset sales, and mergers and acquisitions.[xliv]

In July 2017, SASTIND announced in Beijing the initiation of ownership structure reform for the first group of 41 defense research institutions [军工科研院所转制].[222] This is another sensitive area where similar efforts were initiated in 2000 and 2011 separately but had resulted in little concrete progress. A SASAC researcher pointed out that these institutions were formerly classified as "public institutions" [事业单位] dependent on state financing and which largely operated outside of the market economy, leading to low rates of commercialization.[223] SASTIND had hoped to complete the first round of reform with a group of 41 institutions by the end of 2018, but progress has been slow. China South Industries Group's [中国兵器装备集团] Automation Research Institute [自动化研究所], also known as No.58 Institute, appears to be the only one in the group to have begun the process in 2018.[224] This is an area that merits close observation.

2. REDUCE BARRIERS TO PARTICIPATION IN DEFENSE PRODUCTION

FROM FOUR LICENSES TO THREE

Prior to 2017, civilian companies were required to obtain up to four licenses to take part in the defense supply chain, and the entire process took an average of four years, according to a survey conducted by researchers with the MCF and National Mobilization Research Center under the China Shipbuilding Industry Corporation [中国船舶重工集团公司军民融合与国防动员发展研究中心].[225] In a move to further lower the entry barrier for civilian companies into the weapons and equipment R&D field, in October 2017 the CMC Equipment Development Department (EDD) announced that two of the licenses had been merged, reducing the total number to three and reducing the required time by roughly six months.

xliv Some Chinese analysts believe that the current state of China's defense industry corresponds to the beginning of the "Golden Decade" of the 1990s in the U.S., characterized by mergers and acquisitions among large defense contractors. This paradigm, which was created after World War II and continues to this day, is based on a hybrid economic approach in which the government, through the Department of Defense, privatized much of the defense industrial capacity which had been run by the government more or less directly during the Second World War. This had the benefit of lowering the risks associated with large, long-term and often technically complex projects by funding significant portions of the research and development needed to push the technological envelope while remaining attractive to private investors.

The three licenses are:

1. Weapons and Equipment Research and Production Unit Classified Qualification Permit [武器装备科研生产单位保密资格认证]
2. Weapons and Equipment Research and Production Certificate [武器装备科研生产许可证]
3. Equipment Manufacturing Unit Qualification Permit [装备承制单位资格认证][xlv]

According to EDD data from 2019, the number of civilian companies that have obtained the latter permit had risen from 500 in 2013 to 2,300 in 2019.[226]

Additionally, the 2018 version of the *Weapons and Equipment Research and Production License Catalogue* issued by SASTIND and CMC's Equipment Development Department includes 285 items in seven categories, a 62% reduction compared to the 2015 edition catalog.[227] The 2018 edition reportedly only retained items that have a significant impact on national security and public safety, thereby dramatically reducing the number of licenses private companies must acquire before producing certain products.

SETTING UP PROCUREMENT PLATFORMS

Another move by the CMC Equipment Development Department was the January 2015 launch of an online PLA weapons and equipment procurement platform [http://www.weain.mil.cn/]. The website publishes both classified and public procurement announcements, declassified defense patents, and general knowledge and guidance for interested civilian parties. As of March 2020, it has 53,864 user accounts and had published 67,651 tenders and received 88,889,348 visits. According to the website, a total of 30 service centers have been set up across China to handle inquiries.[xlvi]

SASTIND also operates an online platform—the National Military-Civil Fusion Public Service Platform [国家军民融合公共服务平台] [http://jmjh.miit.gov.cn/] that serves a broader audience and focuses on technology, products, and financing requirements.

xlv Prior to their merger this license consisted of two distinct permits, the Weapons and Equipment Quality Management System Certificate [武器装备质量管理体系认证] and the Equipment Manufacturing Unit Qualification [装备承制单位资格].

xlvi A study by C4ADS, "Open Arms: Evaluating Global Exposure to China's Defense-Industrial Base" examined and analyzed 8,430 military procurement announcements from this website.

3. PROMOTE TWO-WAY TRANSFER OF MATURE TECHNOLOGIES

The *2016 Opinion* argues that the PLA should work to make previously classified patents and technologies available to the broader commercial sector.

Jiang et al. pointed out that the commercialization rate of defense science-derived technologies is between 50-60% in developed countries, but only 15% in China.[228] Many defense patents, therefore, have unrealized commercial potential and are described as "sleeping beauties."[229]

As noted by NDU's *Report on the Development of Military-Civil Fusion in China (2016),* there appear to be several important developments:[230]

- In 2015, SASTIND and the State Intellectual Property Office jointly published the first edition of the "National Defense Science and Technology Industry Intellectual Property Conversion Catalogue" to promote the conversion of military technology to the civilian field. The General Office of MIIT and the Comprehensive Division of SASTIND jointly issued the "Catalogue for Promoting Military Technology for Civilian Use" and "Catalogue of Recommended Civilian Technologies and Products for Military Use" to promote the two-way transfer of military and civilian technological achievements.
- The defense conglomerates built Internet service platforms to promote the sharing of military and civilian resources and collaborative innovation among industries. For example, the China Aerospace Science and Industry Corporation established an "Internet + Smart Manufacturing" service platform called CASICloud [航天云网].
- The National University of Defense Technology (NUDT) set up military-civilian collaborative innovation research institutions [军民协同创新研究机构] with a number of cities including Changsha, Hunan Province, Lüliang, Shanxi Province, Binhai, Tianjin, Xiamen, Fujian Province, and defense conglomerates China Electronics Corporation (CEC), etc. to jointly promote high-tech R&D and commercialization of the resulting technologies.
- Mianyang in Sichuan Province set up a 2 billion RMB ($283 million) MCF Two-Way Technology Conversion Fund[231] dedicated to aerospace, nuclear technology applications, information, and control technology and advanced materials.

China Aerospace Academy of Systems Science and Engineering [中国航天系统科学与工程研究院], also known as CASC 12th Academy, has begun a number of similar initiatives.[232] As explained by Academy Director Xue Huifeng [薛惠锋], the Academy is home to the following centers dedicated to promoting MCF:[233]

- CASC MCF Promotion Center [中国航天科技集团公司军民融合促进中心]
- CASC Intellectual Property Center [中国航天科技集团公司知识产权中心]
- China Cybersecurity & Informatization MCF Development Alliance [中国网信军民融合发展联盟]
- Defense S&T Promotion Center [国防科技生产力促进中心]
- China Academy of Engineering Knowledge Center for Engineering S&T [中国工程院工程科技知识中心]

According to Xue, his institution brings together 37,000 technology patents from the space industry with nearly 170,000 defense technology patents.

In addition to utilizing the digital platforms outlined above, institutions such as the 12th Academy are also setting up offices all over the country to speed up the transfer of intellectual property to local companies. Between 2016 and 2017 the Academy set up MCF conversion centers in Hefei, Anhui Province, Nantong, Jiangsu Province,

Shenyang, Liaoning Province, Foshan, Guangdong, and Shenzhen Guangdong province. Their stated goal was to assist with the commercialization of space technologies at the local level to help boost their economies.

4. SUPPORT EFFORTS IN KEY DOMAINS

In addition to reorganization and restructuring efforts to make the defense industrial base more responsive, agile and promote civilian participation in the space, policymakers have also developed plans to align efforts in the construction of the *industrial SoS* with efforts in the *maritime, space, and cyberspace* domains, as well as the seven sectors flagged for the development of strategic emerging industries [战略性新兴产业].

Strategic Emergent Industries [战略性新兴产业][234]	
New Generation Information Technology	[新一代信息技术]
Energy-Efficient, Environmentally Friendly	[节能环保]
Biotech	[生物产业]
High-end Equipment Manufacturing	[高端装备制造]
New Energy	[新能源]
Advanced Materials	[新材料]
Alternative Fuel Vehicles	[新能源汽车]

5. COORDINATE WITH REGIONAL DEVELOPMENT STRATEGIES

Document No. 91 [2017] also called for the further integration of the defense industry and regional economies under the framework of China's regional coordinated development strategy, which is a system of strategies with the following constituent parts:

- The "Three strategies": "Belt and Road" initiative, coordinated development of Beijing-Tianjin-Hebei, and the development of the Yangtze River Economic Belt [长江经济带]
- "Four Major Economic Plats" [四大板块] covering the "Western Development Drive" [西部开发], "Revitalization of Northeast China" [东北振兴], "Rise of Central China" [中部崛起], and "Eastern Region Spearhead Development" [东部率先]
- Construction of the Hebei Xiong'an New District
- Construction of the Guangdong-Hong Kong-Macao Greater Bay Area

State-owned defense groups are encouraged to strengthen strategic cooperation with local governments in these areas, establish MCF innovation demonstration bases [军民融合创新示范基地], implement a number of MCF megaprojects [军民融合重大项目], and play a leading role in driving the local economic development.

3.1.3 Military-Civil Science and Technology Coordinated Innovation SoS

OVERVIEW

The *Military-Civil Science and Technology Coordinated Innovation SoS* [军民科技协同创新体系] provides the impetus for China's two top strategic priorities: innovation-driven development and PLA reorganization and modernization. Ministry of Science and Technology (MOST) Officials described MCF efforts in this area as "extremely important" to the success of the overall strategy is characterized by both high demand and a high potential for return on investment.[235] Other authors have noted that the PLA is currently in an important stage of concurrent mechanization and informatization and are desperate for defense innovations."[236]

The *Innovation-Driven Development Strategy*, proposed by Xi Jinping in May 2016, traces its roots back to Hu Jintao's *Innovative Nation* [创新型国家] strategy from 2006. The same year, the State Council issued the *2006 Medium to Long-term Plan for the Development of Science and Technology* (2006-2020) (MLP) [国家中长期科学和技术发展规划纲要 (2006-2020年)], which has guided China's science, technology, and innovation (STI) policies since its release.[237] The MLP laid out a blueprint for China to become an *Innovative Nation* [创新型国家] by 2020 and a *Global S&T Great Power* [世界科技强国] by 2050. Xi's updated version of the strategy in 2016 added a new target date—to be in the "front rank" of innovative countries by 2035.

According to the *Innovation-Driven Development Strategy Outline* [创新驱动战略发展纲要], China is currently "following," "keeping pace," and "leading" in different areas of technological development. An important goal of this strategy is, therefore, to drive China's innovation capability to a point where it can uniformly "keep pace" or "lead."[238] Jiang et al. argue that China, despite its efforts, is hard-pressed to catch up to other advanced nations in most traditional science and technology fields.[239] However, in many emerging scientific and technological fields, such as big data, artificial intelligence, Internet of Things, virtual reality, drones, or automated driving, China is at the same starting point as developed countries and can at least maintain its position relative to other countries and not fall behind. In other important fields such as quantum communications, space science, deep-sea exploration, and life sciences, China has the potential to be at the forefront of innovation.

To reach these milestones, the *Innovation-Driven Development Strategy Outline* laid out eight "strategic tasks."[240]

- Promote Innovation in China's Industrial and Technological R&D Systems
- Strengthen 'Original Innovation'
- Optimize the Layout of Regional Innovation
- Deepen Military-Civil Fusion
- Expand the 'Main Body' of Innovation
- Implement S&T Megaprojects and Programs
- Strengthen High-quality Workforce
- Promote Innovation and Entrepreneurship

In a speech Xi delivered in March 2015 in Shanghai, he highlighted the necessity of strengthening "indigenous innovation" "*zizhu chuangxin*" [自主创新] capability as the most fundamental and critical of all tasks.[241]

To better understand the impact of the confluence of the MCF strategy and the Innovation-Driven Development Strategy, it is necessary to fully grasp the shades of meaning behind the term "*zizhu chuangxin*," as it can be particularly misleading, and provides insight into how Chinese leaders understand innovation.

THE STATE OF CHINA'S *ZIZHU CHUANGXIN*

When the term was first introduced in the 1990s, *zizhu chuangxin* [自主创新] was understood as "indigenous innovation." However, its official meaning has shifted over the years in a way that perfectly encapsulates the various shifts in how China has pursued advanced S&T capabilities.

The term was initially reserved for indigenous innovation, used to contrast with "(foreign) technology acquisition" [技术引进] or "imitation" [模仿], which had been the main methods China used to advance technologically between the 1950s and 1980s. However, over the years, there had been arguments that all forms of innovation, as long as independent property rights could be secured eventually, may be labeled *zizhu chuangxin*. So while it is typically translated as "indigenous innovation," it is better understood as "self-initiated innovation." This interpretation was acknowledged by MOST Deputy Director Shang Yong [尚勇] and Premier Wen Jiabao [温家宝] in 2005 and officially used in the *2006 MLP*, which stated that the meaning of self-initiated innovation [自主创新] is three-fold.[xlvii] It covers:[242]

1. *Original innovation* [原始创新], a close match of "indigenous innovation," which requires genuine homegrown scientific and technological breakthroughs
2. *Integrated innovation* [集成创新], which refers to the integration of existing technologies to form new technologies and subsequent development of products based on the new technologies. A prime example of integrated innovation is the Shanghai Zhenhua Port Machinery Company's [ZPMC] refinement of the U.S. GPS system to improve the accuracy of container crane loading and unloading process.[243] A year after deploying the system, the company applied for patents worldwide and became a leader in technological development in this field. China's Shenzhou manned spacecraft project is also held up as a model of integrated innovation.
3. *Re-innovation based on assimilation and absorption of imported technologies* [引进消化吸收再创新]. Often referred to as the IDAR (introduce, digest, absorb, and re-innovate) approach, it consists of "the different steps required to turn foreign technology into a remade domestic variant."[244] China's J-16 fighter jet (based on

xlvii Xi reaffirmed this interpretation in a speech he gave at the Chinese Academy of Science on July 17, 2013.

the Russian Su-30) and the Liaoning aircraft carrier (a refurbished Soviet/Ukrainian carrier) are examples of this approach.

The order in which the three types of innovation were listed reflected the desirability of each approach, rather than the proportion of activities. The situation has remained largely unchanged in the 15 years since the release of the MLP. In his examination of the Chinese defense science, technology, and industrial (DSTI) system, Professor Tai Ming Cheung notes that since the 1980s, China's defense economy has largely pursued a "twin-tracked imitation-innovation approach," but imitation remains the primary focus of activities.[245] In a 2018 research brief he wrote:

> *Important factors that would indicate that the most advanced types of innovation outcomes are gaining traction are still weak, such as the role of the acquisition process, the R&D system, incentive mechanisms, governance norms and institutional culture, and production processes. Overall, this indicates that the locus of China's defense innovation capabilities is between an advanced imitation to a low-to-mid-tier innovation power.*[246]

Chinese leaders have repeatedly questioned the sustainability of the IDAR approach and urged that additional measures be taken to strengthen China's original innovation capability. In a speech from 2015, Xi said:[247]

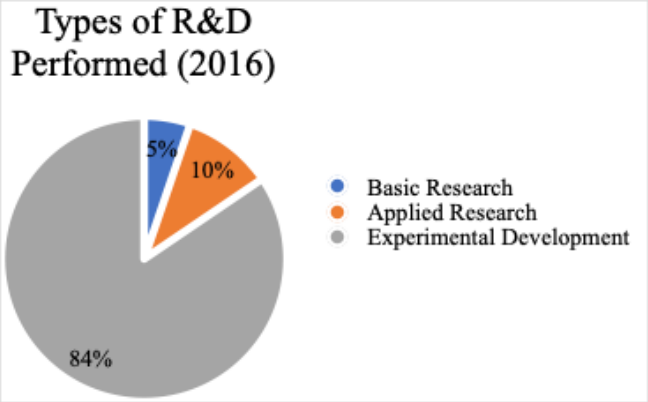
> *We cannot be left behind in this technological innovation competition. We must strive to catch up and to surpass, to seize the initiative, to gain advantages, and to win the future. At this stage of development in our country, not only is it impossible to obtain key core technologies from others, but it is also difficult to obtain general advanced technologies. Western developed countries have this mentality that the 'masters will starve to death if they teach the apprentices,' so [strengthening] self-initiated innovation capability is where we should focus our efforts.*

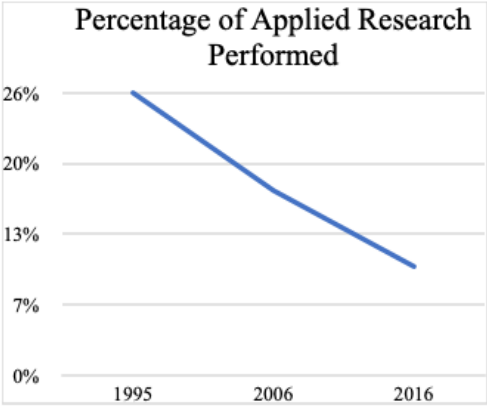
In early 2020, five state agencies—MOST, NDRC, MOE, CAS, and NSFC—jointly issued an action plan to promote "from 0 to 1" basic research ["从0到1"基础研究].[248] According to Wang Yangzong [王扬宗], professor at the University of Chinese Academy of Sciences, "0 to 1" is the essence of original innovation; it is a long and arduous endeavor, and there's no guaranteed success.[249] But technological development cannot be achieved without the "0 to 1" breakthroughs, he argues. According to Wang, a good indicator for measuring breakthroughs in original innovation is through an examination of the award list of the biennial National Natural Science Award—the First Prizes, in particular. It was a telling sign that the first prizes were left vacant in 2004, 2005, 2007, 2008, 2010, 2011, and 2012. Wang further notes that although it has not been left vacant since 2013, there have only been a very limited number of awardees, and some have been mired in controversy.

Wang's observation gets at the heart of a peculiar phenomenon. On the one hand, China overtook the U.S. in terms of the total number of published scientific papers in early 2018, leading some to conclude that China is poised to "outperform America in science."[250] On the other hand, China is struggling to demonstrate its ability to bring original innovation to fruition, and its senior leaders speak of the insufficient supply of core, critical technologies as a matter of life and death. As a result, many within the scientific research community have questioned whether China's high scientific research output has translated into original innovation capability or improved technological readiness.

There has also long been a concern that the dramatic rise in publication numbers might be indicative of an "academic bubble" masking deep-seated problems in China's S&T R&D system, which chiefly include:

- Insufficient investment in basic research; decline in applied research. From 1995 to 2016, China's basic research funding accounted for merely 5% of the total social research and development funding.[251] This topic has attracted the attention of senior leaders, who have called for significant investment in basic research. What is often overlooked, however, is the reduction in funding for applied research, which had dropped from 26% to 10%. In 2016, basic and applied research only made up 15% of China's total R&D expenditures.





- A research assessment metric that ill-incentivizes its research base, which has resulted in instances of academic fraud; practices of "water dumping"—publishing for publishing's sake; concentration of effort on "hot topics" while neglecting traditional areas of strategic concern. In a paper examining the effectiveness of China's talent recruitment programs, Liming Salvivo noted a top complaint among many Chinese scientists: "excessive competition results in significant amounts of valuable time wasted on fighting over resources, seeking quick success, and boosting publication counts rather than maintaining a focus on long-term fundamental research."[252] These scientists reported that their research is only evaluated by counting the "impact factor" of papers in international SCI-ranked journals.[253] As a result, they feared that China's research environment is "not conducive to innovation." As a result of these issues, influential scientists and even Xi Jinping have been openly critical of conflating simple research assessment metrics and scientific progress.

Chinese senior leaders appear to be acutely aware of how far China is from achieving "Scientific Great Power" status. The global backlash against Chinese tech giants ZTE and Huawei has further emphasized the importance of further reforming the scientific research system, supporting indigenous innovation, and absorbing and cultivating scientific research talents. Beginning in the late 2010s, *original innovation* has been in the spotlight as an area that merits close attention, resources, and nationwide efforts.[xlviii]

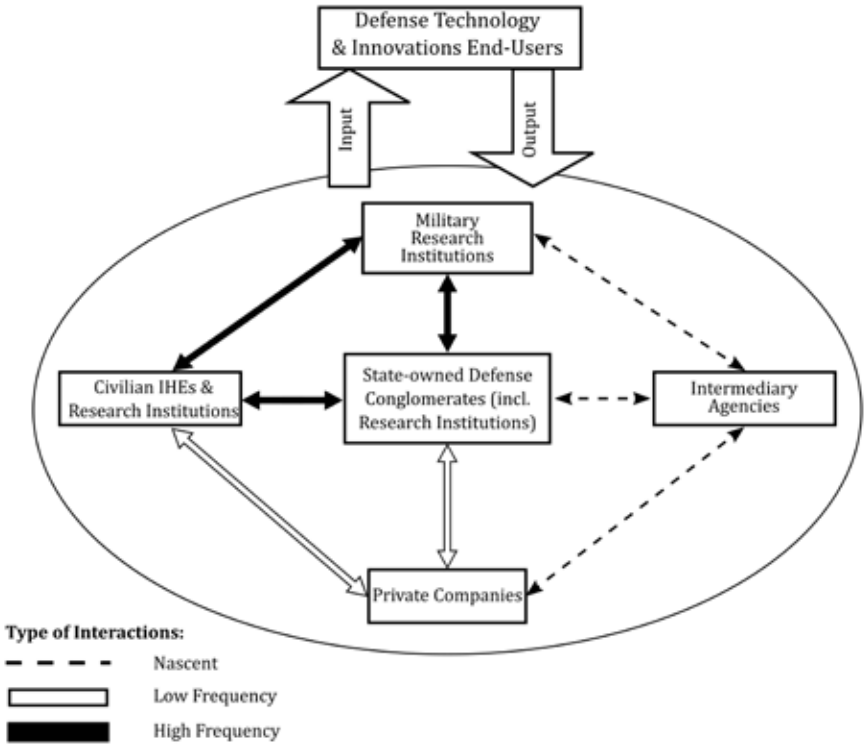
Although the goal is clear, the path to achieving it is not. China appears to be still searching for better ways to promote, fund, and evaluate scientific research. So far, the roadmap to achieving original innovation as outlined in the *Innovation-Driven Development Strategy* (2016) provided only vague guidance:[254]

xlviii It must be noted that IDAR and integrated innovation remain important means of achieving technological progress, and concerns over China's illicit dual-use technology acquisition efforts through the IDAR approach are fully warranted and such efforts must be closely monitored.

- Strengthen research of cutting-edge technologies oriented to national strategic needs
- Strengthen basic research project planning to address the "Chokehold Technology" problem that affects long term economic development and national security
- Strongly support free exploration in basic research
- Promote balanced and coordinated development of disciplines and strengthen interdisciplinary integration.
- Build a group of infrastructure and platforms that support high-level innovation

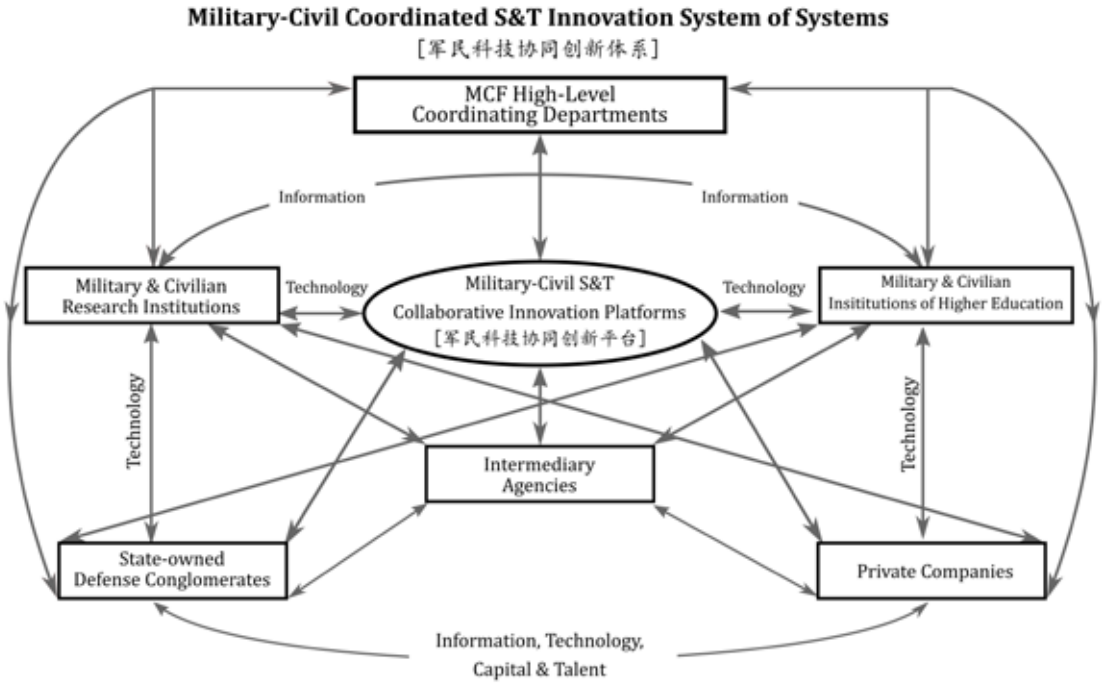
In addition to promoting original innovation, the deepening integration between the civilian and defense domains represents another line of effort for China to revamp and strengthen its innovation system. One reason for this move is that the defense sector no longer has a monopoly over the development of cutting-edge dual-use technologies, which are increasingly born in the commercial sector. But beyond exploiting dual-use technologies to enhance the PLA's warfighting capabilities, MCF initiatives are also designed to broaden communication channels, facilitate resource sharing, and perhaps most importantly, sustain such interactions and the clustering of brilliant minds. Chinese economist and professor at Peking University's National School of Development Zhou Qiren [周其仁] highlighted the presence of sustained "high-concentration, high-frequency, and high-density interaction" as the prerequisite to achieving original innovations and technological breakthroughs.[255]

According to MCF researchers, in its current state, the innovation base has not reached the desired level of concentration, frequency, and density, as illustrated in the graphic below.



Ji Hongliang [计宏亮], "How Do We Achieve Military-Civil Coordinated Self-Initiated Innovation?" [我国军民协同自主创新之路怎么走], Civil-Military Integration on Cyberspace [网信军民融合], no. 7 (July 2019), https://www.secrss.com/article/13869.

As can be seen in the above graphic, MCF analysts see components of the innovation base as having low or nascent levels of interconnectivity. For MCF to achieve its goals in facilitating innovation, they, therefore, believe China must reach a much more integrated state as illustrated below:



Zeng Li [曾立], ed., *Research on the Military-Civil Fusion National Defense Resource Allocation and Management with Chinese Characteristics (Part 1)* [中国特色军民融合国防资源配置与管理探索] (上), (Beijing: Economic and Management Publishing House, 2016), 202.

Such a system would be characterized by the free flow of elements such as information, technology, capital, and talent between its constituent parts.

CENTRAL TASKS

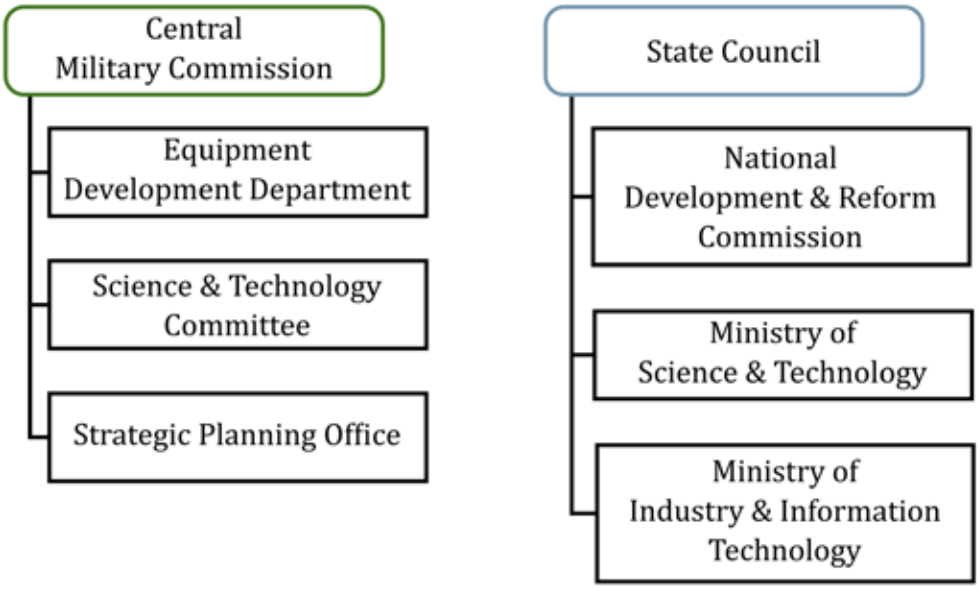
The *Science and Technology Military-Civil Fusion Development Plan for the 13th FYP (S&T MCF Plan)* ["十三五" 科技军民融合发展专项规划] released in April 2017 by MOST and the CMC Science and Technology Committee provides authoritative guidance for the development of the *Military-Civil Science and Technology Coordinated Innovation SoS*.[256] The *S&T MCF Plan* stated that its goal is for the *innovation SoS* to take rough shape by 2020, achieving a "full-element, multi-domain, and high-return technology military-civil fusion deep development pattern."[257]

The plan was sent to the following organizations: S&T departments at the provincial and prefecture levels, the S&T Bureau of the Xinjiang Production and Construction Corps, all S&T departments under various State Council ministries and agencies, the Equipment Development Departments of each military service, the Staff Department of the PLA Strategic Support Force, offices under the CMC headquarters, AMS, NDU, NUDT, and PAP Staff Department, indicating that these are the main organizations involved in implementing the plan.

TASK I: IMPROVE S&T MCF HIGH-LEVEL LEADERSHIP AND COMMUNICATION MECHANISMS

According to MOST Deputy Director Huang Wei [黄卫], MOST has established routine communication channels and work mechanisms with the CMC S&T Committee, CMC Strategic Planning Office [军委战略规划办], CMC EDD, NDRC, and MIIT.[258]

Leading Organizations for MCF Development in the S&T Domain



*The specific interactions between these organizations are unknown

As of August 2017, through coordination with MOST, the CMC S&T Committee has officially joined the LSG for State S&T System Reform and Innovation System Construction [国家科技体制改革和创新体系建设领导小组] and now participates in inter-ministerial meetings overseeing national science and technology program management [国家科技计划管理部际联席会议]. Zhang Xiaoyuan [张晓原], Director-General of MOST's Department of Resource Allocation and Management [科技部资源配置与管理司] emphasized that establishing and maintaining long-term communication mechanisms is key to the success of these scientific programs. He noted that while the military and other defense sector organizations had set up coordinating mechanisms in the past, they functioned ad hoc or as 'one-offs' for a specific project, and after a project was completed, there was no follow-up or coordination about next steps.

While much of the work carried out by the CMC S&T Committee (China's rough equivalent of DARPA), remains secret, two important lines of effort have been made public. The first is the creation of "defense science and technology innovation rapid response small groups" [国防科技创新快速响应小组], a mechanism to rapidly leverage civilian technologies in response to defense technology innovation needs (sometimes characterized as China's DIUx).[259] As of March 2020, the rapid response small groups have set up offices in Shenzhen [深圳], Dalian [大

连], and Chongqing [重庆]. In the first quarter of 2020 alone, the Shenzhen office has released six sets of requests for proposals, seeking technologies ranging from UAV fast obstacle avoidance technology and software-defined multifunction sonar to preparation technology of ceramic coatings.[260] The second line of effort is the *Defense Technology Strategic Pilot Plan* [国防科技战略先导计划] announced in March 2020 that funds routinized information collection, translation, and analysis of defense technology developments abroad.[261] This effort will likely be managed by the AMS's Military Scientific Information Research Center [军事科学院军事科学信息研究中心].

TASK II: STRENGTHEN BASIC RESEARCH AND COORDINATED INNOVATION CAPABILITY

The *S&T MCF Plan* seeks to bring about cutting-edge, disruptive technologies in the fields of intelligent unmanned technologies, interdisciplinary biology [生物交叉], advanced electronics, quantum technology, future internet networks, advanced energy, advanced materials, and advanced manufacturing.

To accomplish this, it called for the establishment of MCF designated funds [军民融合专项基金] to support national defense basic research projects that will be carried out by military and civilian research institutions in a coordinated manner. Another priority is facilitating the transfer of civilian basic research products into military applications.

According to the *S&T MCF Plan*, MCF efforts will be linked with two out of the five existing national research funding vehicles: the *National Key R&D Plan* [国家重点研发计划] and the *National S&T Megaprojects* [国家科技重大专项].[xlix]

Under the *National Key R&D Plan* category, various existing R&D programs under MOST, NDRC, MIIT, and other central government agencies were merged and integrated into a single national plan. These included MOST's *National High Technology R&D Plan* (863), *National Basic Research Program* (973), and the *National Key Technology R&D Plan*, also called the *Zhicheng* [国家科技支撑计划] program, among others.

The *National S&T Megaprojects* category includes the 16 national megaprojects outlined in the MLP in 2006 and an additional group of 16 megaprojects—termed "S&T Innovation 2030 Megaprojects" [科技创新2030重大项目] that were proposed in the *13th Five Year National S&T Innovation Plan* issued in July 2016.[262] These projects reflect the country's strategic intentions and are divided into civilian and military projects, although many projects are dual-use in nature. Historically, scientific projects in this category included the atomic and hydrogen bombs, satellites, manned space flights, and hybrid rice. National megaprojects involve substantial government investment and the national mobilization of R&D resources. Many experts from the Thousand Talents Program [千人计划] were recruited specifically to work on these projects.

xlix A policy document issued by the State Council in December 2014 laid out steps to merge and integrate the existing S&T programs and funding vehicles of central ministries into five broad categories for streamlined management via an open and unified national S&T management platform. See "国务院印发关于深化中央财政科技计划（专项，基金等）管理改革方案的通知_政府信息公开专栏," 3 December 2014, http://www.gov.cn/zhengce/content/2015-01/12/content_9383.htm.

National S&T Megaprojects

MLP 16 megaprojects	S&T Innovation 2030 Megaprojects
1) Advanced numerically-controlled machine tools and basic manufacturing technology 2) Control and treatment of AIDS, hepatitis, and other major diseases 3) Core electronic components, including high-end chip design and software 4) Extra large-scale integrated circuit manufacturing 5) Drug innovation and development 6) Genetically modified organisms 7) High-definition Earth observation systems 8) Advanced pressurized water nuclear reactors and high-temperature gas-cooled reactors 9) Large aircraft 10) Large-scale oil and gas exploration 11) Manned space, including lunar exploration 12) Next-generation broadband wireless telecommunications 13) Water pollution control and treatment 14-16) Three unannounced projects, thought to be classified. Likely candidates include:[263] - Shenguang inertial confinement fusion laser project; - The second-generation Beidou satellite navigation system; - Near-space vehicle technology project.	1) Aero-engine and gas turbine 2) Deep-sea station 3) Quantum communication and quantum computing 4) Brain Science and brain-inspired intelligence 5) National cyberspace security 6) Deep space exploration and spacecraft on-orbit service and maintenance system 7) Seed industry innovation 8) Clean and efficient use of coal 9) Smart grid 10) Space-Earth Integrated Information Network 11) Big Data 12) Intelligent manufacturing and robotics 13) Key new materials development and application 14) Beijing-Tianjin-Hebei Comprehensive Environmental Management 15) Health protection 16) Artificial Intelligence 2.0[264]

TASK III: PROMOTE SHARING OF SCIENTIFIC RESOURCES

LAB RESOURCE SHARING

In June 2018, MOST, NDRC, SASTIND, and the CMC EDD announced measures to promote resource sharing[1] across a wide range of national scientific research facilities, including state key laboratories [国家重点实验室], national defense technology key laboratories [国防科技重点实验室], major military and defense industry test facilities [军工和军队重大试验设施], and the over 60 facilities designated as "national major scientific and technological infrastructure" [国家重大科技基础设施].[265]

State key labs and national defense S&T labs are encouraged to strengthen "two-way opening" [双向开放] and "effective integration" [有效集成]. The degree to which this measure has been implemented is unclear, but state key labs and national defense key labs are often housed under the same institution. For example, the National Defense S&T Key Laboratory of Ultra High-Temperature Composites [超高温复合材料国防科技重点实验室] and the State Key Laboratory of Solidification Processing [凝固技术国家重点实验室] are both housed at Northwestern Polytechnical University (NWPU) and share at least a portion of their research staff.

MILITARY-CIVIL S&T COLLABORATIVE INNOVATION PLATFORMS

With so many competing priorities, the question of how to prioritize funding becomes an important one. The *S&T MCF Plan* proposed maximizing results by building a group of military-civil S&T collaborative innovation platforms in regions and key areas where there is a well-developed defense industry, a concentration of innovative elements and resources, and a strong demand for MCF related services. These innovation platforms appear to take a variety of forms, including:

- National Self-Initiated Innovation Demonstration Zones [国家自主创新示范区]
- National High-Tech Industry Development Zones [国家高新技术产业开发区]
- National Military-Civil Fusion Innovation Demonstration Zones [国家军民融合创新示范区]

1 Here "resources" include facilities, scientific instruments, data, experimental materials, etc.

- Military-Civil Fusion industrial Bases [军民融合产业基地]
- Dual-use Technology Innovation Bases [军民两用技术创新基地]

A detailed examination of each type of platform is outside the scope of this study, but PLA NDU's *Report on the Development of Military-Civil Fusion in China (2016)* suggested that the designation is dependent on the resources and the existing industrial layout of each area or region [因地制宜].[266]

In September 2015, the CCP Central General Office and the General Office of the State Council issued a plan for the systematic promotion of comprehensive innovation reform experiments [创新改革试验] in some regions.[267] The plan specified the following regions as areas that will pilot the MCF innovation reform experiments:

- One inter-provincial administrative area: Beijing, Tianjin, and Hebei
- Four provincial-grade administrative regions [省级行政区域]: Shanghai, Guangdong, Anhui, Sichuan
- Core areas in three provincial-grade administrative regions [省级行政区域的核心区]: Wuhan, Xi'an, Shenyang

TASK IV: STRENGTHEN THE S&T FORCE

EXPAND THE SCOPE OF UNIVERSITIES AND DISCIPLINES WITH NATIONAL DEFENSE CHARACTERISTICS

A report by Alex Joske put out by the Australian Strategic Policy Institute that accompanies its *China Defence Universities Tracker* database has identified 101 agreements signed between SASTIND and the Ministry of Education or provincial governments since 1999 to jointly develop [共建] 61 universities.[268] This initiative has been progressing steadily over the past two decades. In concert with MOE's *World First Class University* and *First-Class Academic Discipline Construction* [世界一流大学和一流学科建设 or 双一流] initiative, "jointly-developed" universities are entitled to funding to strengthen individual faculty departments, disciplines "with defense characteristics" [国防特色], as well as the construction and development of national defense key discipline laboratories [国防重点学科实验室建设].

This move introduced much greater numbers of Chinese universities into the field of defense research, which has traditionally only included the seven defense universities subordinate to MIIT.

The Seven Defense S&T-related IHEs Subordinate to MIIT
Beihang University [formerly Beijing University of Aeronautics and Astronautics] [北京航空航天大学]
Beijing Institute of Technology [北京理工大学]
Harbin Engineering University [哈尔滨工程大学]
Harbin Institute of Technology [哈尔滨工业大学]
Nanjing University of Aeronautics and Astronautics [南京航空航天大学]
Nanjing University of Science and Technology [南京理工大学]
Northwestern Polytechnical University [西北工业大学]

More broadly, it is important to note that the line between civilian and defense universities has always been blurry. Tsinghua University, one of China's top research universities, is a prime example. According to Tsinghua Vice President You Zheng [尤政], the university has always considered MCF as a critical focus area of the university.[269] Although it is "technically" a civilian university and was only added to the SASTIND/MOE list in 2016, it was the first university in China to hold national defense work conferences [国防工作会议] that had the participation of senior military and state ministry officials, in 2000 and 2006. The Tsinghua University Defense Strategic Research Center [清华大学国防战略研究中心] was established in 2003 and is subordinate to the National Defense Work Leading Small Group [国防工作领导小组]. Tsinghua and the former General Armament Department [总装] jointly

established a research institute in May 2004 that has attracted a sizable group of high-level talents and won many national and military S&T awards.

ESTABLISHING NEW-TYPE RESEARCH INSTITUTIONS

The *S&T MCF Plan* encouraged the creation and development of new-type scientific research institutions [新型科研机构] that are more lean, capable, responsive, cutting-edge, and overall more efficiently managed than their wholly state-managed counterparts such as the Chinese Academy of Sciences (CAS).

Shenzhen, across from Hong Kong in Guangdong province, is at the forefront of this effort. The city has reportedly set up over 100 such research institutions.[270] Prominent examples include Research Institute of Tsinghua University in Shenzhen [深圳清华研究院], Shenzhen Innovation and Development Institute [深圳创新发展研究院], Shenzhen Institute of Advanced Technology (SIAT) [中科院深圳先进技术研究院], Kuang-Chi Research Institute [光启研究院].

A key characteristic of these new-type institutions is their management structure and diversified funding methods. The Shenzhen Institute of Advanced Technology was set up jointly by CAS, the Shenzhen Municipal Government, and the Chinese University of Hong Kong, under the guidance of the MLP in 2006.[271] Newly created research institutions such as SIAT are able to quickly improve their research capability by attracting talents from within China and abroad. Overseas experience is clearly valued at SIAT. As of August 2017, 70% of the more than 400 SIAT researchers with doctoral degrees had overseas experience.[272] Some of these professors are prestigious figures in their fields. For example, a research group at SIAT's Advanced Material Research Center [先进材料研究中心] that focuses on electronic packaging materials has been gaining international recognition through the publication of research papers. This group is led by Professor Wang Zhengping [汪正平/Ching-Ping Wong], an award-winning researcher in energy-related materials, nanomaterials, and polymeric composites. Wang has been a member of the U.S. National Academy of Engineering since 2000, as well as a foreign academician of the Chinese Academy of Engineering since 2013.[273] The SIAT website described him as the "father of semiconductor packaging" [半导体封装之父]. His research career has included a postdoctoral fellowship at Stanford, many years working at AT&T Bell Laboratories, and a professorship at Georgia Tech. Wang has published 12 books and over 1000 technical papers and over 65 U.S. patents and numerous international patents.

The *S&T MCF Plan* also points to the extension of similar initiatives abroad to further leverage international resources. The *Plan* seeks to encourage cooperation with internationally renowned scientific research institutions, establish R&D institutions overseas, and build a number of international cooperation platforms such as joint research centers, technology transfer centers, technology demonstration promotion bases, and science and technology parks with countries with innovative advantages in related fields.

3.1.4 Military Personnel Cultivation SoS

OVERVIEW

As the PLA continues to modernize, the rising sophistication of its weapons and equipment is driving requirements for more highly-trained personnel. Xi Jinping, meeting with the PLA delegation to the Fifth Session of the 12th National People's Congress in 2017, stressed the need to take advantage of the country's educational resources to improve the military personnel training system's capacity to produce a large number of high-quality military personnel.[274] MCF analysts characterize the interacting set of systems to attract, train, and retain these personnel as the *Military Personnel Cultivation SoS* [军事人才培养体系]. Similar to other SoSs, MCF researchers highlighted a need to make better use of China's civilian education system to fill the ranks with qualified and capable personnel.

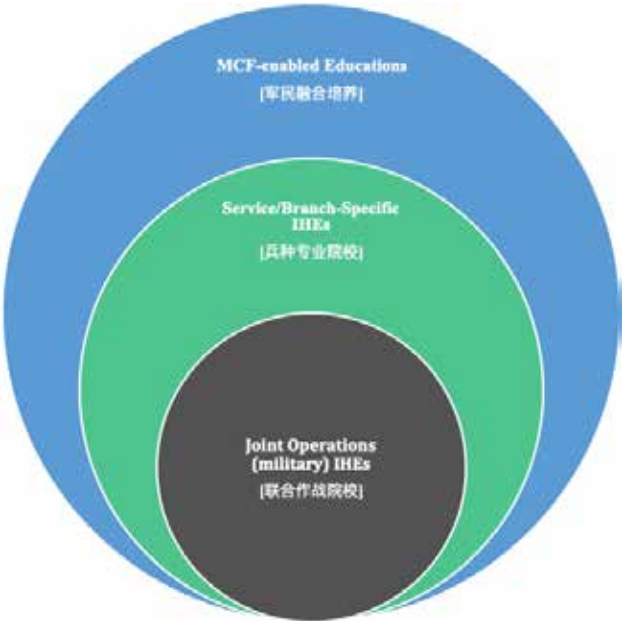
Since the Third Plenary Session of the 18th CCP Central Committee in November 2013, Xi Jinping has been calling for the construction and improvement of the "'Triad' New-Type Military Personnel Cultivation System" [三位一体新型军事人才培养体系] which consists of three mutually-reinforcing segments that fulfill the goal of filling the ranks with high-quality personnel.[275]

Education offered through military Institutes of Higher Education (IHEs) [高等院校] encompasses cadet academic education, officer's professional education, and NCO education. It follows admission procedures and standard curriculums and provides comprehensive and systematic education programs. As military IHEs are not open to all active-duty personnel, the PLA is committed to building a platform for military professional education to expand educational options for the rest of the force. There are different schools of thought regarding military professional education in China, but according to the prevailing view, military professional education[li] refers to internet-enabled learning platforms that are open to all military personnel in service. In theory, military professional education should be able to provide all PLA personnel—officers and enlisted personnel alike—with training opportunities as envisioned in the cultivation system.

li It is worth noting that the PLA's military professional education differs from professional military education (PME) in the United States. Even within China there are different schools of thought regarding military professional education, but according to the prevailing view, military professional education refers to internet-enabled learning platforms that are open to all military personnel in service.

Under the MCF strategy, China hopes to leverage its civilian education resources to complement and improve upon the Triad System. According to Ministry of Defense Spokesperson Senior Colonel Wu Qian [吴谦], MCF deep fusion calls for the building of "an education ecosystem with Joint Operations [military] IHEs as the core, Service / Branch-specific IHEs as the foundation, and MCF-enabled education as the supplement, to [eventually] form the *MCF talent cultivation SoS with Chinese characteristics*."[276]

MCF Talent Cultivation SoS with Chinese Characteristics



NOTABLE DEVELOPMENTS:

- In line with the direction of building a leaner and more capable force, military IHE reorganization launched during the 2016 force structure reforms has reduced the number of officer academic institutions from 63 to 34 and NCO institutions from four to three.[277] In 2019, 27 out of the 37 military IHEs were authorized to admit high school graduates as cadets.[278]
- The National Defense Student [国防生] Program, created in 1999 to educate undergraduates as officers in 122 civilian engineering, science, and technology universities, was canceled in 2017 and will formally end when the last class of students graduate in summer 2020.[279] The termination of this program indicates that the PLA's attempt to leverage the national education system to cultivate officers failed to meet expectations. Some research suggests that graduates from this program had a difficult time acclimating in their billets and were unable to handle the PLA's elevated standards as they try to meet Xi Jinping's demand of "able to fight and win fights."[280]
- In order to leverage a wider pool of civilian IHEs, since 2001, the PLA has been experimenting with the direct recruitment of college graduates from civilian IHEs as conscripts or noncommissioned officers (NCOs).[281] A PLA Daily article noted that 2009 was considered a landmark moment for this nationally-promoted recruitment effort, and succeeded in raising the number of college recruits from 39,000 in 2008 to 120,000 in 2009.[282] There is significant room for growth in this area, given the roughly eight million college degrees granted in China every year. Speaking at a State Council briefing on COVID-19 prevention and policies in February 2020, Weng Tiehui [翁铁慧], a Deputy Minister of Education [教育部副部长] announced

that MOE will "expand employment channels and encourage more college graduates to join the military."[283] Weng revealed that in recent years, over half of the 400,000-500,000 incoming conscripts each year have some form of college education.
    - According to Nanjing Army Command College's Huang Xiangliang [黄相亮], after serving their two-year enlistment, these directly-recruited college graduates, depending on their personal situation and the needs of their units, have the option of being directly promoted to a grassroots commanding officer [部队基层指挥军官], transitioning into civilian personnel or senior NCOs.[284]
- In addition to direct recruitment of college graduates, the PLA has also experimented with a variety of recruitment approaches and training programs administered by civilian entities, including jointly administered master or Ph.D. programs, officer professional education and training programs, NCO direct recruitment program, civilian personnel program, etc.[285]
    - Jiang et al. note that 118 civilian IHEs have some form of standing talent cultivation agreement with the PLA.[286]
    - According to Commandant Liu Guangbin [刘光斌], the PLA Rocket Force University of Engineering, which supplies 90% of the PLARF's missile brigade commanders and 75% of missile brigade chiefs of staff, has benefited greatly from these approaches, citing its joint Doctoral programs with Tsinghua University, Harbin Institute of Technology, Zhejiang University, CASIC, and CASC.[287]
    - The PLA Navy has strengthened strategic cooperation with Tsinghua University, unveiling the Navy High-Tech Talent Cultivation Base [海军高新科技人才培养基地] in 2015.[288] Similar strategic agreements have been signed between the PLAA and China Mobile; between PLAAF and CAAC; between PLASSF and civilian IHEs and state-owned defense conglomerates such as CASC.[289]

Other proposed lines of effort include:

- Incorporate the professional evaluation system for military talents [军事人才专业评价制度] into the national professional qualification management system.[290]
- Further leverage civilian education resources to enhance education and training for cadets, officers, NCOs, and civilian personnel.[291]
- Educate and train civilian personnel in Military IHEs in the following fields: maritime rights protection, civil aviation equipment repair, civil air-defense construction, nuclear-biological-chemical protection, radar and electronics, cyber and informatization, medical service, etc.[292]
- Provide national defense education to Party, state, SOEs leadership.[293]
- Build on existing success and further leverage the large pool of demobilized personnel to support China's economic development. Zhang Jianhua [张建华], a retired PLA officer, noted in his book that as of the end of 2004, among the top 500 companies in China, there were as many as 200 presidents and vice presidents with military backgrounds.[294]

3.1.5 Socialized Support & Sustainment SoS for the PLA

The *Socialized Support & Sustainment SoS* [军队保障社会化体系] consists of two lines of effort. The first concerns leveraging the national social service system and private sector resources to support the logistics functions—such as health services, housing, utilities, provisions of food—that help improve the quality of life of military personnel. The second, with a heavier emphasis on improving operational capabilities, concerns the construction of a modern logistics support system capable of supporting and sustaining integrated joint operations and overseas non-war and wartime missions.[295]

Chinese researchers argue that both elements had been widely adopted by other nations and that the Chinese military needs to "keep up with the times." They observe that Western developed nations have made full use of civilian resources both in peacetime and wartime logistical operations. For example, they note that in recent localized wars (i.e., Iraq or Afghanistan), civilian entities were responsible for everything from providing daily necessities to complex instruments and equipment, and from medical support to technical maintenance and military transportation.[296]

FIRST LINE OF EFFORT: BASIC FUNCTIONS AND QUALITY OF LIFE

The first line of effort follows initiatives begun between 1999 and 2012 to introduce socialized support into the PLA's self-sustained logistical support system that had been deemed overstretched, inefficient, wasteful, and a breeding ground for corruption.[lii] Three rounds of reforms were initiated to outsource non-military service functions such as food, housing, commercial services, municipal water supply, heat and electrical and education for military dependents to government entities or contractors between 1999 and 2012,[297] a move that was considered "conducive to performing military functions, to downsizing and improving efficiency, to improving the support quality, to the stability of the military."[298] These efforts reportedly saved the PLA more than 130 million yuan ($18.4 million) in 2000 alone.[299] Between 1999 and 2010, more than 6,000 military service organizations were abolished, and 20,000 billets eliminated.[300]

Building on existing efforts, the 2016 Opinion called for the further enhancement of the military-civil coordinated public service system with an emphasis placed on the following:[301]

- Establishing a military personnel insurance system with Chinese characteristics;
- Improving the mechanism of military and local medical and health resources sharing;
- Deepening the reform of the military housing system;
- Strengthening local Party committees and governments' active support of armed forces building and reform;
- Strengthening military-civilian cultural exchanges;
- Improving barracks culinary services, commercial services, POL support, incorporating barracks into local utility networks.
- Enhancing pollution controls in military zones

In addition to these traditional logistical support functions, Jiang et al. suggested conducting systematic surveys and research studies of "non-traditional support areas" such as repatriation missions, international peacekeeping, humanitarian relief, and disaster relief mission and military waste recycling.[302]

---

lii Writing in 2012 in support of continuous reforms on the PLA support and sustainment model, the former head of the CMC General Logistics Department [总后勤部部长] Liao Xilong [廖锡龙] pointed out that the military had overstretched itself by taking on too many social functions over the past several decades, making reforms in this area an imperative. See Liao Xilong [廖锡龙], "加快推进军队保障社会化走出一条军民融合式发展路子," *Qiushi*, 16 May 2012, http://www.qstheory.cn/zxdk/2012/201210/201205/t20120511_157242.htm.

SECOND LINE OF EFFORT: CONSTRUCTION OF A MODERN LOGISTICS SYSTEM

This line of effort begun in 2007 with the CMC's release of the "*Outline for Comprehensive Building of Modern Logistics*" [全面建设现代后勤纲要] which called for the integration of the formerly service-specific logistics systems, the optimization of logistics force structure, the integration of information technologies, among others.[liii,303] The Outline envisioned completion of this task by 2020 to lay a solid foundation for providing support in informationized wars. Although there had been some breakthroughs in the area, such as the former Jinan Military Region's successful establishment of a joint logistics system in 2007, significant force-wide breakthroughs failed to materialize until Xi's defense and force structure reforms.[304]

As part of Xi's military reforms, the CMC Logistic Support Department [军委后勤保障部/LSD] was created in January 2016 to replace the former General Logistics Department. The CMC Joint Logistic Support Force [军委联勤保障部队/JLSF] was created in September with the same fanfare as the PLARF and PLASSF, with Xi Jinping conferring the force's flag and delivering training orders. According to the 2019 Defense White Paper—*China's National Defense in the New Era*—the JLSF is the main force supporting joint logistics operations as well as strategic and campaign level operations. As described in a China National Radio article, JLSF exists to support warfighting efforts [保障打仗的后勤], not merely "day-to-day lives" ['过日子'的后勤].

The Wuhan Joint Logistic Support Base [武汉联勤保障基地] serves as the JLSF headquarters with five Joint Logistic Support Centers [联勤保障中心] in Wuxi (Jiangsu Province), Guilin (Guangxi Zhuang Autonomous Region), Xining (Qinghai Province), Shenyang (Liaoning Province), and Zhengzhou (Henan Province), one supporting each theater command (TC), as well as the PLA General Hospital and the PLA Center for Disease Prevention and Control. Dr. Li Ying [李英], a professor at the PLA Logistics College [解放军后勤学院] explained in an interview with Xinhua that the JLSF is managed by the CMC LSD during peacetime but is transferred to the CMC Joint Operations Command Center [军委联指] during wartime.[305] The defining characteristic of the JLSF is "jointness." It is not subordinated to any service and is responsible for supplying general items and universal services used by all PLA services, which have their own service-specific logistics requirements and forces.[306] As described in the 2019 Defense White Paper, the PLA JLSF serves as the backbone force and service logistics units as supplementary elements.

While the LSD and the JLSF represent important milestones in building a modern logistics system, logistics and support systems reform remained a focal point at the 2nd CCMCFD meeting held in September 2017. Notes from the meeting emphasized that there is great potential for MCF in military logistics due to high levels of commonality and interoperability and highlighted the need to:[307]

- Firmly grasp the idea that *modern logistics* = *MCF logistics* [现代后勤就是军民融合后勤];
- Firmly break away from the traditional mindset that favored a self-contained support system and self-support model, and strive to build a modern military logistics MCF SoS [现代化的军事后勤军民融合体系].
- Take advantage of China's modern and well-developed civilian logistics network and promote its integration with military logistics.
- Leverage technologies such as cloud computing, big data, and the Internet of Things to innovate support models, upgrade support methods, and improve the quality and efficiency of logistics support.

liii For a detailed overview of modernization of PLA logistics, see Kevin McCauley, "Modernization of PLA Logistics: Joint Logistic Support Force," Testimony before the U.S.-China Economic and Security Review Commission, 15 February 2018. https://www.uscc.gov/sites/default/files/McCauley_Written%20Testimony_0.pdf

Beginning immediately after the meeting, the PLA began to take major steps to improve MCF involvement in logistics.

- On October 23, the PLAAF Logistics Department signed logistics MCF strategic cooperation agreements with five leading logistics and delivery service companies: SF Express Group, China Railway Express Co., Ltd., China Post Express Logistics Co., Ltd., Debon Logistics, JD Logistics.[308] The agreements were said to enable a civil-military integrated systematic, full-organization, full-coverage logistical delivery system, and included an important clause to guarantee contract fulfillment during wartime.[309] The two parties will carry out in-depth cooperation on 23 projects in eight areas: transportation and distribution, warehousing management, material procurement, information sharing, scientific research and innovation, force building, social services, and other support tasks.
- On November 24, the CMC Logistics Support Department and SASAC signed a strategic cooperation agreement to jointly promote the construction of military facilities.[310]
- In December, CMC LSD issued the *Opinion on Advancing Implementation of Military Logistics in Deep Development of Military-Civil Fusion during the Period of the 13th Five Year Plan* ["十三五"期间推进军事后勤军民融合深度发展的实施意见].[311] The document was not made public but is said to include detailed measures regarding the promotion of MCF in the areas of transport and delivery, military facilities, medical services, military energy needs, military logistics, military personnel benefits, etc.[312]
- In an interview with *PLA Daily* on March 7, 2019, Li Shisheng [李士生], commander of the Wuhan Joint Logistics Base, revealed that the JLSF had experimented with MCF initiatives involving its energy needs, medical services, and transport and delivery. Li stated that the JLSF has plans to significantly expand the scope of MCF work as outlined by the LSD, including the development of a civilian-enabled oversea support system [寓军于民的海外保障体系].[313]

3.1.6 National Defense Mobilization SoS

OVERVIEW

Compared with the other five SoSs, the *National Defense Mobilization SoS* [国防动员体系] appears to lack a well-defined theoretical foundation or an agreed-upon framework for promoting MCF deep development. The quantity and quality of news and journal articles discussing the topic is significantly lower compared to other aspects MCF and discussions of plans are largely presented in aspirational terms. One area that has been identified as a priority by the *2016 Opinion* is the integration of the defense mobilization system and the state emergency management system [国家应急管理体系] to enable coordinated emergency responses and operations in the event of a national emergency. CCMCFD General Office Deputy Director Jin Zhuanglong has written that China needs to develop a modernized *National Defense Mobilization SoS* to support the goal of winning local wars under informatized conditions [保障打赢信息化局部战争].[314] Jin added that the *National Defense Mobilization SoS* needs to better combine peacetime and wartime preparations, be capable of carrying out missions across all domains, and overall increase accuracy and efficiency of defense mobilization capabilities [平战结合, 全域遂行, 精确高效的国防动员能力]. The following sections provide brief analyses of these two lines of efforts.

MODERNIZING THE NATIONAL DEFENSE MOBILIZATION SOS

An important reason for the lack of progress in developing this SoS is that the defense mobilization system has yet to clarify post-2016 reforms including organizations and the chain of command. In early 2016, the CMC National Defense Mobilization Department (NDMD) [中央军事委员会国防动员部] was created to organize and guide defense mobilization by exercising oversight over the provincial military districts and the reserve forces. While the NDMD's predecessor was formerly a second-level department under the former General Staff Department, the newly reorganized department is placed directly under the CMC. Its functions have also grown significantly and it now oversees 28 provincial military districts and municipal garrison commands [警备区], which were previously subordinate to Military Regions [军区].[liv]

There is an additional state organ leading defense mobilization work—the National Defense Mobilization Committee (NDMC) [国家国防动员委员会], a coordinating body of the State Council, created in 1994. It acts as an umbrella for a large number of defense-related tasks including conscription, defense transport, civil air defense, and aspects of economic activity. The NDMC helps coordinate between the CMC and State Council, implementing China's strategic guideline [方针] "Active Defense," organizing defense mobilization work, and formulating laws and regulations for defense mobilization, among other tasks.[315] Besides the NDMC Comprehensive Office [综合办公室], the NDMC oversees at least five offices, each responsible for an area of mobilization work.[lv]

- National People's Armed Forces Mobilization Office [国家人民武装动员办公室]
- National Economic Mobilization Office [国家经济动员办公室][lvi]
- National Civil Air Defense Office [国家人民防空办公室]
- National Transportation Readiness Office [国家交通战备办公室]
- National Defense Education Office [国家国防教育办公室]

liv This excludes the Beijing Garrison [北京卫戍区], Xinjiang Military District [新疆军区] and Tibet Military District [西藏军区] which are directly subordinate to the PLAA

lv Following the principle of "two names, one office" [两块牌子, 一套班子], several of these offices appear to be functionally located under the CMC NDMD or other State Council bodies

lvi This office is responsible for promotion and application of MCF dual-use technology. See: "National Economic Mobilization Office" [国家经济动员办公室], National Defense Mobilization Online [中国国防动员网], 20 July 2012. http://www.gfdy.gov.cn/org/2012-07/20/content_4962718.htm

The same committee-office structure is replicated at the provincial and municipal level (likely under Party Committees), but the provincial level offices are often set up inside the provincial military district headquarters and share the same staff.[316] China has over 2,000 county-grade administrations [县级行政区], and significantly more Townships [乡镇] or subdistrict offices [街道办], most of which will have a PAFD as part of its administration. Others are set up inside large organizations such as enterprises and schools. PAFDs are responsible for conscription, exercise leadership over militias, and manage light weapons warehouses around the country. Organizationally, the PAFDs are under the dual-command of higher-grade [上级] Party Committees and military organs.[317] If China ever hopes to achieve "deep fusion" at a local, granular level, they will likely have to work through the defense mobilization system, and the primary military-civil link at that level will be PAFDs.

Needless to say, this dual-track leadership system can lead to significant confusion, even for officials within the system. PLA Daily reported that during a fact-finding mission conducted by the Jilin Provincial Party, government, and military district officials in early 2017, they found that several municipal level NDMC officials could not name any of the committee's affiliated organizations or even articulate their own job responsibilities.[318] In an interview with *PLA Daily* conducted in early 2019, Bi Zhiyong [毕智勇], director of NDRC's Defense Mobilization Research and Development Center [国家发改委国防动员研究发展中心], said that due to the peaceful environment that China has long enjoyed, its defense mobilization system has never experienced any actual-combat situations, resulting in an incomplete command and coordination mechanism.[319]

An article published in *China National Defense News* on October 18, 2018, titled "Constructing a New-type National Mobilization SoS with Chinese Characteristics" shed some light on the future directions of efforts in this domain. The author, a Military District Mobilization Bureau director, highlighted the need to 1) resolutely strengthen Party leadership; 2) align mobilization work with the nation's overall security strategies, Theater Command and strategic missions, and MCF core missions.[320]

To integrate the defense mobilization system into the joint operations SoS, the author proposed to establish a "small core, large periphery" [小核心, 大外围] command structure:[321]

- The CMC and TC defense mobilization joint command centers and command organizations for defense mobilization at the provincial level form the "small core" that specialize in mobilization planning, organization, and command.
- The State and provincial level NDMCs form the "large periphery" that implement and complete mobilization quotas and missions.

INTEGRATION OF THE DEFENSE MOBILIZATION SYSTEM AND THE STATE EMERGENCY MANAGEMENT SYSTEM

Chinese researchers had previously identified a disconnect between the national defense mobilization system and the state emergency system, noting that the two systems differ in organizational structure, technological systems, information management methods, material storage, and reserve systems, among others, making it difficult to achieve a coordinated response during a crisis.[322]

The outbreak of COVID-19 in January 2020 in China has tested the system. On February 26, 2020, an article in PLA Daily detailed the national defense mobilization system's response to the outbreak in Wuhan. The article considered the response "an example of 'Nonwar Military Activities' [非战争军事行动] and a major test of the post-restructuring national defense mobilization system."[323]

Based on official media coverage of the COVID-19 outbreak in Wuhan, the defense mobilization system, led

by the Hubei Military District appears to have focused on grassroots-level, relatively minor tasks such as security. In one instance, 130 trucks and 260 active-duty personnel drawn from the PLAA, PLAAF, and military academic institutions were seconded to the Hubei MD to assist in the response.[324]

In aggregate, the defense mobilization system can tap a truly massive network. While the total number of participating militia personnel was not disclosed, according to an article in *China Defense News*, militia members nationwide were issued over 8 million tasks over two months in response to the crisis, and 450,000 militia members were mobilized on one day.[325]

There is scant information about the activities of individual PAFDs, but the picture that emerges suggests that there is a long way to go in terms of streamlining the chain of command and mobilizing personnel in a crisis.[326] However, the effectiveness of local militia compared to active-duty units remains unclear. Xi Jinping has argued that the outbreak response "revealed shortcomings" in the National Emergency Response System that is in an early stage of development.[327]

3.2 Major Security Domains

This section provides an overview of MCF efforts in the three "major security domains": maritime, space, and cyberspace. These three domains were identified as major focus areas in Hu Jintao's 18th Party Congress report in 2012, which also put forward, for the first time, the strategic priority of building a Maritime Great Power [海洋强国].[328] The space and cyberspace domains were *officially* elevated to the same "great power" status in Xi Jinping's 19th Party Congress report delivered on October 27, 2017. The significance of these three domains was also clearly evident in the 2019 *Defense White Paper*, which highlighted safeguarding China's maritime rights and interests and interests in major security domains, including nuclear, space, and cyberspace as the core mission set of China's armed forces.[329] Among the three, space and cyberspace are generally regarded by Chinese analysts as the two domains with the greatest potential for achieving leapfrog developments in technology, as well as tremendous economic returns.

In terms of MCF policy guidance in these domains, due to the fact that the importance of the maritime domain was raised five years prior to the space and cyberspace domain, the *2016 Opinion* had a clear maritime focus, calling for MCF development in maritime development, and maritime rights protection, and safeguarding the country's overseas interests. But as the strategic importance of the space domain and the cyber domain continued to grow, they were added to the list of domains to be prioritized for MCF development at the first plenary session of the CCMCFD in 2017.[330]

As stated in Section 1.2.1, MCF initiatives largely rely on the construction of the six SoSs to drive operational effects in priority domains. Therefore, MCF initiatives in these three domains have much in common, including the promotion of military-civil coordinated innovations and the sharing of civil-military resources. Areas which overlap with information provided in 3.1 will not be repeated here. The following section is focused on highlighting notable MCF measures specific to each domain.

3.2.1 MCF in the Maritime Domain

According to *People's Daily*, a Maritime Great Power is a nation that has strong comprehensive strength in the management, control, exploitation, and protection of oceans (and oceanic resources).[331] In his 19th Party Congress report, Xi Jinping called for the coordinated development of land and maritime domains [坚持陆海统筹] to accelerate the Maritime Great Power development. According to Chinese Academy of Social Sciences researcher Wang Jian [王键], Xi's requirement officially linked the Maritime Great Power strategy to the Belt and Road initiative, which consists of an overland component (the Silk Road Economic Belt) and a sea route component (the 21st-century Maritime Silk Road).[332]

NOTABLE EFFORTS

Based on literature examined, notable MCF efforts in the maritime domain to further the above-mentioned strategic goals include:

STRENGTHEN THE MILITARY-POLICE-CIVILIAN MARITIME RIGHTS PROTECTION FORCE

The *2016 Opinion* called for strengthening the military-police-civilian [军, 警, 民] maritime rights protection force [海上维权力量].[333] According to Jiang et al., China's maritime rights protection force consists of:[334]

a) Maritime combat forces: the PLA Navy
b) Maritime law enforcement force or paramilitary force: the Chinese People's Armed Police Force Coast Guard Corps (also referred to as the China Coast Guard Bureau or Maritime Police) and the maritime militia[lvii]
c) Civilian fleets: the merchant and fishing fleets

Under MCF, these forces are expected to coordinate closely to carry out routinized joint patrols, marine surveys, fisheries development, and reconnaissance and measurement activities, to further strengthen the rights protection and management and control missions [维权管控] of relevant islands and reefs and surrounding sea areas.[335]

SPEED UP THE CONSTRUCTION OF MARITIME INFORMATION INFRASTRUCTURE

Multiple MCF researchers spoke of the need to speed up the construction of maritime information infrastructure. Researchers with the China Electronics Technology Group (CETC) [中国电科] argued for the construction of an MCF maritime security information network with a whole host of applications from maritime rights protection, disaster early warning, to island development and sea route protection.[336] The system, supported by a myriad of sensing and detection methods and information transmission networks, will be shared across users within the Party-state-military-police-civilian maritime rights protection force establishment.

Jiang et al. highlighted the need to incorporate the construction of the "maritime battlefield" [海上战场] into the national economic development efforts to establish a maritime information infrastructure comprised of:[337]

- An all-weather, all-day, multi-method, three-dimensional, high-precision maritime battlefield situational awareness network [全天候, 全天时, 多手段, 立体化, 高精度的海洋战场态势感知网];

lvii Jiang et al. labeled the maritime militia "a special branch of the maritime rights protection force." For a detailed examination of the maritime militia force, see Conor Kennedy and Andrew Erickson, "China Maritime Report No. 1: China's Third Sea Force, The People's Armed Forces Maritime Militia: Tethered to the PLA," China Maritime Studies Institute, 1 March 2017, https://digital-commons.usnwc.edu/cmsi-maritime-reports/1.

- A military-civilian compatible communication network [军民兼容的通信网络体系]
- A maritime target joint surveillance and management system [海上目标联合监视与管理体系]
- A national joint marine environment investigation and monitoring System [国家联合海洋环境调查与监测体系]

"China launches new system to defend islands and reefs in South China Sea," *China Military Online*, 1 April 2019. english.chinamil.com.cn/view/2019-04/01/content_9464939.htm

As an example component of these networks include an offshore all-weather information network platform developed by CETC that has been deployed near Bombay Reef and elsewhere in the South China Sea.[338] The platform, with two variants, integrates multi-dimensional situational awareness and integrated information services and is expected to serve a wide range of China's maritime needs.[339]

MARITIME COMPREHENSIVE SUPPORT AND SUSTAINMENT SYSTEM

"Major Breakthrough! Civilian Ship Carries out Dry Cargo Replenishment At Sea for Surface Ships" [重大突破! 民船为水面舰艇实施干货补给], Navy News Public Wechat Account [海军新闻 微信公众], posted on *The Observer* [观察者], 16 November 2019. https://www.guancha.cn/military-affairs/2019_11_16_525353.shtml

China has more than 2,000 ocean-going ships and 650,000 seamen, and its fleet capacity ranks fourth in the world. Jiang et al. argue that these ships can support the PLA Navy's far sea missions [中国海军走向远洋].[340] Accordingly, they proposed using civilian maritime resources to speed up the construction of a triad maritime MCF integrated comprehensive support and sustainment system [三位一体的海上军民融合综合保障力量体系] consisting of active service forces, reserve forces, and civilian entities.

An example of new MCF-enabled capabilities under development, in November 2019, the PLA Navy announced that it had successfully carried out dry goods resupply at sea between two navy ships and a civilian cargo ship, a 180m-long, container ship operated by Sinotrans&CSC Holdings, a state-owned enterprise and the largest logistics company in China.[341] The PLA Navy regarded this as a major step forward in the development of new technologies for replenishment-at-sea, and for the rapid installation of these systems aboard members of China's extensive merchant vessel fleet.

ENHANCE MARITIME SCIENTIFIC RESEARCH AND TESTING CAPACITY

Document No. 91 [2017] (section 3.1.2) states that China's DTIB will take the following actions in the maritime domain:[342]

- Speed up the construction of the deep-sea testing ground.
- Develop technologies such as underwater detection, information transmission, and security to improve the ocean's comprehensive perception capabilities.
- Promote the construction of deep-sea stations, nuclear-powered floating platforms, and deep-sea ocean monitoring equipment, and actively develop high-level professional icebreakers, polar self-icing scientific research ships, polar rescue ships, polar semi-submersible transport ships, polar resource exploration ships, and polar core supporting equipment, materials, etc.

3.2.2 MCF in the Space Domain

In June 2017, Xi Jinping made it clear that MCF was going to be a major part of China's broader space ambitions. Later that year he referenced building a Space Great Power in his 19th Party Congress report.[343] In parallel to Hu's inclusion of the maritime domain in his 18th Party Work report, this appears to mean that there is now a national space strategy, but no further details have been provided. However, China Aerospace Science and Technology Corporation (CASC), one of China's largest state-owned defense conglomerates in the space domain and the main contractor for China's space programs, has since published its roadmaps for implementing the strategy public, shedding some light on the issue.

Speaking to Xinhua News Agency in June 2019, CASC Chairman and Party Group Secretary Wu Yansheng [吴燕生] said that CASC has plans to push China into the ranks of a *Space Great Power* by 2030, by which point "[our] space infrastructure will be complete and reliable, and (China) will have a significant voice globally in this area." By 2045, China will achieve the full goals of a Space Great Power, with "world-leading and original space programs and products to occupy the top of the global space economy industrial supply chain."[344] Wu revealed that CASC has quantified the goal of building a powerful space nation into 100 plus technical indicators and 27 economic indicators. As of 2019, Wu added, CASC has reached the globally advanced level, achieving 1/3 of the technical indicators and 1/2 of the economic indicators.

To advance the construction of a Space Great Power, Jin Zhuanglong, standing deputy director of the CCMCFD General Office, has called for MCF efforts to support both the coordinated development of space exploration and exploitation programs and air and space defense capabilities [推动太空开发利用和空天防御能力协调发展].[345] Specifically, Jin stated that efforts should focus on the following areas:[346]

1. Coordinated development and management of space assets such as satellite resources;
2. Coordinated development of space mega programs and major projects;
3. Creation of a space information service system that integrates military, civilian and commercial businesses [军民商相互衔接的空间信息服务体系];
4. Promotion of space scientific research, enhancing space weather monitoring and early warning service capabilities, and improving military-civil coordinated response to space security threats [军民协同应对太空安全威胁能力].

NOTABLE DEVELOPMENTS

There have been notable developments in some of these areas. In an interview with *S&T Daily* conducted in December 2019, CASC General Manager and Party Group Deputy Secretary Yuan Jie [袁洁] noted two groups of major programs and projects to be implemented in service of CASC's Space Great Power goal.[347] Notably, four out of the six programs under the 2030 group have been highlighted in the State Council's MCF Plan for the defense industrial sector as MCF mega-programs or megaprojects [军民融合重大工程和重大项目].[348]

2030	2045
a) Long March-9 heavy launch vehicle (MCF) b) Spacecraft on-orbit service and maintenance system (MCF) c) Space-earth integrated information network megaproject (MCF) d) Next-generation space infrastructure (MCF) e) Sample return missions to Mars and an asteroid f) Space exploration of habitable planets near the solar system [Seeking Sound Plan/觅音计划]	a) lunar research station b) solar system marginal exploration c) combined propulsion reuse vehicles d) space safety environment global monitoring and governance projects e) Manned Mars exploration

The Space-Earth Integrated Information Network Megaproject [国家天地一体化信息网络工程], led by CETC, represents a significant portion of the national space strategic infrastructure China hopes to build and is designed for the purpose of "providing information network coverage wherever [China has] national interests" [国家利益到哪里, 信息网络覆盖到哪里].[349] It is one of the 16 S&T Innovation 2030 Megaprojects, which are national projects given enormous state budgets and resources. According to CAS Academician and CMC EDD researcher Yin Hao [尹浩], the information network, when completed, will consist of various types of satellite systems (reconnaissance and surveillance satellites, communication satellites, navigation and positioning satellites, early-warning satellites, meteorological satellites, etc.) on different orbits, supplemented by land-, sea-, and space-based information systems and application terminals to form an organic, intelligent, distributed, space-earth integrated global information network system.[350] In April, 2018, CETC announced its "first major achievement" since project inception: a ground information port [地面信息港] that "integrates information network, remote sensing, geographic information, positioning and navigation and other information to connect information resources and user needs."[351]

While these projects have been designated as MCF megaprojects, the actual level of civilian participation in these projects is not clear. Yin Hao has argued strongly for more civilian input, noting that civilian participation in the space-earth integrated information network megaproject has so far been restricted to the purchase, lease and replacement of transponders and cooperation in some spectrum and orbital resources.[352] Yin suggested that greater integration between the military and civilian sectors is needed to coordinate the management of orbits and electro-magnetic spectrum bands [频率轨道资源统筹].[353] Specifically, Yin noted there are four MCF models that can be adopted in the development of the space information network. In the first model, the military builds the system and civilian entities are given access. In the second, the civilian builds the system and shares it with the military. The third and fourth models involve military and civil shared construction, shared use and commercially-built services available for purchase, respectively [军建军民共用, 民建军民共用, 军民共建共用, 商建采购服务].[354]

Due to the sheer size of these projects and the management challenges they create, Chinese researchers have also noted a need to further clarify responsibilities and enhance overall coordination among the large group of military and state entities involved in these major space programs. For instance, Jiang et al. note that the various business components of the Beidou Global Navigation Satellite System (GNSS) fall under the purview of different agencies: the military is in charge of launch services, equipment manufacturing, and acquisition needs while NDRC oversees ground equipment management. Additionally, the China National Space Administration [国家航天局], which is subordinate to SASTIND, is responsible for operations and services.[355] Such fragmentation has a negative impact on the efficient allocation of resources.

In addition to MCF efforts to support the Space Great Power strategy, Chinese researchers also highlighted the enormous economic potential of the satellite industry as a major means to develop higher value-added manufacturing and service jobs to the economy. Chinese planners see the satellite industry as an economic bonanza that will provide space-based communication and television services across Asia and Europe to complement its infrastructure and investment projects that are part of the Belt and Road Initiative. According to one report, 10,000 companies and institutions are involved in satellite navigation and location services in China and employ 500,000 people.[356] Moreover, in 2018, the value of China's satellite navigation and service industry reached 301.6 billion yuan ($42.6 billion USD).

Nanjing Political College professor Wang Yaqing [汪亚青] noted that in the process of development of a complete industrial chain, the GPS global positioning system in the United States quickly created a huge output value worth over $40 billion USD. According to Wang, there is a huge room for growth for the Beidou system in this area in China.[357] Currently, the upstream and downstream distribution ratio of Beidou's supply chain is uncoordinated, with only 15% and 17% of total value derived from upstream and downstream operations, respectively, compared with 68% middle-stream.

3.2.3 MCF in the Cyberspace Domain

Since taking office, Xi Jinping has paid great attention to internet governance, cybersecurity, and informatization. On February 27, 2014, at the first meeting of the Central LSG for Cyber Security and Informatization, Xi Jinping first proposed the goal of building a Cyber Great Power. Since then, Xi has delivered many important speeches on various occasions, outlining his vision for the Cyber Great Power strategy, which appears to be in a state of constant evolution. According to Chinese theorists, taken together, Xi's series of speeches form the important theoretical basis of the strategy.[358]

Xi's requirements for building a Cyber Great Power were most clearly articulated on two separate occasions. At a collective study session of the Politburos Central Committee in October 2016, Xi Jinping listed six "accelerations" [六个 "加快"] necessary for China to become a Cyber Great Power.[359] A slightly different articulation of these ideas was presented two years later at the national cybersecurity and informatization work conference in Beijing on April 20 and 21, 2018.[360]

October 9, 2016	April 20 and 21, 2018
• Accelerate self-initiated innovations of network information technologies • Enhance the contribution of the digital economy to economic development • Enhance internet and network management capability • Enhance cyberspace security defense capabilities • Speed up the use of network information technology to promote social governance • Accelerate the promotion of China's international discourse power and rule-making power in cyberspace	• Strengthen ideological propaganda online [加强网上正面宣传] • Safeguard network security • Promote breakthroughs in core information technologies • Give full play to the leading role of informatization in economic and social development • Strengthen military-civil fusion • Actively participate in the international cyberspace governance discussions and discourse [主动参与网络空间国际治理进程] • Advance Cyber Great Power construction through self-initiated innovations

While his interpretation of the strategy continues to evolve, Xi's Cyber Great Power strategy consistently includes three important components: 1) *cyberspace governance*, which includes elements like internet content governance, public opinion supervision, and active participation in the international discourse; 2) *cybersecurity*; 3) and *informatization*, which includes elements such as big data, Internet+ [互联网+] (internet of things and applications to other industries), and digital economy. It is clear from Xi's articulation of the strategy that in the cybersecurity and informatization domain, the goals go beyond harnessing civilian technological innovation and infrastructure to include shaping public opinion at home and abroad. The cyber domain is a perfect embodiment of Xi Jinping's holistic national security concept, which sees "political security" as the "cardinal element" [以政治安全为根本].[361] As Xi emphasized at the Politburo central committee collective study session in 2016:[362]

> *It is necessary to advance the construction of a Cyber Great Power by correctly handling the relationship between security and development, openness and autonomy, management and service, and constantly improving the ability to grasp the operating laws of the Internet, the ability to guide online public opinion, the ability to control the development of informatization, and the ability to guarantee network security.*

All three components of the strategy, cyberspace governance, cybersecurity, and informatization, are areas where MCF can play a prominent role. According to a *PLA Daily* article from December 2016, there is an official policy document jointly issued by the CCP Central, the state council and the CMC to promote in-depth MCF development in the cyberspace domain; however, this document is not publicly available.[lviii]

lviii This policy document is titled "Opinion on Promoting In-depth Military-Civil Fusion in Cyberspace Security and Informatization" (《关于促进网络安全和信息化军民融合深度发展的意见》), noted in "PLAA and China Mobile Sign Strategic Cooperation Agreement for Military-Civil Fusion Development" [陆军与中国移动签署军民融合发展战略合作协议], *PLA Daily*, 12 December 2016, http://www.81.cn/

NOTABLE EFFORTS

Based on the literature examined, notable MCF efforts in this space include:

"STRENGTHEN CYBER SECURITY MONITORING, EARLY WARNING CAPABILITIES AND EMERGENCY RESPONSES"[363]

AMS and NDU researchers have all raised the need to create and maintain a cybersecurity joint defense and control mechanism.[364] As an example of what the mechanism looks like, an article published in the *National Defense News* on December 15, 2016, two months after Xi outlined the six requests for the acceleration of the construction of a Cyber Great Power, highlighted a need for mobilizing civilian resources to "jointly build a cyberspace line of defense" [共筑网络防线].[365] The article claimed that more than 75,000 Chinese websites had malicious backdoors installed in 2015, and that 4,300 U.S. IP addresses remotely controlled more than 10,000 websites in China. As a result, it argues that China should give full play to the traditional advantages of People's War [人民战争] and extensively recruit civilian IT and cyber talents to join the militia reserve force [民兵预备役] so that the military and civilian sectors can join forces to seize the commanding height of cyber conflict [军地合力夺取网络空间斗争的制高点和主动权].

STRENGTHEN MILITARY-CIVIL JOINT MANAGEMENT OF PUBLIC OPINIONS ONLINE[366]

Jiang et al. highlighted "ideological security" [意识形态安全] as an important component of cybersecurity, representing "a major strategic issue affecting national security, political regime security, and national development."[367] They claim that "hostile forces are using the Internet, mobile phones and other emerging media as an important channel for provoking trouble, spreading and escalating social conflicts." These challenges necessitate a military-civil coordinated response to routinely "guide public opinions" [常态化舆论引导], monitor and manage opinions during major news outbreaks, and strengthen screening for sensitive military information online to avoid leaking military secrets.

Nathan Beauchamp-Mustafaga and Michael S. Chase recently argued that the PLA should be included along with the United Front Work Department and other better-known CCP organizations involved in influence work, though the degree to which this is coordinated with other organizations is unclear.[368]

SUPPORT THE PLA'S INFORMATIZATION DRIVE

Military experts believe that the PLA is in a historic period of modernization and development, including mechanization and informatization. Writing around 2016, the NUDT research team led by Zeng Li noted that the United States Navy is more than 70% informatized, whereas the PLA Navy's level stands at around 10%.[369] An article from *PLA Daily* penned by a Wang Xuecheng [王雪诚] of the PLASSF states that MCF is the "road" that the PLA must take in its pursuit of informatization.[370] Wang proposed a series of measures, including the sharing of communication infrastructure and data resources (discussed in Section 3.1.1), the development of core technologies (3.1.2), and the cultivation of tech-savvy maintenance talents (3.1.4).

In December 2016, the PLA Army signed an MCF strategic agreement with China Mobile that enables cooperation in seven areas including joint construction of information infrastructure, emergency communications support, command and dispatch, "smart" military camps, information system and resource development and utilization, information security, and informatization talent training.[371] The agreement is expected to facilitate the integration of the PLAA's information network system into the joint operations system, significantly advancing the PLAA's informatization drive.

jfjbmap/content/2016-12/12/content_163944.htm.

3.3 Nascent Technological Areas

In addition to the "major security domains," senior Chinese officials and theorists also see major role for MCF in helping China be competitive in nascent technological areas [新科技领域], namely biotechnology [生物], new energy [新能源], and artificial intelligence [人工智能].[lix] The *Military-Civil Coordinated Innovation SoS*, which is critical to achieving breakthroughs in original innovation in these areas, has been covered in detail in section 3.1.3. This section will provide a brief overview of recent notable developments specific to each area.

BIOTECHNOLOGY AND BIOSECURITY

China's rapidly growing biotech industry has attracted attention globally, and some predict that China is poised to become a major powerhouse for biotech innovators.[372] Chinese strategists and experts share a similar view. CCP journals such as *Study Times* has called for "seizing the strategic opportunity of biotech development," presenting biotech as rare opportunities to overtake other nations and leapfrog ahead.[373] The PLA has also taken note of the technology's strategic significance. According to the Science of Military Strategy (2017) "..the field of biotechnology has become the fastest-growing and most cutting edge military domain, as its advances will bring new security threats and military confrontations."[374] Specifically, it suggests that MCF offers the opportunity to seize the commanding heights of military struggle in biology "due to its high-compatibility across society and its unique advantages in that local enterprises are frequently at the forefront of biotech development because they are profit-driven and forced to innovate."[375, lx]

The 13th Five Year Plan (2016-2020)[376] highlighted development of the biotech industry, with imperatives to:

- Move faster to facilitate the wide application of genomics and other biotechnologies;
- Create demonstrations of network-based biotech applications;
- Stimulate the large-scale development of personalized medical treatment, new drugs, bio-breeding, and other next-generation biotech products and services;
- Promote the creation of basic platforms such as gene and cell banks.

In 2016, biotech was listed in the *Development Plan for National Strategic Emerging National Industries* during the 13th Five Year Plan as a key focus area along with aerospace, maritime, information, and nuclear technology. Key components include synthetic biology, biological breeding, ecological protection, and energy production."[377] In May 2017, the Ministry of Science and Technology (MOST) released the "13th Five Year Biotechnology Innovation Plan."[378] This plan coordinates with multiple initiatives under the "Innovation Driven Development Strategy."

To promote military-civil coordinated development in the field of biology, Jin Zhuanglong, standing deputy director of the CCMCFD General Office, has outlined the following tasks in his article from July 2018.[379]

- Strengthen military-civil coordinated work mechanisms in biosecurity;
- Strengthen coordination in the prevention and control of infectious disease outbreaks;
- Promote joint constructions of infrastructure and platforms related to biosecurity, examination, and treatment;
- Strengthen the biosecurity monitoring and early warning network system and improve national biodefense capabilities.

lix It is important to note that some MCF researchers such as Jiang et al. used "n" to describe these areas to denote an indefinite or expanding list.

lx The authors also note that between 2001-2012 the U.S. Government invested almost $67 billion in biodefense.

Efforts in these areas are likely to be amplified in the wake of the COVID-19 outbreak, as China is placing a much greater emphasis on biological security. In April, Xi Jinping added biological security [生物安全][lxi] to the National Security System [国家安全体系],[lxii] which is an expression of his "Holistic National Security Concept" [总体国家安全观].[380]

NEW ENERGY

New energy typically is used to refer to non-carbon emitting energy sources including nuclear, and a range of renewable sources from wind to solar. China has set ambitious development goals in this area, including a pledge to increase its use of non-carbon emitting energy sources to around 20% of the total by 2030.[381] As of writing these plans appear to be on track.[382] China's overall installed renewable capacity reached 728 Gigawatts at the end of 2018.[383] Notably, plans for new energy include a heavy emphasis on vehicles using the technology. China sees this area as having significant positive impacts on its economy and military, reducing smog-producing power plants while reducing its national reliance on imported petroleum or reducing logistical requirements at lower levels. Wind power has also grown enormously, and as of the end of 2019 China's installed wind energy capacity reached 210 million kilowatt-hours.[384]

To promote the military-civil coordinated development in the field of new energy, Jin Zhuanglong has placed an emphasis on the development of new energy industrial clusters [新能源产业集群], as well as the establishment of a safe and controllable MCF new energy research, development, and production system. The 13th FYP placed a special focus on alternative fuel vehicles, with the goal of a total of five million vehicles produced and sold by the end of the FYP.[385]

Jin also proposed measures to build a national new energy supply system supported by both the military and civilian sectors [军地联保] to improve the energy supply strategic capability. While there is insufficient reporting of this effort at the time of writing, the military utility of new energy is clearly visible, with windmills, solar panels, and banks of batteries powering PLA outposts in remote spots from Xinjiang to the South China Sea.[386] The nuclear component of "new energy" is another explicit in its linkages to MCF, with the "Dragon Scale" [龙鳞系统] Nuclear Advanced Safety Platform developed by China National Nuclear Corporation in partnership with the PLA frequently given as an achievement of MCF.[387]

ARTIFICIAL INTELLIGENCE

The PLA has described its development as several parallel phases. The first, "mechanization" [机械化], is slated to be essentially completed by 2020. The PLA has made significant investments in the second phase, informatization [信息化], with uneven results. The next stage along the path toward a more capable military is "intelligentized" or simply "smart" [智能化]. What differentiates "smart warfare" from "intelligentized warfare" will be the widespread application of AI and autonomous systems. The PLA sees AI as a chance to "leapfrog" potential adversaries.[388] Perhaps not surprising given the widespread expected effects of the technology, and China's "systems confrontation" paradigm of international competition, it regards the technology as a vital area to achieve a decisive lead. According

lxi In an interview conducted with the PLA Daily in April 2020, NDU professor Zhu Kangyou [朱康友] and China Association of Policy Science [中国政策科学研究会] researcher Wen Yuanlin [温元麟] explained that biosecurity in a broad sense includes the following issues: major outbreak of infectious diseases, infectious diseases of animals and plants, invasion of alien organisms, loss of biological genetic resources and human genetic resources, laboratory biosecurity, microbial resistance, bioterrorism attacks, threats of biological weapons, etc. See Zhang Junsheng [张军胜]. "On the Fifth National Security Education Day, Experts Share their Interpretation of Biosecurity" [在第5个全民国家安全教育日,专家带你解读生物安全], *China Military Online* [中国军网], 15 April 2020. http://www.chinamil.com.cn/jmywyl/2020-04/15/content_9792091.htm.

lxii The System already included the following security domains: politics, homeland, military, economy, culture, society, science and technology, cyberspace, nuclear, ecology, and resources.

to CAE Academician Zhou Ji, from now until the end of the following decade AI is and will be the "Most important dual-use technology."[389]

MCF will play an important role in achieving this goal. In July 2017, the State Council issued the *AI Development Plan for a New Era* [新一代人工智能发展规划], which stated that China will "promote the two-way transfer and application of military and civilian scientific and technological achievements, and jointly build and share the innovative resources of the military and civilian, so as to form a full-element, multi-domain, and high-return military-civil fusion deep development pattern."[390] Regarding MCF, the plan is specifically attempting to "direct the results of AI technology toward defense applications" and "encourage [civilian] S&T researchers to participate in major national defense-related AI research." Common standards for military and civilian AI technologies will be established, and shared platforms set up to promote innovation.

Jin Zhuanglong reiterated the same points in his *Seeking Truth* article, calling for the enhancement of economic competitiveness and new quality combat capabilities through the military-civil coordinated development of AI technologies.[391]

There is contradictory evidence regarding China's progress in AI development. Chinese and international media have promoted the idea of "Chinese dominance" of AI, typically citing the number of articles published by Chinese researchers (43% according to one report in *PLA Daily*).[392] However, Jeffrey Ding has noted that when a more sophisticated analysis is applied, a different picture appears, indicating that "China is not poised to overtake the U.S. in the technology domain of AI. Rather, the U.S. maintains structural advantages in the quality of S&T inputs and outputs, the fundamental layers of the AI value chain, and key subdomains of AI."[393] This perhaps explains some of the urgency placed on MCF initiatives in AI.

3.4 MCF "Goes Global"

Although Xi Jinping has not expressly demanded that the MCF strategy be extended globally, according to Jiang et al.'s interpretation, the *2016 Opinion* already included a clear signal to promote the "going out" of both China's economic and military interests [统筹经济和军事 '走出去'] through its articulation as follows.[394]

> *Effectively safeguard the country's overseas economic interests and other major interests and protect the legitimate rights and interests of overseas Chinese citizens and institutions. Actively participate in UN peacekeeping operations and deepen international military exchanges and cooperation.*[395]

The term "safeguard," or "protect" [维护] appears to be carefully chosen to fit the narrative in the 2019 *China's National Defense in the New Era* Defense White Paper that China will "never seek hegemony, expansion, or spheres of influence." [坚持永不称霸, 永不扩张, 永不谋求势力范围]. However, China has clearly pursued national strategies—the Belt and Road Initiative being the clearest example—to actively expand its presence, and national economic interests, abroad. According to Jiang et al., it follows that that once China's national economic interests become truly global, they will act as a driver of the PLA's growing global reach. According to their reasoning, "both history and reality demonstrate that the globalization of the interests of great powers will inevitably require development of capabilities to protect overseas national interests" [大国利益的全球化, 必然要求安全保障的全球化].[396]

Currently, China has two national strategies that help advance its economic presence and interests abroad. The first of these is the "Going Out" strategy [走出去战略] initiated in the 1990s that promotes the overseas investment and international operations of Chinese companies. The other is the Belt and Road Initiative (BRI) launched in 2013 that promotes "communication" [沟通] between China and BRI nations (125 as of 2019) through six major channels: policy agreements, infrastructure development, investment, trade, cultural exchange, and supply chain cooperation.[397] A Forbes contributor succinctly captured the open and opaque nature of the BRI as follows:

> *The BRI was fully culturally, politically, and economically amorphous: it could shape-shift to meet the form of whatever country it entered, blending smoothly into the existing economic and political landscape, serving whatever regime that welcomed it.*[398]

While, as this author suggests, the "laissez-faire, undefined, wide-open" nature of the strategy is now doing itself a disservice and preventing it from "becoming the paradigm-shifting international endeavor it was meant to be," the "flexible and modular" nature of BRI clearly serves the goal of increasing the presence of Chinese economic interests abroad, which, based on Jiang et al.'s reasoning, should pave the way for the military's global presence.

The MCF strategy complements and supports both strategies to advance China's economic and security interests abroad. Efforts include the going out of the national defense industry, the development of overseas logistical facilities, and international military exchange activities under the Belt and Road Initiative.

THE 'GOING OUT' OF CHINA'S DEFENSE INDUSTRY[LXIII]

Jiang et al. see defense exports as a means of facilitating the convergence and deep linkage of national interests.[399] They argue that an inter-dependent relationship built upon the provision of weapons and equipment, training of

lxiii For a detailed study on this subject and AVIC's Going Out strategy, see Greg Levesque and Mark Stokes, "Blurred Lines: Military-Civil Fusion and the Going Out of China's Defense Industry," Pointe Bello, December 2016, https://static1.squarespace.com/static/569925bfe0327c837e2e9a94/t/593dad0320099e64e1ca92a5/1497214574912/062017_Pointe+Bello_Military+Civil+Fusion+Report.pdf.

personnel, and logistical support is conducive to the formation of a deeply interdependent relationship based on economic interests and a community with a shared future for mankind [命运共同体].[400]

The State Council's *Document 91 [2017]* has called for the expansion of defense trade and international cooperation in support of both the BRI and the Going Out strategy. According to the Plan, MCF actors should:

- Promote the export of nuclear power plants and nuclear technology equipment, aerospace equipment, aviation equipment, high-tech and high-value-added ships and other high-tech equipment;[lxiv]
- Promote the construction of the "Belt and Road" space information corridor and remote sensing satellite constellations among BRICS nations;[lxv]
- Encourage participation in overseas oil and mineral resources development and international engineering contracting.
- Give full play to the role of the foreign cooperation platform of the National Atomic Energy Agency and the National Space Administration and deepen international cooperation in the nuclear and aerospace fields.

In addition to these initiatives, Jiang et al. also put forward the need to strengthen IDAR approach to acquire advanced technologies, to establish international joint laboratories and joint technology centers, to "actively make use of a variety of channels and methods to 'conceal military activities with civilian activities'" [积极利用多种渠道, 多种方式, 做好高技术和敏感领域的'以民掩军'] in advanced technology and sensitive fields.[401]

OVERSEAS LOGISTICS FACILITIES

The *2019 China's National Defense in the New Era* Defense White Paper clearly identified overseas interests as a crucial part of China's national interests and the refinement of mechanisms for protecting China's overseas interests as an important mission for China's armed forces.

> *To address deficiencies in overseas operations and support, the PLA builds far seas forces, develops overseas logistical facilities, and enhances capabilities in accomplishing diversified military tasks. The PLA conducts vessel protection operations, maintains the security of strategic SLOCs, and carries out overseas evacuation and maritime rights protection operations.*[402]

MCF plays a significant role in advancing the development of overseas logistical facilities. Naval Research Institute [海军军事学术研究所] researcher Xu Qi [徐起] argues that China should build on the success of its previous replenish missions in Djibouti, Yemen, and Oman, which received assistance from civilian elements such as the Chinese embassies and COSCO Group West Asia and other organizations, and continue to rely on MCF initiatives to expand China's overseas logistical facilities.[403] Xu outlined the different stages this approach can take. First, negotiation done through diplomatic channels, assisted by overseas enterprises and Chinese-funded

lxiv Chinese experts describe China's high-speed rail and nuclear power energy technologies as the nation's two most recognizable name brands on the international market. They speak highly of the enormous potential of nuclear technology in stimulating economic growth and structural adjustment in China. See Qian Zhiming [钱智明], "Promote the Construction of a Nuclear Industry Great Power through Military-Civil Deep Fusion" [以军民深度融合推动核工业强国建设] in *Military-Civil Fusion Deep Development Theory* Part 2 [军民融合深度发展论(下册)], (Beijing: Military Sciences Press, 2016), 333-336.

lxv In 2016, SASTIND and NDRC issued the "Guiding Opinion on Accelerating the Construction and Application of the 'Belt and Road' Space Information Corridor." The space information corridor will connect communication, navigation, and remote-sensing satellite constellations, supplemented by space-based resources and ground information sharing networks, to provide spatial information service capabilities for BRI nations. See "Guiding Opinion on Accelerating the Construction and Application of the 'Belt and Road' Space Information Corridor" [国防科工局发展改革委关于加快推进'一带一路'空间信息走廊建设与应用的指导意见], NDRC, 23 November 2016, https://www.ndrc.gov.cn/fzggw/jgsj/kfs/sjdt/201611/t20161123_1086163.html.

institutions, can facilitate the establishment of overseas temporary berths and supply points in countries along the Indian Ocean or in other seas. The military function can then be added to civilian infrastructures funded and built by China, and such facilities can be converted into military-civilian joint use as the situation dictates. The special facilities can, in due time, be transferred to the PLA Navy for management, and be expanded into fully functional overseas logistical facilities.

Jiang et al. also acknowledge the validity of this approach. They note that it is a common practice of the world's maritime and military powers to promote the construction of overseas support and sustainment systems by "deriving strength from the People, Civilian for Military Use" [借力于民, 民为军用]. [404] They also consider international Military operations other than war (MOOTW) missions such as overseas escort missions and counter-terrorism cooperation as an excellent opportunity to actively explore options for cooperation with friendly nations. Jiang et al. also highlighted China's vigorous development of far seas fishing as an advantage to advance the same cause. For example, China has more than 100 overseas representative offices and joint ventures and 30 bases have been established offshore. Other marine industries, such as the offshore oil and gas industry, ocean shipping industry, and marine equipment manufacturing industry, all have overseas outposts. Given the resources at its disposal, China can adopt a "nestling the military within the civilian" [寓军于民] approach to coordinate the construction of commercial outposts with the construction of overseas support bases.

INTERNATIONAL MILITARY EXCHANGE

The *2016 Opinion* called for active participation in UN peacekeeping operations and the deepening of international military exchanges and cooperation, which Jiang et al. described as an important form of "going out" of military forces during peacetime.[405] It appears that China is actively seeking channels to broaden the scope of these non-war missions. In July 2019, Chinese Defense Minister Wei Fenghe said that China is willing to deepen military exchanges and cooperation through anti-terrorism, peacekeeping, and disaster relief missions with the Caribbean countries and Pacific island countries under the framework of the Belt and Road Initiative (BRI).[406] As an example of what military cooperation under the BRI might look like, on December 18 2019, *The New York Times* reported that China has implanted military projects under the BRI framework in Pakistan to work on defense-related projects including new fighter jets.[407]

Conclusion

Since elevating MCF to a national strategy in 2014, China has successfully created a framework for its implementation. In the intervening six years, a management structure has been assembled that permeates the entire Party, state, and military structure of the PRC from Beijing to the provinces. A coordinated set of policies for top-priority domains has been issued to improve information sharing and collaboration among the MCF actors.

However, implementation of the MCF strategy is still in its early stages, and unlike other state strategies or initiatives has no clear date of completion. As Brian Lafferty has noted, "it was about laying groundwork, rather than producing immediate results."[408]

SHORT-TERM OUTLOOK FOR MCF

The near-term goal of the MCF strategy, achieving a state of "MCF deep development" characterized by interconnectivity, higher efficiency, and optimal allocation of resources, is difficult to assess quantitatively as a whole. Measuring levels of interoperability or gains in productivity is difficult in the best of circumstances. For outside observers, analyzing MCF's progress accurately is even more difficult using anecdotal data. Tellingly, even the Chinese government is finding quantifying MCF's progress difficult given the fragmented levels of implementation. After some provinces began issuing a "MCF development coefficient," when asked how they derived the various numbers, the issuing authorities were unable to clarify.[409] Studies have been commissioned to develop evaluating mechanisms, but official national metrics for assessing MCF have not yet been published.

While a comprehensive assessment may not be possible at this stage, China made notable progress promoting and implementing the strategy over the past five years, with varying degrees of success in streamlining processes, breaking down barriers, and promoting resource sharing across all MCF priority domains.

Xi's administration has been able to push through significant reforms of the defense industrial base that his predecessors failed to achieve. MCF has increased the efficiency of China's defense industries through better acquisition platforms and better data sharing. Significant investment in basic "building blocks" of China's S&T infrastructure innovation system has the potential to pay dividends in the near future. Multiple agreements signed between the services of the PLA and major Chinese corporations such as China Mobile, COSCO, and SF Express also have the potential to provide significant strategic effects or combat multipliers. These agreements could vastly accelerate progress in areas such as informatization or deployment of digital and physical infrastructure that previously slowed PLA modernization. The expansion of agreements between the PLA, defense conglomerates, and universities provide opportunities for major breakthroughs and their rapid incorporation into defense capabilities. The velocity for spin-on or spin-off of new technologies is greater than ever before.

However, the short term outlook for MCF and likely many of China's other plans have been drastically altered in recent months. COVID-19 has helped emphasize the fragility of the international trade routes, services, and supply chains that power China's economy. Slowed growth in the short term will likely impact local governments' ability to service their debt or engage in the sorts of construction-led growth that have helped prop up China's GDP. Abroad, countries along the Belt and Road are already begging for debt relief incurred from BRI projects, and will likely be much more cautious when agreeing to new projects.

With state coffers diminished, there is a possibility that MCF could fall into the old pattern in which the private sector is encouraged—or required—to contribute to projects without reimbursement. Such an action could fundamentally disincentivize private companies or local governments from engaging in MCF initiatives.

LONG-TERM OUTLOOK FOR MCF

Over the long term, China's political system presents significant obstacles to the success of the strategy. MCF represents an attempt by Chinese leaders to "square the circle" of having a law-based society, with free flow of information and a dynamic market system, while at the same time retaining centralized control of the economy and society. Xi Jinping's concentration of power at the central level and China's rigid hierarchical bureaucracy ironically run counter to the hallmarks of MCF initiatives: increased transparency, devolution of authority and greater private sector participation. Xi's political moves have emphasized that those who step out of line will be severely punished, exacerbating the "play it safe" mentality of officials and company managers that might otherwise take risks on MCF initiatives.

Despite the obstacles that remain, given the progress in the period of the 13th FYP documented by this report, it would be foolish to discount MCF's ability to help China achieve its long-term strategic goals. If MCF can be understood as a whole-of-government or whole-of-society approach to security and development, evaluating China's capabilities will, therefore, require a similar viewpoint to provide accurate assessments.

The goal of his study is to provide a relatively complete theoretical framework for understanding the MCF strategy. Given the ambitious scope of the strategy, close monitoring of developments in the MCF priority domains during the period of 14th Five Year Plan (2021-2025) will be important. These domains are integral components of MCF and will ultimately determine whether the strategy succeeds or fails. Assessment of MCF operationalization in these domains will help the United States avoid strategic surprise and craft proper policy responses.

Addendum: Military-Civil Fusion English Literature Review

By Quinn Rask

Introduction

The Chinese policy of Military-Civil Fusion (MCF, or Civil-Military Fusion) is among the most contentious of the current policies of the People's Republic of China. Prominent members of the Trump Administration and Congress have specifically called out this policy as a key challenge to continued American superiority in a burgeoning technological Cold War between the two countries. Reflecting the anxiety that the MCF policy has caused among the American foreign policy establishment, hundreds of news articles and dozens upon dozens of opinion editorials in the English language media have converged upon a standard understanding of MCF itself and what it means for the geopolitical rivalry between the United States and China. The perception of the threat that MCF poses to the strategic geopolitical environment and global technological ecosystem extends beyond the United States, however. Europe, Japan, Australia, and India are also publicly discussing the range of their own exposure to the threats it may cause and what their countries are placed to do in response.

Understanding the Chinese government's own perspective on Military-Civil Fusion has been central to the debate about MCF in English language news and opinion outlets. A general agreement emerged among the authors writing about the subject, even if their opinions about the implications for U.S. policy diverged considerably. MCF is generally viewed to be part of a larger attempt by the Chinese Communist Party (CCP) to achieve the "great rejuvenation of the Chinese nation" and, by extension, the end of the American-dominated system of international organizations and treaty obligations that constrains their actions in East Asia and globally.[410] While there have been previous attempts at policies similar to MCF, Xi has been personally involved in MCF and made it a central aspect of an overall strategy of military modernization in an attempt to "leapfrog" the United States' traditional military, economic, and technological advantages.[411] Part of this is an attempt by the CCP to learn from the decline of the Soviet Union and avoid the overextension caused by very high military spending that they believe was a central cause of this collapse.[412] The CCP sees the civilian economy as far more dynamic than the defense sector and increasing the technology transfer between the two would provide considerable strategic benefit without a tremendous increase in defense expenditure (in 2016 the Chinese government increased defense spending to $142.98 billion, less than one-quarter of the U.S.'s defense budget in the same year).[413] As such, the Chinese leadership sees MCF as their own attempt to replicate the U.S. model of defense technology transfer within the confines of their own system (although this is not without pushback from American commentators on the subject).[414] MCF must, therefore, be seen within a larger political and strategic context that takes into effect interconnections with other strategic initiatives, such as Belt and Road to advance China's strategic goal of parity with the U.S. and economic goal of getting through the "middle-income trap."[415]

The United States sees MCF quite differently. American officials and commentators view MCF as an extension of long-standing Chinese policy to erode the United States' comparative advantage in technology research and development by intellectual property theft and illicit technology transfer.[416] While some commentators view the openness of the U.S. system as a competitive advantage, many commentators and public officials believe that the MCF will be a decisive advantage for the Chinese in key technological areas of competition between the two

countries, especially in artificial intelligence/machine learning and cyber. The relationship is further complicated by the United States' reliance on Chinese graduate students to maintain a considerable portion of its S&T ecosystem – roughly 25% of all STEM graduate students in the U.S. are Chinese citizens. The threat of American companies inadvertently undermining the U.S. government's national security priorities through tech transfer to Chinese civilian companies that will be then provided to the People's Liberation Army (PLA) has been dubbed the "dual-use dilemma."[417] American political leaders have turned to arguments for corporate "patriotism" to attempt to entice American companies to avoid doing business with Chinese civilian companies to overcome this dilemma.[418] The former Chairman of the Joint Chiefs of Staff, General Joseph Dunford, has been directly critical of American tech companies that refuse to work with the Pentagon given that they will work with Chinese companies that directly benefit the PLA through MCF.[419] One commentator went so far as to suggest that the U.S. compel tech companies to serve national security purposes through law.[420]

The United States is far from the only country that feels threatened by China's MCF policy. Europeans fear that their strategic position has been eroded vis-à-vis both the United States and China because of their lack of competitiveness in information technology (IT) infrastructure. This lack of competitive advantage has been made even more challenging by the adoption of MCF as a strategic priority. Japan feels a more direct strategic threat: they fear that MCF will help change the current status quo regarding territorial disputes with the PRC, especially over the Senkaku/Diaoyu islands.[421] Australia, a member of the Five Eyes, has roughly six times the amount of collaboration with researchers tied to the PLA that the United States does. India, which also has territorial disputes with the Chinese, sees itself well placed to help mitigate some of the fears of MCF and related technologies, especially AI, by helping develop norms regarding the use of these technologies.[422]

FOCUS AREAS OF MCF

The English language discussion of MCF focused on two primary overarching strategic priorities of MCF, one internal and one external. As discussed above, the Chinese civilian economic sector is substantially more dynamic than its defense sector. Chinese companies are already leading their American counterparts in key technologies such as 5G wireless infrastructure, drones, batteries, hypersonics, solar and wind energy, and cryptocurrency.[423] MCF provides the Chinese government with a policy instrument to transfer any and all advances made on these and other domestically developed technologies in the civilian sector to bolster defense and national security needs. Chinese supremacy in 5G technology has already come under considerable scrutiny in the United States and elsewhere.[424] Huawei, one of the world's foremost providers of 5G IT infrastructure, has considerable personnel overlap with the PLA.[425] This overlap and the MCF's focus on domestic technology and knowledge transfer caused considerable fear in the U.S. that Chinese dominance in U.S. IT infrastructure would give the Chinse government access to massive troves of data about American citizens and companies. In January 2019, the State Department put Huawei on the Entity List for a host of legal violations, including theft of trade secrets, wire fraud, and violating U.S. sanctions against Iran.[426]

The external element of MCF is the particularly threatening element to most American officials and other contributors to the English-language discourse. There are a number of technologies that the Chinese believe will be key to 21st century geopolitical and military competition, which the U.S. current dominates in the international research and development landscape, including artificial intelligence and machine learning, electromagnetic spectrum research, swarm robotics, cyber, and biotechnology.[427] Of these technologies, most of the English-language literature focuses on artificial intelligence and machine learning.[428] Interestingly, Chinese views about the criticality of this category of technologies were greatly influenced by strategic thinking from within the United States government, including the Department of Defense's Obama-era Third Offset Strategy. There are divergent

views about which system is "better" for this type of technological research and development, but there is certainly a perception that the Chinese authoritarian system does provide certain inherent advantages with regard to artificial intelligence and machine learning. Chief among these perceived advantages are fewer qualms about the deployment of lethal autonomous weapons, a more hierarchical or "coherent" national strategic planning process, and huge centrally controlled datasets on which to train AI. In response to the U.S.'s current advantage in AI/ML technologies, China encouraged commercial companies to expand their capacity through access to international capital and financial markets. Through MCF, the PLA hopes to leverage that capacity to enable the next generation of military technology, including swarming unmanned systems, which they see as an integral part of the next generation of military competition through "intelligent warfare" [智能战争].[429]

The literature points to a series of other technologies, although they received considerably less coverage. Cyber is an area where China is already strong relative to the United States, especially in an offensive capacity. China has sought to become a leader in quantum cryptography, which would tremendously augment its existing cyber capabilities.[430] One main challenge facing the Chinese in this regard is that their existing domestic IT ecosystem and physical infrastructure is relatively weak. Biotechnology is another high impact area of MCF focus identified in the English-language coverage of MCF. Elsa Kania and Wilson Vorndick argued that the PLA is using MCF to "weaponize biotech" such as the CRISPR gene-editing technology, advanced biomimetic systems, biological and biomimetic materials, and human performance enhancement.[431] They are also trying to leverage their aforementioned focus on AI/ML to achieve these advances, including through collaboration with foreign partners.[432]

CHALLENGES TO MCF

While MCF could provide considerable benefits to the PLA and overall Chinese revisionist foreign policy, it is important to note that many authors have highlighted a number of internal challenges that will play a significant role in translating MCF from policy into reality. Despite the fear of China as a monolithic entity that is directly subservient to the CCP, domestic opinion in China is not entirely behind MCF and is concerned both that it will (and has) affected their ability to access foreign markets and that it may, paradoxically, shut civilian companies out of the defense sector entirely. The CCP has also attempted to pursue similar policies in the past, to little effect, although reforms such as MCF tend to take a while to show results, making it challenging to assess their success or failure. On a practical level, one author suggested that beyond the reluctance of many companies to embrace MCF, the resulting militia's and reserve unit's performance has been outright bad, indicating that MCF has not been as successful as Xi and the CCP had hoped, at least so far.[433] Lastly, China is extremely reliant on the U.S. and the rest of the West to train its STEM workforce, making even their domestic S&T R&D very vulnerable to exclusion from those academic markets.[434]

POLICY RECOMMENDATIONS AND STRATEGIC OPPORTUNITIES

1. Because of the nature of MCF, the United States has a limited ability to influence the PRC to change or abandon its course. The U.S. may be best served by conducting an internal self-assessment and bolstering its comparative advantages, such as open access to global S&T research while preparing for a world in which the U.S. may not have such a preponderant lead in technological innovation, R&D, and resulting military capabilities.[435]
2. MCF may actually provide an opportunity for the U.S. to better understand China's strategic priorities and interests in geopolitical competition based on how companies involved in MCF act internationally.[436]
3. One author proposed that the U.S. build a "global economic alliance" to counter Chinese challenges to the current U.S.-dominated international political economy.[437]

4. One Asian American writer voiced concerns that the increased fear of China's growing ability to challenge U.S. hegemony will manifest itself in harsher immigration policies and nativist rhetoric that will negatively impact Asian communities within the U.S. itself.[438]
5. Many authors, especially those coming from conservative-aligned think tanks and outlets, saw MCF and other aggressive Chinese actions as a justification for an increasingly hardline and aggressive U.S. posture in East Asia. One commentator suggested that the United States should legally bar companies like Google from working with Chinese companies or the PRC.[439]
6. While all authors recognized the potential risks to the U.S. posed by MCF, several authors warned against an outsized backlash that may actually stifle technological innovation both in the U.S. and around the world.[440]
7. Because of China's reliance on American R&D and academia, the U.S. can cut off their access in order to put strategic pressure on Xi and others to change course. In addition, the U.S. should take further steps to curb illicit or "problematic" tech transfer from U.S. companies to Chinese ones.[441]
8. At least one author called for the U.S. government to develop a national strategy to match Chinese efforts to pull ahead in the race for AI supremacy.[442] However, several authors highlighted the need to develop an AI strategy or rules in a way that is consistent with American liberal democratic values and oppose "digital authoritarianism."[443]
9. One author proposed a three-part categorization for the types of technology that should be controlled[444]
    a. Those that are essential to military operations, beyond simply "dual-use" technologies
    b. Technologies with a scarcity of knowledge that is concentrated in the U.S. or an allied country
    c. Tech that is developed or made exclusively in the U.S.

English Literature Review Bibliography

Chang, Gordon G. "U.S. Must Put a Ban on Google Helping China Develop a Global Digital Dictatorship." The Daily Beast, March 26, 2019, sec. world. https://www.thedailybeast.com/google-snubbed-the-pentagonbut-not-the-chinese-military.

Cheng, Yangyang. "For Science, or the 'Motherland'? The Dilemma Facing China's Brightest Minds." SupChina, January 30, 2019. https://supchina.com/2019/01/30/for-science-or-the-motherland-chinas-brightest-minds/.

"China Vows to Use Market Forces to Boost Defense Capabilities." Reuters, July 21, 2016. https://www.reuters.com/article/us-china-defence-idUSKCN1011QT.

Dotson, John. "Military-Civil Fusion and Electromagnetic Spectrum Management in the PLA." China Brief, October 8, 2019. https://jamestown.org/program/military-civil-fusion-and-electromagnetic-spectrum-management-in-the-pla/.

Fickling, David. "Xi's Leading China Toward Stagnation." Bloomberg Opinion, January 12, 2019. https://www.bloomberg.com/opinion/articles/2019-01-13/xi-s-leading-china-s-economy-into-the-middle-income-trap.

"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: Office of the Trade Representative of the United States, March 22, 2018. https://ustr.gov/sites/default/files/Section%20301%20FINAL.PDF.

Flournoy, Michelle, and Josh Hochman. "U.S. Tech Companies Should Embrace Export Controls to China - Bloomberg." Bloomberg Opinion, January 31, 2019. https://www.bloomberg.com/opinion/articles/2019-01-31/u-s-tech-companies-should-embrace-export-controls-to-china.

Ford, Christopher Ashley. Huawei and its Siblings, the Chinese Tech Giants: National Security and Foreign Policy Implications. Remarks to Multilateral Action on Sensitive Technologies (MAST) Conference, September 11, 2019. https://www.state.gov/huawei-and-its-siblings-the-chinese-tech-giants-national-security-and-foreign-policy-implications/.

Hille, Kathrin, and Richard Waters. "Washington Unnerved by China's 'Military-Civil Fusion.'" Financial Times, November 8, 2018. https://www.ft.com/content/8dcb534c-dbaf-11e8-9f04-38d397e6661c.

"Huawei CVs Show Close Links with Military – Study." Irish Times, July 8, 2019. https://www.irishtimes.com/business/technology/huawei-cvs-show-close-links-with-military-study-1.3950211.

Ignatius, David. "Opinion | How Xi Overplayed His Hand with America." Washington Post, April 16, 2019. https://www.washingtonpost.com/opinions/global-opinions/how-xi-overplayed-his-hand-with-america/2019/04/16/de39df54-608b-11e9-bfad-36a7eb36cb60_story.html.

Irvine, Caitlin. "The Chinese Swarming Programme." The Security Distillery, September 7, 2018. https://thesecuritydistillery.org/all-articles/the-chinese-swarming-programme-part-three-of-three.

Ismail, Yacqub, and Eleanor Shiori Otsuka Hughes. "Japan in a New Northeast Asian Security Environment." International Policy Digest (blog), October 22, 2019. https://intpolicydigest.org/2019/10/22/japan-in-a-new-northeast-asian-security-environment/.

Johnson, James. "China and the U.S. Are Racing to Develop AI Weapons." The Conversation. Accessed April 13, 2020. http://theconversation.com/china-and-the-us-are-racing-to-develop-ai-weapons-97427.

Kania, Elsa. China's Threat to American Government and Private Sector Research and Innovation Leadership, § House Permanent Select Committee on Intelligence (2018). https://docs.house.gov/meetings/IG/IG00/20180719/108561/HHRG-115-IG00-Wstate-KaniaE-20180719.pdf.

———. "In Military-Civil Fusion, China Is Learning Lessons from the United States and Starting to Innovate." The Strategy Bridge, September 27, 2019. https://thestrategybridge.org/the-bridge/2019/8/27/in-military-civil-fusion-china-is-learning-lessons-from-the-united-states-and-starting-to-innovate.

———. "Is China Seeking 'Quantum Surprise?'" Bulletin of the Atomic Scientists (blog), March 1, 2018. https://thebulletin.org/2018/03/is-china-seeking-quantum-surprise/.

———. "Swarms at War: Chinese Advances in Swarm Intelligence." China Brief 17, no. 9 (July 6, 2017). https://jamestown.org/program/swarms-war-chinese-advances-swarm-intelligence/.

———. "Technological Entanglement: Cooperation, Competition and the Dual-Use Dilemma in Artificial Intelligence." Policy Brief. Canberra, Australia: Australian Strategic Policy Institute, June 2018. https://s3-ap-southeast-2.amazonaws.com/ad-aspi/2018-07/Tech-Entanglemen_PolicyBrief_20180702-v2.pdf?7BahbUgNHCY1umz4PCrLOEdBJUrjULCg.

———. "The AI Titans' Security Dilemmas." Governance in an Emerging World Fall Series, no. 218 (October 29, 2018).

———. "The Dual-Use Dilemma in China's New AI Plan: Leveraging Foreign Innovation Resources and Military-Civil Fusion." Lawfare (blog), July 28, 2017. https://www.lawfareblog.com/dual-use-dilemma-chinas-new-ai-plan-leveraging-foreign-innovation-resources-and-military-civil.

Kania, Elsa B. "Battlefield Singularity: Artificial Intelligence, Military Revolution, and China's Future Military Power." Washington, D.C: Center for a New American Security, November 2017. https://s3.amazonaws.com/files.cnas.org/documents/Battlefield-Singularity-November-2017.pdf?mtime=20171129235805.

———. "China's AI Giants Can't Say No to the Party." Foreign Policy (blog), August 2, 2018. https://foreignpolicy.com/2018/08/02/chinas-ai-giants-cant-say-no-to-the-party/.

———. "New Frontiers of Chinese Defense Innovation: Artificial Intelligence and Quantum Technologies." SITC Research Briefs Series 10, no. 2018–12 (May 30, 2018). https://escholarship.org/uc/item/66n8s5br.

———. Technology, Trade, and Military-Civil Fusion: China's Pursuit of Artificial Intelligence, New Materials, and New Energy, § U.S.-China Economic and Security Review Commission (2019). https://www.uscc.gov/sites/default/files/2019-10/June%207,%202019%20Hearing%20Transcript.pdf.

Kania, Elsa B., and Wilson VornDick. "China's Military Biotech Frontier: CRISPR, Military-Civil Fusion, and the New Revolution in Military Affairs." China Brief 19, no. 18 (October 8, 2019). https://jamestown.org/program/chinas-military-biotech-frontier-crispr-military-civil-fusion-and-the-new-revolution-in-military-affairs/.

Kania, Elsa B., and Wilson VornDick. "Weaponizing Biotech: How China's Military Is Preparing for a 'New Domain of Warfare.'" Defense One, August 14, 2019. https://www.defenseone.com/ideas/2019/08/chinas-military-pursuing-biotech/159167/.

La Bruyere, Emily de, and Nathan Picarsic. "Military-Civil Fusion: Crafting a Strategic Response." CHIPS: The Department of the Navy's Information Technology Magazine, September 2019. https://www.doncio.navy.mil/CHIPS/ArticleDetails.aspx?ID=12635.

Lafferty, Brian. "Civil-Military Integrations and PLA Reforms." In Chairman Xi Remakes the PLA: Assessing Chinese Military Reforms, edited by Philip C Saunders, Arthur S. Ding, Andrew Scobell, Andrew N.D. Yang, and Joel Wuthnow, 627–60. Washington, D.C: National Defense University Press, 2019. https://ndupress.ndu.edu/Portals/68/Documents/Books/Chairman-Xi/Chairman-Xi_Chapter-16.pdf?ver=2019-02-08-112005-803.

Laskai, Lorand. "Civil-Military Fusion and the PLA's Pursuit of Dominance in Emerging Technologies." China Brief 18, no. 6 (April 9, 2018). https://jamestown.org/program/civil-military-fusion-and-the-plas-pursuit-of-dominance-in-emerging-technologies/.

Layton, Roslyn. "China Expert Applauds Trump's Hard Line On China. Says Congress, CEOs, And Media Need To Do More." Forbes, July 18, 2019. https://www.forbes.com/sites/roslynlayton/2019/07/18/china-expert-applauds-trumps-hard-line-on-china-says-congress-ceos-and-media-need-to-do-more/#2346eedf2f35.

Levesque, Greg. "Military-Civil Fusion: Beijing's 'Guns AND Butter' Strategy to Become a Technological Superpower." China Brief 19, no. 18 (October 8, 2019). https://jamestown.org/program/military-civil-fusion-beijings-guns-and-butter-strategy-to-become-a-technological-superpower/.

Linn, Thomas. "Race to Develop Artificial Intelligence Is One between Chinese Authoritarianism and U.S. Democracy." San Francisco Chronicle, August 28, 2018, sec. Open Forum. https://www.sfchronicle.com/opinion/openforum/article/Race-to-develop-artificial-intelligence-is-one-13189380.php.

Majumdar, Dave. "Dirty Little Secret: How China Built Its Military Might (Thanks to America and Russia)." Text. The National Interest. The Center for the National Interest, July 24, 2018. https://nationalinterest.org/blog/buzz/dirty-little-secret-how-china-built-its-military-might-thanks-america-and-russia-26721.

Ray, Trisha. "India Must Take the Lead in the AI Norms Race." Pacific Forum (blog), July 26, 2019. https://pacforum.org/publication/yl-blog-6-india-must-take-the-lead-in-the-ai-norms-race.

Somerville, Heather. "China Has 'Concerning' Leads Over U.S. in Tech, Defense Department Official Says." Wall Street Journal, October 23, 2019, sec. Tech. https://www.wsj.com/articles/china-has-concerning-leads-over-u-s-in-tech-defense-department-official-says-11571856288.

Su, Alice. "The Question of 'patriotism' in U.S.-China Tech Collaboration." Los Angeles Times, August 13, 2019, sec. World & Nation. https://www.latimes.com/world-nation/story/2019-08-12/china-us-tech-patriotism-ethics-ai.

Tadjdeh, Yasmin. "Dunford Slams Tech Companies That Work with China over Pentagon." National Defense, May 13, 2019. https://www.nationaldefensemagazine.org/articles/2019/5/13/just-in-dunford-slams-tech-companies-that-work-with-china-over-pentagon.

Upchurch, Tom. "How China Could Beat the West in the Deadly Race for AI Weapons." Wired UK, August 8, 2018. https://www.wired.co.uk/article/artificial-intelligence-weapons-warfare-project-maven-google-china.

"U.S. Tech Companies Should Embrace Export Controls to China - Bloomberg." Accessed April 13, 2020. https://www.bloomberg.com/opinion/articles/2019-01-31/u-s-tech-companies-should-embrace-export-controls-to-china.

Waddell, Kaveh. "The Devil's Bargain for AI Companies Working in China." Axios. Accessed April 13, 2020. https://www.axios.com/china-artificial-intelligence-ai-military-e274d4f6-71b6-4d76-b54a-c0510e7cc277.html.

Warner, Mark. "Senator Warner Letter to Secretary Mnuchin on Foreign Investment Risk Review Modernization Act," November 14, 2018. https://nvca.org/wp-content/uploads/2018/11/Warner-exempted-countries-letter-to-Mnuchin.pdf.

Weisberger, Marcus. "Pentagon To Explore Potential of 5G — and Its Made-in-China Hazards." Defense One, March 25, 2019. https://www.defenseone.com/technology/2019/03/pentagon-explore-5gs-potential-and-its-made-china-hazards/155812/.

Wortzel, Larry. "The Limitations of Military-Civil Mobilization: Problems with Funding and Clashing Interests in Industry-Based PLA Reserve Units." China Brief 19, no. 18 (October 8, 2019). https://jamestown.org/program/the-limitations-of-military-civil-mobilization-problems-with-funding-and-clashing-interests-in-industry-based-pla-reserve-units/.

Endnotes

1 "Xi Jinping Chairs First Plenary Meeting of the Central Commission for Military-Civil Fusion Development" [习近平主持召开中央军民融合发展委员会第一次全体会议], *Xinhua*, 20 June 2017, http://www.gov.cn/xinwen/2017-06/20/content_5204059.htm.

2 Jiang Luming [姜鲁鸣], Wang Weihai [王伟海], Liu Zuchen [刘祖辰], *Initial Discussion on the Military-Civil Fusion Strategy* [军民融合发展战略探论], (Beijing: People's Press, 2017), 15.

3 See Marcel Angliviel de la Beaumelle, Benjamin Spevack, Devin Thorne, "Open Arms: Evaluating Global Exposure to China's Defense-Industrial Base." C4ADS, October 7, 2019. https://www.c4reports.org/open-arms.

4 Greg Levesque and Mark Stokes, "Blurred Lines: Military-Civil Fusion and the Going Out of China's Defense Industry," Pointe Bello, December 2016, https://static1.squarespace.com/static/569925bfe0327c837e2e9a94/t/593dad0320099e64e1ca92a5/1497214574912/062017_Pointe+Bello_Military+Civil+Fusion+Report.pdf.

5 Brian Lafferty, "Civil-Military Integrations and PLA Reforms," In *Chairman Xi Remakes the PLA: Assessing Chinese Military Reforms*, edited by Philip C Saunders, Arthur S. Ding, Andrew Scobell, Andrew N.D. Yang, and Joel Wuthnow, (Washington, D.C: National Defense University Press, 2019).

6 "Remarks by Vice President Pence at the Frederic V. Malek Memorial Lecture," *WhiteHouse.gov*, 24 October 2019. https://www.whitehouse.gov/briefings-statements/remarks-vice-president-pence-frederic-v-malek-memorial-lecture/.

7 "Addressing China Threats Requires Unity of U.S., World Effort, Esper Says," *DOD News*, 24 January 2020. https://www.defense.gov/Explore/News/Article/Article/2065332/addressing-china-threats-requires-unity-of-us-world-effort-esper-says/.

8 "Remarks by Secretary Pompeo on Technology and the China Security Challenge," U.S. Embassy & Consulates in Indonesia, 14 January 2020. https://id.usembassy.gov/remarks-by-secretary-pompeo-on-technology-and-the-china-security-challenge/.

9 "Intelligence Law of the People's Republic of China" [中华人民共和国国家情报法], *Xinhua*, 27 June 2017. http://legal.china.com.cn/2017-06/28/content_41110366.htm.

10 "National Security Law of the People's Republic of China" [中华人民共和国国家安全法]," *Ministry of Defense Online*, 7 April 2017. http://www.81.cn/2017gjaqjyr/2017-04/07/content_7553456_5.htm.

11 "CCP Central, State Council, CMC release *Opinion on the Integrated Development of Economic Construction and National Defense Construction*" [中共中央 国务院 中央军委印发《关于经济建设和国防建设融合发展的意见》], *Xinhua*, 21 July 2016, http://www.xinhuanet.com//politics/2016-07/21/c_1119259282.htm.

12 China Book Publishing Database [中国图书出版数据库], Accessed January 2020, at cnpub.com.cn.

13 Li Zhiyi [李智毅], Yang Xiaochun [杨晓春], Wu Guangyin [吴广印], and Xiong Wei [熊伟], "Research on Core Authors about Civil-Military Integration based on the Bibliometrics" [基于文献计量的军民融合文献核心作者分析], *Technology Intelligence Engineering* [情报工程] 4, no. 5 (April 2018): 105–115, http://tie.istic.ac.cn/qbgc/ch/reader/view_abstract.aspx?file_no=201805010;

14 Zhao Yiran [赵苡然], Wang Xin [王鑫], "Using an Integrated Approach in the Research of Fusion: An Impression of the Academy of Military Sciences' Military-Civil Fusion Research Center" [用融合的办法研究融合军事科学院军民融合研究中心印象], *Xinhua*, 6 May 2017, http://www.xinhuanet.com/mil/2017-05/06/c_129592161.htm.

15 Ibid

16 "NDU creates Research Center for Military-Civil Fusion Deep Development in Beijing" [国防大学军民融合深度发展研究中心在京成立], *China Military Television Online* [中国军视网], 21 July 2015. http://www.js7tv.cn/news/201507_15365.html.

17 Li et al., "Research on Core Authors about Civil-Military Integration based on the Bibliometrics," 105–115; The WeChat Official Account "Yangshan Think Tank" featured a four-part series based on this article in late 2017. Both sources were referenced throughout this report.

18 Zheng Bo [郑波], "Military-Civil Fusion Development: Breakthroughs Rest Chiefly on the Strengthening of Theoretical Research" [军民融合发展: 破局之策首在强化理论], in *Military-Civil Fusion Deep Development Theory Part 1* [军民融合深度发展论(上册)], (Beijing: Military Sciences Press, 2016), 84-87.

19 Zheng, "Military-Civil Fusion Development: Breakthroughs Rest Chiefly on the Strengthening of Theoretical Research," 85.

20 Chu Zhenjiang [褚振江], "The Pioneer of Research on the Development of China's Civil-Military Integration ——Professor Jiang Luming, former director of the National Defense Economic Research Center of National Defense University" [中国军民融合发展研究的先行者——记国防大学国防经济研究中心原主任姜鲁鸣教授], *Zhong Hua Hun Records* [中华魂] no. 8 (2017): accessed March 2020, http://www.cnki.com.cn/Article/CJFDTotal-ZHHZ201708024.htm.

21 The digital version can be accessed at www.dacihai.com.cn.

22 *Government Work Report* [政府工作报告], PRC Ministry of Commerce, 24 March 2016, http://www.mofcom.gov.cn/article/i/jyjl/l/201603/20160301282908.shtml

23 Original Chinese: "国家机关, 政党组织, 企业和事业单位在机构设置, 领导隶属关系和管理权限划分等方面的体系, 制度, 方法, 形式等的总称."

24 "Xi Jinping: Build on Previous Successes and Strive to Achieve the Goal the Lunar Exploration Project and Contribute to the World's Space Exploration Endeavor" [习近平:为实现我国探月工程目标乘胜前进 为推动世界航天事业发展继续努力], *Xinhua*, 20 February 2019, http://www.xinhuanet.com/politics/leaders/2019-02/20/c_1124142195.htm.

25 Wang Menghan [王梦涪], Fang Weihua [方卫华]. "Innovative Development of Military-Civil Deep Fusion: Historical Logic and Mechanism" [军民深度融合创新发展:历史逻辑与作用机制], *Science & Technology Progress and Policy* [科技进步与对策], no. 01 (2018) http://tow.cnki.net/kcms/detail/detail.aspx?filename=KJJB201801021&dbcode=CRJT_CJFD&dbname=CRJT_CJFDTOTAL&v=.

26 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 4.

27 Shi Shiyin [石世印], "Creating a Path of Fusion-Style Military-Civilian Development with Chinese Characteristics is a Great Achievement of 40 Years of Reform and Opening Up" [开创一条中国特色军民融合式发展路子是改革开放四十年来的一项伟大成就和基本经验], *Security Internal Reference* [安全内参], 19 November 2018, https://www.secrss.com/article/6515.

28 Fang Min [方敏], Yang Fang [杨放], Wang Yinquan [王银泉], Qiu Shichang [邱世昌], "Mao Zedong's View on National Defense and its Practical Significance" [毛泽东的国防观及其现实意义]," *People's Daily Online*, accessed March 2020, http://www.people.com.cn/GB/shizheng/8198/30446/30451/2210772.html.

29 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 5

30 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 6.

31 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 7.

32 *Selected Works of Deng Xiaoping* [邓小平文选], Vol. 3, 128.

33 Shi Shiyin [石世印], "Creating a Path of Fusion-Style Military-Civilian Development with Chinese Characteristics is a Great Achievement of 40 Years of Reform and Opening Up."

34 Ibid.

35 Jiang Zemin, Jiang Zemin wenxuan [Jiang Zemin's Selected Works], Vol. 1, (Beijing: Renmin chubanshe, 2006), 285. Cited in M. Taylor Fravel, "China's New Military Strategy: 'Winning Informationized Local Wars'," *China Brief*, 2 July 2015. https://jamestown.org/program/chinas-new-military-strategy-winning-informationized-local-wars/

36 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 10-11.

37 The original text is: "军民结合, 寓军于民, 大力协同, 自主创新" 的国防科技工业发展方针"

38 "Hu Jintao's Report at the 17th Party Congress" [胡锦涛在党的十七大上的报告], *People's Daily Online*, 24 October, 2007, http://politics.people.com.cn/GB/8198/6429196.html.

39 Ibid.

40 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 13.

41 "Several Opinions of the State Council on Encouraging, Supporting, and Guiding the Development of the Private Economy" [国务院关于鼓励支持和引导个体私营等非公经济发展的若干意见], *gov.cn*, 12 August 2005, http://www.gov.cn/zwgk/2005-08/12/content_21691.htm

42 Shi Shiyin [石世印], "Creating a Path of Fusion-Style Military-Civilian Development with Chinese Characteristics is a Great Achievement of 40 Years of Reform and Opening Up.".

43 Ibid.

44 Ibid.

45 Brian Lafferty, "Civil-Military Integrations and PLA Reforms," 641-642.

46 Shi Shiyin [石世印], "Creating a Path of Fusion-Style Military-Civilian Development with Chinese Characteristics is a Great Achievement of 40 Years of Reform and Opening Up."

47 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 42.

48 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 77.

49 Brian Lafferty, "Civil-Military Integrations and PLA Reforms," 643-644.

50 Bi Jingjing [毕京京], The Significance and Approaches of In-depth Implementation of the Military-Civil Fusion Strategy [深入实施军民融合发展战略的意义和路径], in *Military-Civil Fusion Deep Development Theory Part 1* [军民融合深度发展论(上册)], (Beijing: Military Sciences Press, 2016), 19.

51 Bi Jingjing [毕京京] and Xiao Dongsong [肖冬松], eds., *Report on the Development of Military-Civil Fusion in China (2016)* [中国军民融合发展报告2016] (Beijing: National Defense University Press, 2016), 42.

52 The terms are 拆壁垒, 破坚冰, 去门槛, 涉险滩, 动奶酪, 破难题, 闯难关, 趟路子, 辟新径

53 "Xi Jinping Chairs First Plenary Meeting of the Central Commission for Military-Civil Fusion Development," 20 June 2017.

54 The original Chinese text: "在这一表述中, "全要素""多领域""高效益", 是定位"军民深度融合发展"的三个基本属性, 是需要首先达到和实现的基本目标. 这一目标与构建"军民一体化的国家战略体系和能力"的目标在时序上有继起的关系, 事实上体现着军民融合发展所要实现的基本目标与终极目标的关系"

55 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 38.

56 Ibid.

57 Zhong Xin [钟新], "Deepen the Implementation of the Military-Civil Fusion Strategy" [深入实施军民融合发展战略], Guangming Daily [光明网], 16 November 2017. http://epaper.gmw.cn/gmrb/html/2017-11/16/nw.D110000gmrb_20171116_3-13.htm.

58 "CCP Central Politburo Holds Meeting, Xi Jinping Chairs Meeting" [中共中央政治局召开会议习近平主持会议], *People's Daily Online*, 26 March 2016. http://cpc.people.com.cn/n1/2016/0326/c64094-28228451.html.

59 Zhong Xin [钟新], "Deepen the Implementation of the Military-Civil Fusion Strategy."

60 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 38-39.

61 "CCP Central, State Council, CMC release *Opinion on the Integrated Development of Economic Construction and National Defense Construction*," *Xinhua*, 21 July 2016; Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 60-61; Jin Zhuanglong [金壮龙], "Promote Military-Civil Fusion Deep Development in the New Era" [开创新时代军民融合深度发展新局面], *Xinhua*, 16 July 2018, http://www.xinhuanet.com/politics/ 2018-07/16/c_1123133733.htm.

62 The Original Chinese is "技术, 人才, 服务, 资本, 设施, 信息, 管理, 标准, 政策, 制度, 法规, 文化等要素." Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 38; Yu Chuanxin [于川信] and Liu Zhiwei [刘志伟], "The Strategic Guidance to Promote Military-Civil Fusion Deep Development" [推进军民融合深度发展的战略引领], *National Defense News*, 1 June 2017.

63 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 51.

64 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 60-61.

65 "CCP Central, State Council, CMC release Opinion on the Integrated Development of Economic Construction and National Defense Construction," *Xinhua*, 21 July 2016.

66 "Xi Jinping Chairs First Plenary Meeting of the Central Commission for Military-Civil Fusion Development," 20 June 2017.

67 Jin Zhuanglong [金壮龙], "Promote Military-Civil Fusion Deep Development in the New Era," *Xinhua*, 16 July 2018.

68 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 60.

69 "CCP Central, State Council, CMC release *Opinion on the Integrated Development of Economic Construction and National Defense Construction*," *Xinhua*, 21 July 2016; Jiang et al., Initial Discussion on the Military-Civil Fusion Strategy, 60

70 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 60; Zeng Li [曾立], ed., *National Defense Resource Allocation and Management System with Chinese Characteristics under Military-Civil Fusion—National Strategy and Policies (Part 1)* [中国特色军民融合国防资源配置与管理探索—国家战略与基本国策] (上), (Beijing: Economic and Management Publishing House, 2016), 39.

71 He Kun [贺坤], Zeng Li [曾立], "A Analysis of the Scope of Military-Civil Fusion Deep Development and its Economy of Scale" [军民融合深度发展的范围与规模经济分析], in *Military-Civil Fusion Deep Development Theory Part 1* [军民融合深度发展论(上册)], (Beijing: Military Sciences Press, 2016), 109-112.

72 "China's National Defense in the New Era" [新时代的中国国防], State Council Information Office [国务院新闻办公室] 24 July 2019. http://www.xinhuanet.com/politics/2019-07/24/c_1124792450.htm

73 "Defense budget increase is lowest in 32 years," *China Daily*, 22 May 2020. http://www.chinadaily.com.cn/a/202005/22/WS5ec73de1a310a8b241157994.html

74 "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China," Office of the Secretary of Defense, 2 May 2019. https://media.defense.gov/2019/May/02/2002127082/-1/-1/1/2019_CHINA_MILITARY_POWER_REPORT.pdf

75 "What does China really spend on its military?" *China Power - CSIS*, accessed March 2020. https://chinapower.csis.org/military-spending/

76 "China's National Defense in the New Era" [新时代的中国国防], State Council Information Office [国务院新闻办公室] 24 July 2019. http://www.xinhuanet.com/politics/2019-07/24/c_1124792450.htm; "Zhang Yesui: National Defense Expenditures for 2018 are Around 1.3% of GDP" [张业遂, 2018年国防费占GDP比例约1.3%], *Beijing News* [新京报], 4 March 2019. http://www.bjnews.com.cn/news/2019/03/04/552551.html; "In 2019 Central Government Defense Spending 1.189 trillion RMB, an increase of almost 7.5%" [2019年中央财政预算国防支出11899亿元, 增长约7.5%], *Observer*, 5 March 2019. https://www.guancha.cn/politics/2019_03_05_492342.shtml; "In 2019 China's GDP reaches almost 100 trillion RMB, an increase of 6.1%" [2019年我国GDP近百万亿元, 增长6.1%], *People's Daily*, 18 January 2020. http://www.gov.cn/xinwen/2020-01/18/content_5470531.htm

77 Sam Perlo-Freeman, "Deciphering China's latest defence budget figures," SIPRI, 31 March 2014. https://www.sipri.org/node/377

78 "Military expenditure (% of GDP) - China - Data via SIPRI," World Bank, accessed May 2020, https://data.worldbank.org/indicator/MS.MIL.XPND.GD.ZS?end=2018&locations=CN&start=1989&view=chart

79 "China's National Defense in the New Era" [新时代的中国国防], State Council Information Office [国务院新闻办公室], 24 July 2019. http://www.xinhuanet.com/politics/2019-07/24/c_1124792450.htm; "What does China really spend on its military?" *China Power - CSIS*, accessed March 2020. https://chinapower.csis.org/military-spending/

80 "2018 Investment Promotion Report on the Military-Civil Fusion Technology and Equipment Industry" [2018军民融合科技装备产业投资促进报告], November 2018, 24.

81 Brian Lafferty, "Civil-Military Integrations and PLA Reforms," 631.

82 "GDP growth (annual %) - China," The World Bank, accessed March 2020, https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=CN; "Instant View: China's economic growth slows to 6.1% in 2019, near 30-year low," *Reuters*, 16 January 2020. https://www.reuters.com/article/us-china-economy-gdp-instantview/instant-view-chinas-economic-growth-slows-to-61-in-2019-near-30-year-low-idUSKBN1ZG092

83 "China's Economic Rise: History, Trends, Challenges, and Implications for the United States," Congressional Research Service, Updated 25 June 2019. https://crsreports.congress.gov/product/pdf/RL/RL33534; "Real GDP growth Annual percent change," International Monetary Fund, accessed

84 "Real GDP growth Annual percent change," International Monetary Fund, accessed March 2020. https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/CHN

85 David Barboza, "China unveils $586 billion stimulus plan," *New York Times*, 10 November 2008. https://www.nytimes.com/2008/11/10/world/asia/10iht-10china.17673270.html

86 David Orsmond, "China's Economic Choices," Lowy Institute, 17 December 2019. https://www.lowyinstitute.org/publications/china-s-economic-choices

87 "The Three Characteristics of the New Normal State of Chinese Economy as Proposed by Xi Jinping and the Four Opportunities it Brings" [习近平提出中国经济新常态的3个特点及带来的4个机遇], *People's Daily Online* [人民网], 9 November 2014. http://politics.people.com.cn/n/2014/1109/c1024-25998809.html.

88 John Boulter, "China's Supply-Side Structural Reform," *Reserve Bank of Australia Bulletin*, December (2018), https://www.rba.gov.au/publications/bulletin/2018/dec/chinas-supply-side-structural-reform.html.

89 "China's debt tops 300% of GDP, now 15% of global total: IIF," *Reuters*, 18 July 2019. https://www.reuters.com/article/us-china-economy-debt/chinas-debt-tops-300-of-gdp-now-15-of-global-total-iif-idUSKCN1UD0KD.

90 "World Economic Outlook: Global Manufacturing Downturn, Rising Trade Barriers," International Monetary Fund, October 2019. https://www.imf.org/en/Publications/WEO/Issues/2019/10/01/world-economic-outlook-october-2019.

91 Ana Swanson and Alan Rappeport, "Trump Signs China Trade Deal, Putting Economic Conflict on Pause," *New York Times*, 15 January 2020. https://www.nytimes.com/2020/01/15/business/economy/china-trade-deal.html.

92 "CCP Central Economic Work Conference Held in Beijing" [中央经济工作会议在北京举行], *Xinhua*, 12 December 2019. http://politics.people.com.cn/n1/2019/1212/c1024-31503677.html.

93 "Examining the Six 'Stabilities'" at Year-end: Why Stabilities are Desired and How to Achieve it" [年底看'六稳': 因何要'稳' 如何求'稳'"] *Economic Information Daily* [经济参考报], 9 December 2019. http://www.xinhuanet.com/fortune/2019-12/09/c_1125322361.htm.

94 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 24-25.

95 Tan Yungang [谭云刚], "The 'Fourteenth Five-Year Plan' for China's national economic and social development should fully reflect the 'Five Major Characteristics'" [中国国民经济和社会发展'十四五'规划应当充分体现'五大特性'], Military-Civil Fusion Observations [军民融合观察] (Official WeChat Account), 27 March 2020.

96 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 2.

97 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 2.

98 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 34.

99 Original text reads: "..而是消除国家统筹安全和发展的'制度差,'"

100 Yu Chuanxin [于川信] and Liu Zhiwei [刘志伟], "Construct Unified National System of Strategies and Capability" [构建一体化的国家战略体系和能力], *China Defense News* [中国国防报], 9 November 2017, http://www.81.cn/gfbmap/content/2017-11/09/content_191425.htm.

101 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 40, 49.

102 Yu Chuanxin [于川信], "Grand Layout of the Military-Civil Fusion National Strategy" [国家战略的军民融合大布局], *Aisixiang* [爱思想], September 26, 2017, http://www.aisixiang.com/data/106172.html.

103 See Yao Bo [姚博], *A Study on the Development of Military-Civil Fusion Industrial Bases* [军民融合产业基地建设研究] (Beijing: Beijing Institute of Technology Press, 2016), 1-2; Gao Dongguang [高东广], Military-Civil Fusion Mechanisms, Models, Approaches, and Inspirations from Major Military Powers," [世界主要军事强国军民融合机制模式, 有益做法及启迪], *Dual Use Technology and Products* [军民两用技术与产品] 411, no. 1 (July 2018), https://www.secrss.com/article/7646.

104 Elsa B. Kania, "In Military-Civil Fusion, China Is Learning Lessons from the United States and Starting to Innovate," The Strategy Bridge, 27 August 2019, https://thestrategybridge.org/the-bridge/2019/8/27/in-military-civil-fusion-china-is-learning-lessons-from-the-united-states-and-starting-to-innovate.

105 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 42-43

106 Yu Chuanxin and Liu Zhiwei, *Military-Civil Fusion: DARPA's Path to Innovation* [军民融合: DARPA创新之路], (Beijing: National Defense Industry Press, 2018).

107 Zeng Li, ed., *National Defense Resource Allocation and Management with Chinese Characteristics under Military-Civil Fusion (Part 1)*, 57-59.

108 Zeng Li, ed., *National Defense Resource Allocation and Management with Chinese Characteristics under Military-Civil Fusion (Part 1)*, 43.

109 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 31, 42-43

110 "CCP Central, State Council, CMC release *Opinion on the Integrated Development of Economic Construction and National Defense Construction*," *Xinhua*, 21 July 2016; Zhang Gaoli [张高丽], "Accelerate the Formation of the Military-Civil Fusion Deep Development Pattern" [加快形成军民融合深度发展新格局], SASTIND, 2 October 2017. http://www.sastind.gov.cn/n112/n451217/c6797266/content.html.

111 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 43

112 "Xi Jinping: Implement the Military-Civil Fusion Development Strategy, Strive to Build a Strong Military" [习近平:深入实施军民融合发展战略努力开创强军兴军新局面], *People's Daily Online*, 13 March 2015. http://cpc.people.com.cn/n/2015/0313/c64094-26685982.html.

113 Brian Lafferty, "Civil-Military Integrations and PLA Reforms," 646.

114 Zeng Li, ed., *National Defense Resource Allocation and Management with Chinese Characteristics under Military-Civil Fusion (Part 1)*, 199.

115 Sebastian Heilmann and Lea Shih, "Central Leading Small Groups: Top-level decision-making under Xi Jinping," in Sebastian Heilmann, Ed. *China's Political System*, (Lanham, Maryland: Rowman & Littlefield, 2017), 169.

116 Nis Grünberg, "The CCP's Nerve Center," Mercator Institute for China Studies, 30 October 2019, https://www.merics.org/en/china-mapping/the-ccps-nerve-center.

117 The exact composition of both Commissions has not been made public, but a Beijing-based WeChat Public Account "Zheng Zhi Jian" [政知见] analyzed the composition of the CCMCFD from a CCTV news footage broadcast on June 20, 2017. See: "Twelve Central Leaders Assume Position in a New Organization—What Exactly is the Central Commission for Military-Civil Fusion Development?" [12名中央领导在新机构任职,中央军民融合发展委员会究竟是做什么的?], *Junmin.org* [军民网], 21 June 2017, https://web.archive.org/web/20170918154202/http://news.junmin.org/2017/xinwen_shehui_0621/230461.html.

118 "Xi Jinping Chairs First Plenary Meeting of the Central Commission for Military-Civil Fusion Development," 20 June 2017.

119 "Xi Jinping Chairs Second Plenary Meeting of the Central Commission for Military-Civil Fusion Development" [习近平主持召开中央军民融合发展委员会第二次全体会议], *Xinhua*, 22 September 2017, http://www.gov.cn/xinwen/2017-09/22/content_5226942.htm.

120 "Xi Jinping Chairs First Plenary Meeting of the Central Commission (19th) for Military-Civil Fusion Development" [习近平主持召开十九届中央军民融合发展委员会第一次全体会议], gov.cn, 2 March 2018. http://www.mod.gov.cn/shouye/2018-03/02/content_4805753.htm.

121 "Xi Jinping Chairs Second Plenary Meeting of the Central Commission (19th) for Military-Civil Fusion Development" [习近平主持召开中央军民融合发展委员会第二次全体会议], *Xinhua*, 15 October 2018, http://www.gov.cn/xinwen/2018-10/15/content_5330964.htm.

122 Several of these commissions are recently upgraded from LSGs. For instance, the former Central Leading Small Group for the Protection of Maritime Rights and Interests was integrated into the renamed Central Foreign Affairs Commission. See Nis Grünberg, "The CCP's Nerve Center," Mercator Institute for China Studies," 30 October 2019, https://www.merics.org/en/china-mapping/the-ccps-nerve-center.

123 Li Xin [李欣], Wei Yong [魏永], "Comprehensively Promote Military-Civil Deep Fusion from Top-Level Design to Implementation Rules" [从顶层设计到实施细则全面推进军民深度融合], *China Aviation News*, 29 March 2017, http://www.cannews.com.cn/2017/0329/163303.shtml.

124 "Xi Jinping Chairs Work Meeting on National Security" [习近平主持召开国家安全工作座谈会], *Xinhua*, 17 February 2017, http://www.xinhuanet.com/politics/2017-02/17/c_1120486809.htm; "Central Security Commission Members Make First Appearance on Xinwen Lianbo" [中央国家安全委员会成员首度亮相《新闻联播》], 17 February 2017. http://news.sohu.com/20170217/n481030722.shtml; "Twelve Central Leaders Assume Position in a New Organization—What Exactly is the Central Commission for Military-Civil Fusion Development?," 21 June 2017.

125 "SASTIND System Engineering Fourth Division" [国防科工局系统工程四司], China Association of the National Shipbuilding Industry [中国船舶工业行业协会], 28 January 2019, http://www.cansi.org.cn/xievip/shownews.php?lang=cn&id=11558.

126 Li Xin [李欣], Wei Yong [魏永], "Comprehensively Promote Military-Civil Deep Fusion from Top-Level Design to Implementation Rules."

127 "Department of National Defense," gov.cn, accessed May 2020, https://www.ndrc.gov.cn/fzggw/jgsj/gfs/; "NDRC Explains: Military-Civil Fusion Deep Development Pattern" [发改委解读军民融合深度发展战略格局], *Zhihu* [知乎], 20 November 2018, https://zhuanlan.zhihu.com/p/50473525.

128 "Prospects for the Development of Military-Civil Fusion in 2019" [2019年中国军民融合发展形势展望], CCID Think Tank [赛迪智库], 2019, 3.

129 "Spotlight! Xiuzhou held the first meeting of the District Committee for Military-Civil Fusion Development" [聚焦! 秀洲召开区委军民融合发展委员会第一次会议], 23 June 2019, https://zj.zjol.com.cn/news/1226739.html.

130 "Prospects for the Development of Military-Civil Fusion in 2019" [2019年中国军民融合发展形势展望], CCID Think Tank [赛迪智库], 2019, 9.

131 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 145

132 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 48

133 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 146

134 Zeng Li, ed., *National Defense Resource Allocation and Management with Chinese Characteristics under Military-Civil Fusion (Part 1)*, 56.

135 Ibid.

136 Zeng Li, ed., *Research on the Military-Civil Fusion National Defense Resource Allocation and Management with Chinese Characteristics (Part 1)*, 57.

137 "Xi Jinping Discusses Military-Civil Fusion: It is a National Strategy that Concerns National Security and China's Overall Development" [习近平谈军民融合：是国家战略关乎国家安全和发展全局], *People's Daily Online*, 23 January 2017. http://cpc.people.com.cn/xuexi/n1/2017/0123/c385474-29043923.html.

138 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 214

139 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 213

140 "CCP Central, State Council, CMC release *Opinion on the Integrated Development of Economic Construction and National Defense Construction*," *Xinhua*, 21 July 2016.

141 Jin Zhuanglong [金壮龙], "Promote Military-Civil Fusion Deep Development in the New Era," 16 July 2018.

142 "General Office of the CCP Central Committee Issues 'Notice on Rooting out Red-Tapism at the Grassroots Level in Service of the Goal of Building a Moderately Prosperous Society'" [中共中央办公厅印发《关于持续解决困扰基层的形式主义问题为决胜全面建成小康社会提供坚强作风保证的通知》], 14 April 2020. http://www.gov.cn/zhengce/2020-04/14/content_5502349.htm.

143 Bi Jingjing [毕京京] and Xiao Dongsong [肖冬松], eds., *Report on the Development of Military-Civil Fusion in China (2016)*, 29.

144 Zhang Jiantian [张建田], "Military-Civil Fusion Legislation: Ban that which is Wrong and Establish that which is Correct step by step," *People's Daily Online*, 13 October 2018.

145 "CCP Central Committee General Office, State Council General Office, Central Military Commission General Office Issue 'Notice on Clearing up Military-Civil Fusion Development Laws and Regulations'" [中共中央办公厅国务院办公厅中央军委办公厅印发《关于开展军民融合发展法规文件清理工作的通知》], *Xinhua*, 22 February 2018, http://www.xinhuanet.com/politics/2018-02/22/c_1122438131.htm.

146 Zhang Jiantian [张建田], "Military-Civil Fusion Legislation: Ban that which is Wrong and Establish that which is Correct step by step" [军民融合立法: 禁非立是 循序渐进], *People's Daily Online*, 13 October 2018, http://military.people.com.cn/n1/2018/1013/c1011-30338769.html.

147 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 60; Zeng Li, ed., *National Defense Resource Allocation and Management with Chinese Characteristics under Military-Civil Fusion (Part 1)*, 39.

148 "CCP Central, State Council, CMC release *Opinion on the Integrated Development of Economic Construction and National Defense Construction*," *Xinhua*, 21 July 2016.

149 Chen Zhenkai [陈振凯], "China is Accelerating its New Infrastructure Construction (A Series of Commentaries on new infrastructure construction(1))" [中国加快'新基建'进度[新型基础设施建设系列述评[1]], *People's Daily Online*, 11 March 2020, http://politics.people.com.cn/n1/2020/0311/c1001-31626324.html.

150 Jin Zhuanglong [金壮龙], "Promote Military-Civil Fusion Deep Development in the New Era," 16 July 2018.

151 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 69.

152 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 63.

153 "CCP Central, State Council, CMC release *Opinion on the Integrated Development of Economic Construction and National Defense Construction*," *Xinhua*, 21 July 2016.

154 Lu Xu [卢旭],Sun Wei [孙伟], "Strengthen National Defense Transportation Infrastructure Construction — Promote Military-Civil Fusion Deep Development" [加强国防交通基础设施建设—推进军民融合深度发展], in *Military-Civil Fusion Deep Development Theory Part 2* [军民融合深度发展论(下册)], (Beijing: Military Sciences Press, 2016), 217.

155 Wang Xiaofang [王晓方], Shi Zhibin [石志彬], "Preliminary Analysis on the Path to Military-Civil Fusion Deep Development" [浅析军民融合深度发展的实现路径], in *Military-Civil Fusion Deep Development Theory Part 1* [军民融合深度发展论(上册)], (Beijing: Military Sciences Press, 2016), 47-50.

156 Lu Xu [卢旭],Sun Wei [孙伟], "Strengthen National Defense Transportation Infrastructure Construction," 217-219.

157 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 66.

158 Lu Xu [卢旭],Sun Wei [孙伟], "Strengthen National Defense Transportation Infrastructure Construction," 217-218.

159 Yin Hao [尹浩], "Develop National Space Information Network using Military-Civil Fusion" [军民融合建设国家空间信息网络], *People's Tribune* [人民论坛], June 2017, 29-31. http://webcache.googleusercontent.com/search?q=cache:TuV4oZ2_6ngJ:www.rmlt.com.cn/2017/0630/481131.shtml+&cd=2&hl=en&ct=clnk&gl=uk&client=firefox-b-1-d

160 Zhang Jianheng [张建恒], "Research on the Key Domains in Information Infrastructure Construction for Military-Civil Fusion Deep Development" [信息基础设施建设军民融合深度发展的重点领域研究], *Wireless Internet Technology* [无线互联科技], No.18 (September 2015), 115-117.

161 For more information on MCF and EMSM, see John Dotson, "Military-Civil Fusion and Electromagnetic Spectrum Management in the PLA," *China Brief*, 8 October 2019, https://jamestown.org/program/military-civil-fusion-and-electromagnetic-spectrum-management-in-the-pla/.

162 In December 2001, the Ministry of Science and Technology initiated a scientific data-sharing pilot project in fields most relevant to defense needs such as meteorology, hydrology, surveying, medicine, health care, transportation, etc. However, progress had been slow in this area due to a host of factors such as the lack of top-level design and coordination, inadequate policies and regulations to ensure funding, talent training, etc. See "Promote Information Resource Exploitation—Research on the Strategy to Leverage Military-Civil Fusion Deep Development" [推进信息资源开发—利用军民融合深度发展策略研究] in *Military-Civil Fusion Deep Development Theory Part 2* [军民融合深度发展论(下册)], (Beijing: Military Sciences Press, 2016), 82-85.

163 "CCP Central, State Council, CMC release *Opinion on the Integrated Development of Economic Construction and National Defense Construction*," *Xinhua*, 21 July 2016.

164 "CCP Central, State Council, CMC release *Opinion on the Integrated Development of Economic Construction and National Defense Construction*," *Xinhua*, 21 July 2016.

165 In 2015, the National Surveying and Mapping Geographic Information Bureau and the PLASSF Information Engineering University signed a "strategic cooperation agreement" to jointly promote the establishment of a national standard system for surveying and mapping geographic information. In the same year, the National Standardization Management Committee and SASTIND jointly released the China Aerospace Standard System and the first batch of China Aerospace Standards. See Bi Jingjing [毕京京] and Xiao Dongsong [肖冬松], eds., *Report on the Development of Military-Civil Fusion in China (2016)* [中国军民融合发展报告 2016] (Beijing: National Defense University Press, 2016), 7.

166 "Notice of the General Office of the State Council on Issuing and Implementing the Key Task Division [2017-2018] of the 'Deepening Standardization Reform Program'" [国务院办公厅关于印发贯彻实施《深化标准化工作改革方案》重点任务分工[2017-2018年]的通知], gov.cn, 1 April 2017, http://www.gov.cn/zhengce/content/2017-04/01/content_5182637.htm.

167 *Law of the People's Republic of China on National Defense Transportation* [中华人民共和国国防交通法], National People's Congress, 3 September 2016. http://www.npc.gov.cn/zgrdw/npc/xinwen/2016-09/03/content_1996764.htm.

168 "CAAC-PLAAF Dual Use Airport Military-Civil Fusion Development and Airfield New Technology Promotion Meeting Held" [空军民航军民合用机场军民融合发展暨机场新技术应用推广会议召开], Civil Aviation Administration of China, 21 September 2017, http://www.caac.gov.cn/XWZX/MHYW/201709/t20170921_46852.html.

169 "Seminar on Safe Operation and Management Dual Use Airports" [军民合用机场安全运行管理交流研讨会召开], Civil Aviation Administration of China, 10 August 2018. http://www.caacnews.com.cn/1/1/201808/t20180810_1253516.html.

170 "Nearly 60 PLAAF Airports are Dual Use" [空军近60个机场实行军民合用], *Xinhua*, 2 August 2019, http://m.xinhuanet.com/mil/2019-08/02/c_1210225890.htm.

171 "Seminar on the Management and Safe Operation of Civil-Military-Shared Use Airports" [军民合用机场安全运行管理交流研讨会召开," Civil Aviation Administration of China, 10 August 2018. http://www.caacnews.com.cn/1/1/201808/t20180810_1253516.html.

172 "Joint Construction and Joint Use—PLAAF Combat Aircraft Takes Conducts Flights at Civilian Airports" [共建共享, 民用机场起降空军战机———全国机场保障领域军民融合之路回顾与前瞻], *Xinhua*, 6 May 2017, http://www.xinhuanet.com/mil/2017-05/06/c_129592152.htm.

173 "Military Use of Civilian Airports Will Assist Air Force in Emergency Situations and Future Wars," [军民合用机场助空军应对紧急情况和未来战争], *China Youth Daily*, 30 June 2016. https://mil.huanqiu.com/article/9CaKrnJWchS.

174 "China Ramps Up Rotations at Tibet's Gonggar Airfield," Bellingcat, 11 January 2016. https://www.bellingcat.com/news/rest-of-world/2016/01/11/china-bolstered-rotations-at-gonggar/

175 Andreas Rupprecht, *Modern Chinese Warplanes – Chinese Airforce – Aircraft and Units*, (Houston: Harpia Publishing, 2018), 158

176 Wang Xiaofang and Shi Zhibin, "Preliminary Analysis on the Path to Military-Civil Fusion Deep Development," 47-50.

177 "China's High-Speed Rail and Highway Mileage Ranks First in the World, its Transportation Infrastructure Improved Significantly in the Past 70 Years [高速铁路高速公路里程世界第一中国交通70年大幅跃升], *Xinhua*, 13 August 2019, http://www.xinhuanet.com/fortune/2019-08/13/c_1124871897.htm.

178 Hao Maojin [郝茂金], Yang Cun [杨存], "Air Force Third-Generation Jet Takes off and Lands on Highway for First Time" [空军首次在高速公路上起降三代战机], *China Youth Daily* [中国青年报], 30 May 2014, http://zqb.cyol.com/html/2014-05/30/nw.D110000zgqnb_20140530_2-10.htm.

179 Zeng Li, ed., *Research on the Military-Civil Fusion National Defense Resource Allocation and Management with Chinese Characteristics (Part 1)*, 69.

180 "'Yixinou' China-Europe Express Train from Yiwu to Madrid Brings More Opportunities" [从义乌到马德里的'义新欧'中欧班列架起开放新桥梁], *Xinhua*, 26 November 2018. http://www.xinhuanet.com/silkroad/2018-11/26/c_1210002724.htm.

181 "China - Waterways," Encyclopedia Britannica, accessed April 2020. https://www.britannica.com/place/China/Waterways

182 "Major Breakthrough! Civilian Ship Carries out Dry Cargo Replenishment At Sea for Surface Ships" [重大突破! 民船为水面舰艇实施干货补给], Navy News Public WeChat Account [海军新闻], posted on The Observer [观察者], 16 November 2019. https://www.guancha.cn/military-affairs/2019_11_16_525353.shtml; For an excellent study of this topic, see Conor Kennedy, "China Maritime Report No. 4 - Civil Transport in PLA Power Projection," China Maritime Studies Institute, December 2019. https://digital-commons.usnwc.edu/cgi/viewcontent.cgi?article=1003&context=cmsi-maritime-reports

183 "Assessing the Potential for Civil-Military Integration: Technologies, Processes, and Practices OTA-lSS-611," U.S. Congress, Office of Technology Assessment, [Washington, DC: U.S. Government Printing Office, September 1994].

184 Huang Yusen [黄毓森], Ji Jianqiang [纪建强], Guo Qin [郭勤], The Connotation and Realization Path of the Advanced Defense Science and Technology Industrial [中国特色先进国防科技工业体系内涵与实现路径], *Science & Technology Progress and Policy* [科技进步与对策], no. 15 (August 2019).

185 Tan Yungang [谭云刚], "The 'Fourteenth Five-Year Plan' for China's national economic and social development should fully reflect the 'Five Major Characteristics'."

186 "Roughly 3,000 Private Chinese Enterprises Have Entered the Front Line of Military Industrial Procurement [我国大约3000家民企已进入军工采购一线], *Xinhua*, 14 March 2018, http://m.xinhuanet.com/mil/2018-03/14/c_129829001.htm; Tan Yungang [谭云刚], "The 'Fourteenth Five-Year Plan' for China's national economic and social development should fully reflect the 'Five Major Characteristics'."

187 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 76

188 "Opinion Regarding the Promotion of National Defense Science and Technology Industry's Deep Development of Military-Civil Fusion" [国务院办公厅关于推动国防科技工业军民融合深度发展的意见], gov.cn, 4 December 2017. http://www.gov.cn/zhengce/content/2017-12/04/content_5244373.htm.

189 Ibid.

190 Li Zhiyi et al., "Research on Core Authors about Civil-Military Integration based on the Bibliometrics."

191 See: Technology Readiness Levels in the Department of Defense (DoD) (Source: DoD (2010), Defense Acquisition Guidebook) https://api.army.mil/e2/c/downloads/404585.pdf.

192 "Notice on the State Council's Releases of *Made in China 2025*" 国务院关于印发《中国制造2025》的通知], 19 May 2015, http://www.gov.cn/zhengce/content/2015-05/19/content_9784.htm.

193 "Beijing's 'Made in China 2025' Plan Isn't Dead, It's out of Control," South China Morning Post, 8 April 2019, https://www.scmp.com/week-asia/opinion/article/3004900/beijings-made-china-2025-plan-isnt-dead-its-out-control.

194 Zhang Kejian [张克俭], "Strive to launch New Era's Innovative Sci-tech Development of National Defence Industry" [奋力谱写新时代国防科技工业创新发展新篇章], *Bulletin of Chinese Academy of Sciences* [中国科学院院刊] 33, no.4 (2018): 396-400.

195 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 76

196 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 43

197 "2018 Investment Promotion Report on the Military-Civil Fusion Technology and Equipment Industry" [2018军民融合科技装备产业投资促进报告], November 2018, 28.

198 Information available upon request.

199 "MIIT: China is Import-Dependent on 130 Critical and Basic Materials" [工信部: 130多种关键基础材料中32%在中国仍空白], *The Paper*, July 17, 2018, http://finance.sina.com.cn/china/2018-07-17/doc-ihfkffam5060901.shtml.

200 Ibid.

201 Tan Yungang [谭云刚], "The "Fourteenth Five-Year Plan" for China's national economic and social development should fully reflect the 'Five Major Characteristics'."

202 "Xi Jinping Tells a Story: Core, Critical Technologies Cannot be Requested, Purchased, or Begged for" [习近平讲故事: '关键核心技术是要不来, 买不来, 讨不来的'], *People's Daily Online*, 6 June 2019, http://cpc.people.com.cn/n1/2019/0606/c64094-31123936.html.

203 The original text is "真正的核心关键技术是花钱买不来的, 靠进口武器装备是靠不住的, 走引进仿制的路子是走不远的"

204 "Recall Xi Jinping's speeches on S&T innovation since the 18th National Congress" [回顾十八大以来习近平关于科技创新的精彩话语], *People's Daily Online*, 31 May 2016, http://cpc.people.com.cn/xuexi/n1/2016/0531/c385476-28398570-3.html.

205 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 78-79

206 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 78-79

207 Tan Yungang [谭云刚], "The 'Fourteenth Five-Year Plan' for China's national economic and social development should fully reflect the 'Five Major Characteristics'."

208 Wu Weihai [吴维海], Sun Lu [孙鲁], "Military-Civil Fusion Development Strategy and Research Path" [军民融合发展战略及路径研究], *Journal of New Era* [新时代学刊], August 31, 2018, http://www.gjjcwh.com/H5/20181224%E6%96%B0%E6%97%B6%E4%BB%A3%E5%AD%A6%E5%88%8A201801033.html.

209 Chen Weiping [陈卫平], Huang Chao [黄超], Wang Zekui [王泽奎], "Strengthen Military-Civil Mutual Trust, Promote Deep Fusion" [强化军民互信, 推动深度融合], in *Military-Civil Fusion Deep Development Theory Part 1* [军民融合深度发展论(上册)], (Beijing: Military Sciences Press, 2016), 102-105.

210 Zeng Hao [曾昊], Lv Bin [吕彬], "On the Institutional Barriers Preventing Private Companies from Participating in Equipment Development" [民营企业参与装备建设制度障碍研究], in *Military-Civil Fusion Deep Development Theory Part 2* [军民融合深度发展论(下册)], (Beijing: Military Sciences Press, 2016), 244-248.

211 Tai Ming Cheung, ed. *Forging China's Military Might*, (Baltimore, Johns Hopkins University Press, 2014), 51.

212 Tai Ming Cheung, ed. *Forging China's Military Might*, 53.

213 Zeng Li, ed., *National Defense Resource Allocation and Management with Chinese Characteristics under Military-Civil Fusion (Part 1)*, 125.

214 "CSSC Chairman Lei Fanpei: Build a Globally Competitive 'CSSC Brand'" [中船集团董事长雷凡培: 打造具有全球竞争力的中船CSSC品牌] SASAC Report [国资报告], 21 November 2018. https://www.sohu.com/a/276846504_100082376.

215 Zeng Li, ed., *National Defense Resource Allocation and Management with Chinese Characteristics under Military-Civil Fusion (Part 1)*, 172.

216 Zeng Li, ed., *National Defense Resource Allocation and Management with Chinese Characteristics under Military-Civil Fusion (Part 1)*, 176.

217 Zeng Li, ed., *National Defense Resource Allocation and Management with Chinese Characteristics under Military-Civil Fusion (Part 1)*, 178.

218 "AVIC Completes Restructuring and Name Change" [中航工业改制更名完成], *Xinhua*, 5 January 2018, http://www.xinhuanet.com/energy/2018-01/05/c_1122213236.htm.

219 "The Three Departments Jointly Issue Guiding Opinion on Promoting Reform of Shareholding System for Military Industries" [三部门联合发布推进军工企业股份制改造指导意见], gov.cn, 23 June 2007. http://www.gov.cn/ztzl/2007-06/23/content_658955.htm.

220 "69 Central Enterprises Are Still Entirely Owned by the People? Before the End of the Year All Will Be Restructured as Companies!" [69户央企集团仍为全民所有制? 年底前全部改为公司制!], gov.cn, 26 July 2017. http://www.gov.cn/zhengce/2017-07/26/content_5213521.htm.

221 "Central Enterprises Embracing the Era of Corporations" [央企跑步进入公司制时代], *Economic Daily,* 28 July 2017. http://www.gov.cn/xinwen/2017-07/28/content_5213940.htm. July 28, 2017.

222 Yu Xiangming [于祥明], "The First Group of 41 Defense Research Institutes are to be Restructured, Beginning the Accelerated Implementation of Military-Civil Fusion" [首批41家军工科研院所转制启动军民融合加速实施], *People's Daily Online*, 10 July 2017, http://money.people.com.cn/stock/n1/2017/0710/c67815-29393131.html.

223 Wang Jiang [王绛], "Why the Restructuring of Defense Research Institutes is so Important" [军工院所转制为什么重要], *China Economic Weekly* [中国经济周刊], 4 June 2018, http://paper.people.com.cn/zgjjzk/html/2018-06/04/content_1860325.htm.

224 "Lower Than Expected? Restructuring of the First Group of 41 Defense Research Institutes in the First Half of the Year Was Difficult to Complete" [低于预期?首批41家军工科研院所改制上半年难完成], *Sina*, 24 February 2019, https://finance.sina.com.cn/stock/hyyj/2019-02-24/doc-ihrfqzka8787030.shtml.

225 Zhong Tingkuan [钟庭宽], Liu Hailin [刘海林], Zhuo Chuo [卓倬], "An Analysis of Market Barriers to Private Enterprises' to Participate in Research and Development of Weapon Equipment" [民营企业参与武器装备科研生产的市场壁垒分析], in *Military-Civil Fusion Deep Development Theory Part 2* [军民融合深度发展论(下册)], (Beijing: Military Sciences Press, 2016), 262-265.

226 "Prospects for the Development of Military-Civil Fusion in 2019" [2019年中国军民融合发展形势展望], CCID Think Tank [赛迪智库], 2019, 9.

227 "2018 Version of Weapons and Equipment Research and Production License Catalogue Issued" [2018年版武器装备科研生产许可目录发布], SASTIND, December 27, 2018. http://www.sastind.gov.cn/n64823/n284741/c6804960/content.html.

228 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 90

229 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 90

230 Bi Jingjing [毕京京] and Xiao Dongsong [肖冬松], eds., *Report on the Development of Military-Civil Fusion in China (2016)*, 12-13.

231 The full name of the fund is 《绵阳科技城军民融合成果转化基金设立方案》

232 "China Aerospace Academy of Systems Science & Engineering" [中国航天系统科学与工程研究院], CAASSE, accessed March 2020, https://www.caasse.com/index.asp?modelname=about_yjj_index

233 "Xue Huifeng: Let the Space Domain Act As the First Test of Military-Civil Fusion" [薛惠锋: 让太空领域军民融合先行先试" *China Radio International Online* [国际在线], 18 December 2017. http://cx.cri.cn/20171218/da3418dc-3acb-bcbe-b9e8-e0ebc6a1fa39.html.

234 Zeng Li, ed., *Research on the Military-Civil Fusion National Defense Resource Allocation and Management with Chinese Characteristics (Part 1)*, 206.

235 "MOST Press Conference for the *Science and Technology Military-Civil Fusion Development Plan for the 13th FYP*" [科技部《'十三五'科技军民融合发展专项规划》发布会], State Council Information Office, 24 August 2017, https://www.scio.gov.cn/xwfbh/gbwxwfbh/xwfbh/kjb/Document/1561810/1561810.htm.

236 Wang Xuecheng [王雪诚], "Military-Civil Fusion is the Only Path to Informatization," [军民融合是信息化建设的必由之路], *Xinhua*, 5 January 2018. http://www.xinhuanet.com/mil/2018-01/05/c_129783567.htm.

237 "*2006 Medium to 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)], gov.cn, 9 February 2006. http://www.gov.cn/jrzg/2006-02/09/content_183787_2.htm

238 "Outline of the National Strategy of Innovation-Driven Development Issued, Proposes that China Will Become a World S&T Innovation New Great Power by 2050" [《国家创新驱动发展战略纲要》印发提出2050年建成世界科技创新强国], gov.cn, 20 May 2016, http://www.gov.cn/xinwen/2016-05/20/content_5074905.htm.

239 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 82-83.

240 "Outline of the National Strategy of Innovation-Driven Development Issued, Proposes that China Will Become a World S&T Innovation New Great Power by 2050," Gov.cn, 20 May 2016.

241 "Recall Xi Jinping's speeches on S&T innovation since the 18th National Congress" [回顾十八大以来习近平关于科技创新的精彩话语【2】], *People's Daily Online*, 31 May 2016, http://cpc.people.com.cn/xuexi/n1/2016/0531/c385476-28398570-2.html.

242 "*2006 Medium to Long-term Plan for the Development of Science and Technology [2006-2020]*", Gov.cn, 9 February 2006; Tai Ming Cheung, "The Role of Foreign Technology Transfers in China's Defense Research, Development, and Acquisition Process," January 2014, SITC Policy Brief.

243 Zhu Huaxia [朱华夏], "The Secret Behind the Rise of Zhenhua Port Machinery Company" [振华港机崛起的奥秘], *People's Daily Online*, 7 November 2005, http://finance.people.com.cn/GB/8215/54920/54921/3834704.html.

244 Tai Ming Cheung, "The Role of Foreign Technology Transfers in China's Defense Research, Development, and Acquisition Process," SITC Policy Briefs 2014, no. No. 5 (2014), https://escholarship.org/uc/item/4dp213kd.

245 Ibid.

246 Tai Ming Cheung, "How China's Defense Innovation System Is Advancing the Country's Military Technological Rise," SITC Research Briefs Series 10, no. 2018–3 (May 30, 2018), https://escholarship.org/uc/item/7c75995r.

247 "Recall Xi Jinping's speeches on S&T innovation since the 18th National Congress" [回顾十八大以来习近平关于科技创新的精彩话语【3】], *People's Daily Online*, 31 May 2016, http://cpc.people.com.cn/xuexi/n1/2016/0531/c385476-28398570-3.html.

248 "MOST and other Departments Issue 'Strengthen 'from 0 to 1' Basic Research Work Plan" [科技部等部门印发《加强'从0到1'基础研究工作方案》], Cyberspace Administration of China, accessed April 2020. http://www.cac.gov.cn/2020-03/04/c_1584872637385792.htm.

249 Wang Yangzong [王扬宗], "A Perspective on Original Innovation from the National Award for Natural Sciences First Prize" [从国家自然科学奖一等奖透视原始创新], *Science Net* [科学网], 18 March 2020, http://news.sciencenet.cn/htmlnews/2020/3/437137.shtm.

250 "China is Overtaking the U.S. in Scientific Research," *Bloomberg.com*, 12 September 2018, https://www.bloomberg.com/opinion/articles/2018-09-12/chinese-researchers-are-outperforming-americans-in-science.

251 In early 2019, a research team with the Department of Management and Economics of Dalian University of Technology (DLUT) (大连理工大学管理与经济学部) analyzed China's R&D expenditures between 1995 and 2016 and released a report presenting its findings. See "DLUT's School of Economic Management releases 'China R&D Expenditure Report (2018)'" [我校经济管理学院发布《中国研发经费报告（2018）》], 7 March 2019, https://news.dlut.edu.cn/info/1003/54708.htm.

252 Liming Salvino, "China's Talent Recruitment Programs: The Road to a Nobel Prize and World Hegemony in Science?" *SITC Research Briefs* 2015, no. No. 2 (2015), https://escholarship.org/uc/item/30h2t8tr.

253 Ibid.

254 "Outline of the National Strategy of Innovation-Driven Development Issued, Proposes that China Will Become a World S&T Innovation New Great Power by 2050," Gov.cn, 20 May 2016.

255 "Zhou Qiren: Innovation should be highly concentrated, and have high frequency and have high density-interactions" [周其仁: 创新要有高浓度, 高频度, 高密度的互动], *Sohu*, 21 September 2017, https://www.sohu.com/a/168853685_330810.

256 "'Science and Technology Military-Civil Fusion Development Plan for the 13th FYP' Recently Issued" [《"十三五"科技军民融合发展专项规划》近日印发], *Xinhua*, 23 August 2017. http://www.xinhuanet.com/mil/2017-08/23/c_1121531750.htm

257 Ibid.

258 "MOST Press Conference for the *Science and Technology Military-Civil Fusion Development Plan for the 13th FYP*" [科技部《'十三五'科技军民融合发展专项规划》发布会], State Council Information Office, 24 August 2017.

259 "China Launches First Defense Technology Rapid Response Small Group; China's DIUx?" [我国首个国防科技创新快速响应小组启动, 中国的DIUx?], *Security Internal Reference* [安全内参], 16 March 2018, https://www.secrss.com/article/1467.

260 The National Military-Civil Fusion Public Service Platform [国家军民融合公共服务平台] can be found here http://jmjh.miit.gov.cn/.

261 "CMC S&T Committee Issues Grant Application Guidance for the Defense Technology Strategic Pilot Plan" [国防科技战略先导计划] "军委科技委发布国防科技战略先导计划项目申报指南], MIIT, 19 March 2020, http://jmjh.miit.gov.cn/tzgg/HZ8080816f4123090170f079e4e52979.shtml.

262 "An Introduction of the Megaprograms," accessed 6 August 2019, http://www.nmp.gov.cn/zxjs/; "State Council's Notice on the Release of the 13th Five Year National Science and Technology Innovation Plan" [国务院关于印发"十三五"国家科技创新规划的通知], gov.cn, 28 July 2016, http://www.gov.cn/zhengce/content/2016-08/08/content_5098072.htm.

263 Michael Raska, "China's [Secret] Civil-Military Megaprojects," RISI Commentaries, no.163, 2 September 2013, https://www.files.ethz.ch/isn/171687/RSIS1632013.pdf.

264 "Artificial Intelligence 2.0 added to China's 'S&T Innovation 2030 Megaprojects'" [中国"科技创新2030—重大项目"将新增"人工智能2.0"], *Chinanews*, 16 February 2017, http://www.most.gov.cn/ztzl/lhzt/lhzt2017/hkjlhzt2017/hkj_fbh02/201702/t20170228_131502.htm.

265 "Notice from MOST, NDRC, SASTIND, CMC EDD, CMC S&T Committee on the issuance of the Measure to Promote Resource Sharing between State Key Laboratories, National Defense Key Laboratories, Defense and Military Major Test Infrastructures" [科技部国家发展改革委国防科工局军委装备发展部军委科技委关于印发《促进国家重点实验室与国防科技重点实验室, 军工和军队重大试验设施与国家重大科技基础设施的资源共享管理办法》的通知], 22 June 2018, http://www.most.gov.cn/mostinfo/xinxifenlei/fgzc/gfxwj/gfxwj2018/201806/t20180627_140319.htm.

266 Bi Jingjing [毕京京] and Xiao Dongsong [肖冬松], eds., *Report on the Development of Military-Civil Fusion in China (2016)*, 4.

267 "Overall Plan for Systematically Promoting Comprehensive Innovation Reform Experiments in Some Regions" [关于在部分区域系统推进全面创新改革试验的总体方案], *Guangming Daily*, 8 September 2015. http://epaper.gmw.cn/gmrb/html/2015-09/08/nw.D110000gmrb_20150908_1-06.htm?div=-1.

268 Alex Joske, "The China Defence Universities Tracker," 25 November 2019, https://www.aspi.org.au/report/china-defence-universities-tracker; https://unitracker.aspi.org.au/

269 You Zheng [尤政], "Implement Military-Civil Fusion, Explore the Path to Innovative Development" [落实军民融合国策探索创新发展之路], in *Military-Civil Fusion Deep Development Theory Part 2* [军民融合深度发展论(下册)], (Beijing: Military Sciences Press, 2016), 341-345.

270 "Why New-Type Research Institutes Can Rise in Shenzhen" [新型科研机构为什么能在深圳崛起], *People's Daily Online*, 8 March 2015, http://scitech.people.com.cn/n/2015/0308/c1057-26655146.html.

271 "Brief Overview" [机构简介], Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences [中国科学院深圳先进技术研究院]," accessed 7 October 2019, http://www.siat.cas.cn/jgsz2016/jgjj2016/.

272 "Postdoctoral Fellow Recruitment Notice for Academician Wang Zhengping and Researcher Sun Rong, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences" [中科院深圳先进院汪正平院士/孙蓉研究员课题组招聘启事-博士后], 10 August 2017, http://www.siat.cas.cn/jgsz2016/jgdh2016/kybm2016/jcs2016/yjdy2016/xjclyjzx2016/xxfb13/201708/t20170810_4841054.html.

273 C. P. Wong, Georgia Tech, [accessed March 2020], http://www.mse.gatech.edu/people/c-p-wong

274 He Haiyan [何海燕], Improve the Civilian-resource Enabled Military Talent Cultivation System [健全军事人才依托培养体系], *People's Daily Online*, 26 March 2017, http://opinion.people.com.cn/n1/2017/0326/c1003-29169251.html.

275 Jun Xunxuan [钧训轩], "Improve the Triad New-Type Military Personnel Cultivation System" [着力健全三位一体新型军事人才培养体系], *PLA Daily*, July 29, 2018, http://www.81.cn/jfjbmap/content/2018-02/28/content_200585.htm.

276 "PLA to Gradually Form an Academic Institution System with Joint Operation Academic Institutions as the Core" [我军将逐步建立以联合作战院校为核心的院校格局], *People's Daily Online*, March 30, 2017, http://military.people.com.cn/n1/2017/0330/c1011-29180178.html.

277 Kenneth Allen, Mingzhi Chen, and Ringo Chan, "Overview of the People's Liberation Army's 37 Academic Institutions," China Aerospace Studies Institute, upcoming CASI report.

278 "List of Military Academic Institutions that Enroll High School Graduates in 2019" [2019年招收普通高中毕业生的军校名录], *China Military Online*, 13 June 2019, http://www.chinamil.com.cn/201311jxjjh/2019-06/13/content_9529514.htm.

279 Kenneth Allen, Mingzhi Chen, and Ringo Chan, "Overview of the People's Liberation Army's 37 Academic Institutions."

280 Sun Guizhen [孙桂珍], "Problems and Countermeasures in the Training of National Defense Students" [国防生培养中存在的问题及对策] in *Military-Civil Fusion Deep Development Theory Part 1* [军民融合深度发展论(上册)], (Beijing: Military Sciences Press, 2016), 380-382.

281 Dong Qiang [董强], "China Recruits College Graduates on a Large Scale for the First Time" [我国首次大规模征集高校应届生], *PLA Daily*, 29 June 2009, http://www.mod.gov.cn/service/2009-06/29/content_4086052.htm.

282 Ibid.

283 "Ministry of Education: Encourage College Graduates to Join the Military" [教育部: 鼓励毕业生参军入伍], *Xinhua*, 28 February 2020, http://www.xinhuanet.com/politics/2020-02/28/c_1125639172.htm.

284 Huang Xiangliang [黄相亮], "Looking Back on the National Defense Student Program: Reforms Began as Early as 2015" [回望国防生制度: 早在2015年制度就开始改革], China MOD, 1 June 2017, http://www.mod.gov.cn/education/2017-06/01/content_4781836_2.htm.

285 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 96

286 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 96

287 "Documenting the Two Sessions. Liu Guangbin: Cultivating PLARF's Backbone Officers and Future Leaders" [纪录两会 | 刘光斌: 培养战略导弹部队的骨干军官和未来领导者], 19 March 2018, http://military.cnr.cn/ycdj/20180319/t20180319_524170138.html.

288 "PLAN and Tsinghua University jointly held the 9th Ocean View Education Day" [海军与清华大学联合举办第九届海洋观教育日活动], 24 April 2015, https://www.tsinghua.edu.cn/publish/thunews/9650/2015/20150424160101260574082/20150424160101260574082_.html.

289 "Strategic Support Force Signs Talent Cultivation Strategic Agreement with Nine Local Entities" [战略支援部队与地方9单位签订人才培养战略合作框架协议], Xinhua, 12 July 2017, http://www.xinhuanet.com/mil/2017-07/12/c_129653088.htm; "PLAA and China Mobile Sign Strategic Cooperation Agreement for Military-Civil Fusion Development," *PLA Daily*, 12 December 2016; "PLA Air Force Signs Military-Civil Fusion Agreement with CAAC" [空军与民航签署军民融合协议], *Xinhua*, 31 December 2018, http://www.xinhuanet.com/mil/2018-12/31/c_1210027948.htm.

290 "CCP Central, State Council, CMC release *Opinion on the Integrated Development of Economic Construction and National Defense Construction*," *Xinhua*, 21 July 2016.

291 Du Renhuai [杜人淮], "Improve the Institutional Framework for the Cultivation of Military Talents under Military-Civil Fusion" [完善军民融合军事人才培养使用体系的制度安排], *Theoretical Studies on PLA Political Work* [军队政工理论研究] 18, no.1, (Feb 2017).

292 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 98

293 Ibid.

294 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 99-100

295 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 99-100; Kevin McCauley, "China's Logistic Support to Expeditionary Operations," Testimony before the U.S.-China Economic and Security Review Commission, 20 February 2020; https://www.uscc.gov/sites/default/files/McCauley_Written%20Testimony_0.pdf

296 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 100

297 Gu Jianyi [顾建一], "Thoughts on Promoting Military-Civil Fusion Deep Development in the Logistics Domain" [成体系推进后勤领域军民融合深度发展的思考], *Dual Use Technology and Products* [军民两用技术与产品] 415, (September 2019), 08-13.

298 "Socialized Support Paints a New Blueprint for Military Support: Reform Will Be Unwavering" [保障社会化绘出军队保障新蓝图: 改革将坚定不移], 24 November 2010, http://www.gov.cn/gzdt/2010-11/24/content_1752065.htm.

299 Ibid.

300 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 101

301 "CCP Central, State Council, CMC release *Opinion on the Integrated Development of Economic Construction and National Defense Construction*," *Xinhua*, 21 July 2016.

302 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 102

303 "CMC Issues Outline for the Comprehensive Development of Modern Logistics Approved by Hu Jintao" [经胡锦涛批准中央军委颁发全面建设现代后勤纲要], 24 December 2007, http://www.gov.cn/jrzg/2007-12/24/content_842409.htm.

304 Kevin McCauley, "Modernization of PLA Logistics: Joint Logistic Support Force," Testimony before the U.S.-China Economic and Security Review Commission, 15 February 2018. https://www.uscc.gov/sites/default/files/McCauley_Written%20Testimony.pdf

305 Wang Jun [王俊], "Experts Explain the Relationship Between the CMC Joint Logistics Support Force and the CMC Logistics Support Department" [专家详解军委联勤保障部队与军委后勤保障部是何种关系], *The Paper*, 27 November 2016, https://www.thepaper.cn/newsDetail_forward_1569162.

306 "Explainer: How Important is this Force just Created by the CMC?" [解读: 中央军委刚刚成立的这支部队有多重要?] *CCTV*, Baidu Snapshot.

307 "Xi Jinping: Concentrate on Key Domains to Develop of Military-Civil Fusion" [习近平: 向军民融合发展重点领域聚焦用力], *Xinhua*, 22 September 2017, http://m.xinhuanet.com/2017-09/22/c_1121709932.htm.

308 "Air Force Logistics Military-Civilian Fusion Strategic Cooperation Agreement Signing Conference Held in Beijing" [空军后勤物流军民融合战略合作协议签约会议在京召开], 81.cn, 25 October 2017, http://kj.81.cn/content/2017-10/25/content_7799399.htm.

309 Zhao Yiran [赵苡然], Liang Wei [袁伟], "Academy of Military Sciences Expert's View of Military-Civil Fusion Strategic Management," [军事科学院专家眼中的军民融合战略管理], 81.cn, 11 January 2019. http://www.81.cn/jmywyl/2019-01/11/content_9402071.htm.

310 "CMC Logistic Support Department and SASAC Signed Cooperative Agreement Advancing Military Infrastructure and Military-Civil Fusion Strategic Cooperation" [军委后勤保障部与国资委签署协议推进军事设施建设军民融合战略合作], 81.cn, 27 November 2017, http://www.81.cn/2018zt/2017-11/27/content_7992487.htm.

311 Sun Xingwei [孙兴维], Lang Zhanqiang [郎占强], "Opinion on Promoting Deep Development of Military Civil Fusion in Military Procurement During the '13th Five Year Plan' Released" [十三五'期间推进军队采购军民融合深度发展《意见》印发]," China Ministry of Defense, 8 December 2017, http://www.mod.gov.cn/regulatory/2017-12/08/content_4799373.htm.

312 Gu Jianyi [顾建一], "Thoughts on Promoting Military-Civil Fusion Deep Development in the Logistics Domain" [成体系推进后勤领域军民融合深度发展的思考], *Dual Use Technology and Products* [军民两用技术与产品] 415, (September 2019), 08-13.

313 "Chairman Xi's Mandate Inspires Us to Forge Ahead Courageously" [习主席的嘱托激励我们奋勇担当], *Xinhua*, 7 March 2019, http://www.xinhuanet.com/mil/2019-03/07/c_1210075279_3.htm.

314 Jin Zhuanglong [金壮龙], "Promote Military-Civil Fusion Deep Development in the New Era," 16 July 2018.

315 "National Defense Mobilization Committee" [国家国防动员委员会], National Defense Mobilization Online [中国国防动员网], 14 July 2017. http://www.gfdy.gov.cn/organization/2017-07/14/content_7676149.htm

316 Xi Zhigang [席志刚], "军改后的国防动员部- 中国日报网," November 25, 2016, https://cn.chinadaily.com.cn/2016jungai/2016-11/25/content_27481907.htm.

317 "Administrative Divisions of the PRC" [中华人民共和国行政区划], *Baidu Baike,* accessed March 2020, https://baike.baidu.com/item/%E4%B8%AD%E5%8D%8E%E4%BA%BA%E6%B0%91%E5%85%B1%E5%92%8C%E5%9B%BD%E8%A1%8C%E6%94%BF%E5%8C%BA%E5%88%92

318 "Three Questions about the Responsibilities of the National Defense Mobilization Committee: Who Are We, What Do We Do, and How Do We Do it" [国防动员委员会三问明责: 我是谁, 干什么, 怎么干]," *People's Daily Online*, 27 June 2018, http://military.people.com.cn/n1/2018/0627/c1011-30090329.html.

319 Cheng Rong [程荣], Jia Yong [贾勇], "NDRC Defense Mobilization Research Development Center Director: Defense Mobilization Work Stands at New Historical Starting Point [发改委国防动员研究发展中心主任: 国防动员工作站上新的历史起点], 81.cn, 22 March 2019, http://www.81.cn/gfsy/2019-03/22/content_9487494.htm.

320 Wang Yaping [王亚平], "Building a New Type National Defense Mobilization System With Chinese Characteristics" [构建中国特色的新型国防动员体系], China MOD, 18 October 2018, http://www.mod.gov.cn/jmsd/2018-10/18/content_4826977.htm.

321 Wang Yaping [王亚平], "Building a New Type National Defense Mobilization System With Chinese Characteristics" [构建中国特色的新型国防动员体系], China MOD, 18 October 2018.

322 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 105

323 Zhang Heyun [张和芸]. "Defense Mobilization System: Bring Together Full Strength of the People in Fight Against the Epidemic" [国防动员系统: 汇聚同心抗疫的全民力量], *PLA Daily*, 26 February 2020. http://www.xinhuanet.com/2020-02/26/c_1210490583.htm.

324 Tian Guosong [田国松], He Wutao [何武涛], "Hubei Provincial Military District Military-Civil Coordination Department: On the 'Anti-Epidemic Battlefields' This Dispatcher is No Ordinary Person" [湖北省军区军地协调部: 抗疫战场, 这个'调度员'不一般], China MOD, 18 March 2020, http://www.mod.gov.cn/mobilization/2020-03/18/content_4862122.htm.

325 "Cracking the Code to Defense Mobilization in the Fight Against the Epidemic" [探寻国防动员战"疫"密码], *China Defense News* [中国国防报], 8 April 2020. http://www.xinhuanet.com/mil/2020-04/08/c_1210548801.htm

326 See for example "The 'Hard Core' Power of Mass-Enabled Prevention and Control—A Account of the Hubei Military District's Mobilization of Militias in its Fight Against Covid-19" [群防群控的"硬核"力量——湖北省军区组织广大民兵抗击疫情纪实] *Hubei Daily* [湖北日报], 2 April 2020, http://cpc.people.com.cn/n1/2020/0402/c431601-31658973.html; "Hubei Public Security County People's Armed Forces Department and Militia Mobilize to Fight Against the Novel Coronavirus" [湖北公安县人武部动员民兵抗击新冠肺炎疫魔], *China Military Online*, 9 February 2020. http://www.chinamil.com.cn/hbll/2020-02/09/content_9737434.htm

327 "Deepen Reforms In the Midst of Struggle" [在斗争中全面深化改革], *Xinhua*, 15 February 2020. http://www.xinhuanet.com/2020-02/15/c_1125579601.htm

328 "Explaining the 18th Party Congress Part 5: 18th Party Congress Pays Particular Attention to Maritime, Space, and Cyberspace Domains" [十八大解读系列五, 十八大高度关注海洋, 太空和网络安全], accessed March 5, 2020, http://www.cecep.cn/g1320/s3950/t12304.aspx.

329 China's National Defense in the New Era [新时代的中国国防],State Council Information Office [国务院新闻办公室] 24 July 2019. http://www.xinhuanet.com/politics/2019-07/24/c_1124792450.htm.

330 "Xi Jinping Chairs First Plenary Meeting of the Central Commission for Military-Civil Fusion Development," 20 June 2017.

331 Original text: "综合来说, 海洋强国是指在管控海洋, 开发利用海洋, 保护海洋方面具有强大综合实力的国家," see "People's Daily: Push Forward Efforts to Build a Maritime Great Power and Make New Achievements" [人民日报:努力推动海洋强国建设取得新成就], 10 June 2014, http://www.mnr.gov.cn/zt/hd/hyr/sjhyrjqgxcr/sjhyrjqgxcr_xwzx/201808/t20180802_2158111.html.

332 "Wang Jian: Building a Maritime Great Power and the 21st Century Maritime Silk Road (3)" [王键: 建设海洋强国与21世纪海上丝绸之路 (3)], 71.cn, 17 May 2017, http://www.71.cn/2017/0517/948127_3.shtml.

333 "CCP Central, State Council, CMC release *Opinion on the Integrated Development of Economic Construction and National Defense Construction*," *Xinhua*, 21 July 2016.

334 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 122

335 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 119

336 Xu Hai [徐海], Liu Minghui [刘明辉], Shi Jian [石健], "Develop a Military-Civil Fusion Maritime Rights Protection System" [打造军民融合的海上维权体系], *Security Internal Reference* [安全内参], 22 October 2018, https://www.secrss.com/article/5841.

337 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 121

338 Mike Dahm, "Chinese "Ocean E-Stations" Deployed To the South China Sea," CSIS, 10 December 2018. https://amti.csis.org/chinese-ocean-e-stations-deployed-south-china-sea/

339 "China launches new system to defend islands and reefs in South China Sea," *China Military Online*, 1 April 2019. english.chinamil.com.cn/view/2019-04/01/content_9464939.htm

340 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 123

341 "Major Breakthrough! Civilian Ship Carries out Dry Cargo Replenishment At Sea for Surface Ships [重大突破! 民船为水面舰艇实施干货补给], *Navy News* Public WeChat Account [海军新闻微信公众], posted on *The Observer* [观察者], 16 November 2019, https://www.guancha.cn/military-affairs/2019_11_16_525353.shtml

342 "Opinion Regarding the Promotion of National Defense Science and Technology Industry's Deep Development of Military-Civil Fusion," gov.cn, 4 December 2017.

343 "Xi Jinping: Comprehensively Improve the Ability to Carry Out Launch and Test Missions and Make New Contributions to Building a Space Great Power," [习近平: 全面提高遂行发射和试验任务能力为建设航天强国再立新功], 25 June 2017, http://cpc.people.com.cn/n1/2017/0625/c64094-29360551.html; "Secure a Decisive Victory in Building a Moderately Prosperous Society in All Respects and Strive for the Great Success of Socialism with Chinese Characteristics for a New Era—Report Delivered at the 19th Party Congress" [习近平: 决胜全面建成小康社会夺取新时代中国特色社会主义伟大胜利———在中国共产党第十九次全国代表大会上的报告], *Xinhua*, 27 October 2017, http://www.xinhuanet.com//politics/19cpcnc/2017-10/27/c_1121867529.htm.

344 "CASC: Strive to Push China into the Ranks of World Space Powers by 2030" [中国航天科技集团: 将力争到2030年推动我国跻身世界航天强国行列], Gov.cn, June 26, 2019, http://www.gov.cn/xinwen/2019-06/26/content_5403596.htm.

345 Jin Zhuanglong [金壮龙], "Promote Military-Civil Fusion Deep Development in the New Era," 16 July 2018.

346 Ibid.

347 Fu Yifei [付毅飞], "Experts Explain the Roadmap for China to Become a Space Great Power" [专家详解我国航天强国建设路线图," *S&T Daily* [科技日报], 13 December 2019, https://tech.huanqiu.com/article/3wBLYOJsJw0.

348 "Opinion Regarding the Promotion of National Defense Science and Technology Industry's Deep Development of Military-Civil Fusion," gov.cn, 4 December 2017.

349 Fu Yifei [付毅飞], "'Space-Earth Integrated Information Network Project Announces First Major Results" ['天地一体化信息网络'项目首次发布重大成果," *Xinhua*, 24 April 2018, http://www.xinhuanet.com/tech/2018-04/24/c_1122729995.htm.

350 Yin Hao [尹浩], "Yin Hao: Military-Civil Fusion in Building a National Space Information Network," *Aisixiang* [爱思想], 25 September 2017.

351 Fu Yifei [付毅飞], "'Space-Earth Integrated Information Network Project Announces First Major Results" *Xinhua*, 24 April 2018, http://www.xinhuanet.com/tech/2018-04/24/c_1122729995.htm.

352 Yin Hao [尹浩], "Yin Hao: Military-Civil Fusion in Building a National Space Information Network" [尹浩: 军民融合建设国家空间信息网络], *Aisixiang* [爱思想], 25 September 2017, http://m.aisixiang.com/data/106156.html.

353 Ibid.

354 Ibid.

355 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 128.

356 "China's Beidou System now has 39 satellites in Orbit, will be completed next year" [我国北斗系统在轨卫星已达39颗明年全面完成建设], *Guangming Daily* [光明日报], 12 September 2019, http://www.xinhuanet.com/politics/2019-09/12/c_1124988764.htm

357 Wang Yaqing [汪亚青], "Analysis of the Transformation of the Commercial Development Model of the Beidou Navigation System" [北斗导航系统转变经济发展方式路径分析], in *Military-Civil Fusion Deep Development Theory Part 2* [军民融合深度发展论(下册)], (Beijing: Military Sciences Press, 2016), 192-193.

358 "The Logic and Key Points of Xi Jinping's Thought on Great Cyber Power Strategy" [习近平网络强国战略思想的逻辑与要点], 2 August 2018, http://www.cac.gov.cn/2018-08/02/c_1123212094.htm

359 "Xi Jinping's Six Demands to 'Accelerate' Construction of a Cyber Great Power" [习近平六个'加快'要求提升网络强国建设加速度], *People's Daily Online*, 11 October 2016, http://cpc.people.com.cn/xuexi/n1/2016/1011/c385477-28767910.html.

360 "Xi Jinping Attended National Conference on Cybersecurity and Informationization Work and Delivered an Important Speech" [习近平出席全国网络安全和信息化工作会议并发表重要讲话], *Xinhua*, 21 April 2018, http://www.gov.cn/xinwen/2018-04/21/content_5284783.htm.

361 "National Security Law of the PRC" [中华人民共和国国家安全法 (主席令第二十九号)], Gov.cn, 7 April 2017, http://www.gov.cn/zhengce/2015-07/01/content_2893902.htm.

362 "Excerpts from Xi Jinping's Brilliant Discussion of the Cyber Great Power Strategy Since the 18th Party Congress" [十八大以来习近平关于网络强国战略的精彩论述摘编], *People's Daily Online*, 21 April 2018, http://cpc.people.com.cn/xuexi/n1/2018/0421/c385474-29941405.html.

363 Jin Zhuanglong [金壮龙], "Promote Military-Civil Fusion Deep Development in the New Era," 16 July 2018.

364 Yu Chuanxin [于川信], Liu Zhiwei [刘志伟], "Accelerate and Promote Military-Civil Fusion Development in Cybersecurity and Informatization" [加快推动网络安全和信息化军民融合深度发展], *China Military Online*, April 13, 2015, http://www.81.cn/jmywyl/2015-04/13/content_6439373.htm.

365 "Key Point! This advances the in-depth development of Military-Civil Fusion in the Cyberspace Domain" [重点来了! 这样推进网信领域军民融合深度发展], *China Military Online*, 15 December 2016, http://www.81.cn/jwgz/2016-12/15/content_7408174_2.htm.

366 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 114

367 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 114

368 Nathan Beauchamp-Mustafaga Michael S. Chase, "Borrowing a Boat Out to Sea: The Chinese Military's Use of Social Media for Influence Operations," SAIS Foreign Policy Institute, 2019. https://ac594fe2-a8ef-4a25-a40c-8acd006ea1a4.filesusr.com/ugd/b976eb_ad85a42f248a48c7b0cb2906f6398e71.pdf

369 Zeng Li, ed., *National Defense Resource Allocation and Management with Chinese Characteristics under Military-Civil Fusion (Part 1)*, 35.

370 Wang Xuecheng [王雪诚], "Military-Civil Fusion is the Only Path to Informatization," *Xinhua*, 5 January 2018.

371 "PLAA and China Mobile Sign Strategic Cooperation Agreement for Military-Civil Fusion Development" [陆军与中国移动签署军民融合发展战略合作协议], *PLA Daily*, 12 December 2016, http://www.81.cn/jfjbmap/content/2016-12/12/content_163944.htm

372 "The next Biotech Superpower." Nature Biotechnology 37, no. 11 (November 2019): 1243–1243. https://doi.org/10.1038/s41587-019-0316-7; Will Ballard. "Chinese Biotech: From Copycat to Innovator," October 10, 2019. https://www.ft.com/content/03812ddf-84a3-4540-9850-9a33cfe637d0.

373 Sun Yanrong [孙燕荣], Wang Ying [王莹], "Grasp the Strategic Opportunity for Biotechnology Development" [把握生物技术发展的战略机遇], *Study Times* [学习时报], 24 October 2018. http://www.qstheory.cn/zhuanqu/bkjx/2018-10/24/c_1123606801.htm

374 Xiao Tianliang [肖天亮], ed., *Science of Military Strategy (2017 Revision)* [战略学(2017 年修订)], (Beijing: National Defense University Press, 2015), 165.

375 Xiao Tianliang [肖天亮], ed., *Science of Military Strategy (2017 Revision)*, 171.

376 "Outline of the People's Republic of China's Economic and Social Development 13th Five Year Plan" *Xinhua*, 17 March 2016.

377 "'13th Five Year Plan' National Strategic Emerging Industries Development Plan" [十三五' 国家战略性新兴产业发展规划], Ministry of Science and Technology, 29 November 2016. http://www.sastind.gov.cn/n174/n52514/c6794736/attr/6862863.pdf

378 " '13th Five Year Plan' Biotechnology Innovation Plan, 13th Five Year Plan' Biotech Innovation Special Plan" [十三五"生物技术创新专项规划, '十三五'生物技术创新专项规划], Ministry of Science and Technology, 10 May 2017. http://www.most.gov.cn/tztg/201705/W020170510451953592712.pdf

379 Jin Zhuanglong [金壮龙], "Promote Military-Civil Fusion Deep Development in the New Era," 16 July 2018.

380 "Xi Jinping on the Holistic National Security Concept: Integrate Biosecurity into the National Security System of Systems" [习近平谈总体国家安全: 把生物安全纳入国家安全体系], *People's Daily Online*, 14 April 2020. http://cpc.people.com.cn/n1/2020/0414/c164113-31673157.html

381 "China's non-fossil energy consumption will account for about 15% of primary energy consumption by 2020" [到2020年我国非化石能源消费占一次能源消费比重达15%左右], *China Economy Daily* [经济日报], 8 November 2016. http://www.ce.cn/xwzx/gnsz/gdxw/201611/08/t20161108_17601767.shtml

382 "Renewable energy development should focus on quality improvement" [再生能源发展应注重质量提升], *China Electric Power News* [中国电力新闻], 30 May 2019. http://www.cec.org.cn/xinwenpingxi/2019-05-30/191464.html

383 "Glowing year for the solar power sector," *China Daily*, 12 February 2019. http://www.chinadaily.com.cn/a/201902/12/WS5c620fd4a3106c65c34e8cc8.html

384 "China makes great strides in clean energy generation," *People's Daily Online*, 4 March 2020. http://en.people.cn/n3/2020/0304/c90000-9664498.html

385 "Outline of the People's Republic of China's Economic and Social Development 13th Five Year Plan" [中华人民共和国国民经济和社会发展第十三个五年规划纲要], *Xinhua*, 17 March 2016. http://www.gov.cn/xinwen/2016-03/17/content_5054992.htm

386 "The Military's First Military-Civil Fusion-Derived Renewable Local Grid Completed" [全军首个军民融合可再生能源局域网建成发电]," *PLA Daily*, 11 January 2019. http://www.mod.gov.cn/mobilization/2019-01/11/content_4834337.htm; Wilson VornDick, "Renewable Energy and the PLA's Next Generation of Self-Sufficiency (Part 2)," *China Brief*, 14 March 2017. https://jamestown.org/program/renewable-energy-plas-next-generation-self-sufficiency-part-2/

387 "China's First Military-Civilian Fusion-derived Nuclear Safety-class DCS Platform Released" [我国首套军民融合核安全级DCS平台发布], 81.cn, 7 December 2018. http://www.81.cn/jkhc/2018-12/07/content_9371400.htm

388 For more on this topic see Elsa Kania's testimony before the U.S.-China Economic and Security Review Commission Hearing on Trade, Technology, and Military-Civil Fusion. "Chinese Military Innovation in Artificial Intelligence," USCC, 7 June 2019. https://s3.amazonaws.com/files.cnas.org/documents/June-7-Hearing_Panel-1_Elsa-Kania_Chinese-Military-Innovation-in-Artificial-Intelligence.pdf?mtime=20190617115242

389 "The Dual Variations of Military-Civil Fusion and Artificial Intelligence: Observing a New Field from a National Strategic Perspective (Part 1)" [军民融合与人工智能的双重变奏——以国家战略视野观察一个新兴领域(上)], *PLA Daily*, 15 September 2018. http://www.81.cn/jfjbmap/content/2018-09/15/content_215934.htm

390 "*AI Development Plan for a New Era*" [新一代人工智能发展规划的通知国发(2017)35号], State Council, 8 July 2017. http://www.gov.cn/zhengce/content/2017-07/20/content_5211996.htm

391 Jin Zhuanglong [金壮龙], "Promote Military-Civil Fusion Deep Development in the New Era," 16 July 2018.

392 The Dual Variations of Military-Civil Fusion and Artificial Intelligence: Observing a New Field From a National Strategic Perspective (Part 1)," *PLA Daily*, 15 September 2018.

393 Jeffrey Ding, "Hearing on Technology, Trade, and Military-Civil Fusion: China's Pursuit Of Artificial Intelligence, New Materials, And New Energy," U.S.-China Economic And Security Review Commission, 7 June, 2019. https://www.uscc.gov/sites/default/files/2019-10/June%207,%202019%20Hearing%20Transcript.pdf. p. 16.

394 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 131.

395 "CCP Central, State Council, CMC release *Opinion on the Integrated Development of Economic Construction and National Defense Construction*," *Xinhua*, 21 July 2016.

396 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 132.

397 "Building the Belt and Road Initiative: Progress, Contributions and Prospects" [共建'一带一路'倡议: 进展, 贡献与展望], *Xinhua*, 22 April 2019, http://www.xinhuanet.com/2019-04/22/c_1124400071.htm.

398 Wade Shepard, "How China Is Losing Support for its Belt and Road Initiative," *Forbes*, 28 February 2020, https://www.forbes.com/sites/wadeshepard/2020/02/28/how-beijing-is-losing-support-for-its-belt-and-road-initiative/.

399 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 134

400 Ibid.

401 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 135

402 China's National Defense in the New Era, 24 July 2019.

403 Xu Qi [徐起], "Adapt to the Expansion of Maritime Interests and Deepen Maritime Military-Civil Fusion" [适应海上利益拓展深化海上军民融合建设] in *Military-Civil Fusion Deep Development Theory* Part 2 [军民融合深度发展论(下册)], (Beijing: Military Sciences Press, 2016), 135-139.

404 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 133

405 Jiang et al., *Initial Discussion on the Military-Civil Fusion Strategy*, 135

406 "China to Deepen Military Cooperation with Caribbean Countries, Pacific Island Countries: Defense Minister - Xinhua," 8 July 2019, http://www.xinhuanet.com/english/2019-07/08/c_138209338.htm.

407 Maria Abi-Habib, "China's 'Belt and Road' Plan in Pakistan Takes a Military Turn," *The New York Times*, December 19, 2018, sec. World, https://www.nytimes.com/2018/12/19/world/asia/pakistan-china-belt-road-military.html.

408 Brian Lafferty, "Civil-Military Integrations and PLA Reforms," 638

409 Zhao Yiran [赵苡然], Liang Wei [袁伟], "Academy of Military Sciences Expert's View of Military-Civil Fusion Strategic Management," 11 January 2019.

410 Layton, "China Expert Applauds Trump's Hard Line on China. Says Congress, CEOs, And Media Need To Do More."

411 Majumdar, "Dirty Little Secret." Laskai, "Civil-Military Fusion and the PLA's Pursuit of Dominance in Emerging Technologies." Lafferty, "Civil-Military Integrations and PLA Reforms."

412 Kania, "In Military-Civil Fusion, China Is Learning Lessons from the United States and Starting to Innovate."

413 Kania, "In Military-Civil Fusion, China Is Learning Lessons from the United States and Starting to Innovate." "China Vows to Use Market Forces to Boost Defense Capabilities."

414 Kania, "In Military-Civil Fusion, China Is Learning Lessons from the United States and Starting to Innovate." de La Bruyere and Picarsic, "Military-Civil Fusion: Crafting a Strategic Response."

415 Levesque, "Military-Civil Fusion: Beijing's 'Guns AND Butter' Strategy to Become a Technological Superpower." Fickling, "Xi's Leading China Toward Stagnation."

416 Hille and Waters, "Washington Unnerved by China's 'Military-Civil Fusion.'" Somerville, "China Has 'Concerning' Leads Over U.S. in Tech, Defense Department Official Says." "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." Warner, "Senator Warner Letter to Secretary Mnuchin on Foreign Investment Risk Review Modernization Act," November 14, 2018.

417 Kania, "Technological Entanglement: Cooperation, Competition and the Dual-Use Dilemma in Artificial Intelligence." Kania, "The Dual-Use Dilemma in China's New AI Plan: Leveraging Foreign Innovation Resources and Military-Civil Fusion." Upchurch, "How China Could Beat the West in the Deadly Race for AI Weapons."

418 Su, "The Question of 'patriotism' in U.S.-China Tech Collaboration."

419 Tadjdeh, "Dunford Slams Tech Companies That Work with China over Pentagon." Waddell, "The Devil's Bargain for AI Companies Working in China."

420 Upchurch, "How China Could Beat the West in the Deadly Race for AI Weapons."

421 Ismail and Hughes, "Japan in a New Northeast Asian Security Environment."

422 Ray, "India Must Take the Lead in the AI Norms Race."

423 Somerville, "China Has 'Concerning' Leads Over U.S. in Tech, Defense Department Official Says."

424 Weisberger, "Pentagon To Explore Potential of 5G — and Its Made-in-China Hazards."

425 "Huawei CVs Show Close Links with Military – Study."

426 Ford, Huawei and its Siblings, the Chinese Tech Giants: National Security and Foreign Policy Implications.

427 Kania, "The AI Titans' Security Dilemmas." Dotson, "Military-Civil Fusion and Electromagnetic Spectrum Management in the PLA." Johnson, "China and the U.S. Are Racing to Develop AI Weapons."

428 Kania, China's Threat to American Government and Private Sector Research and Innovation Leadership.

429 Kania, "Swarms at War: Chinese Advances in Swarm Intelligence." Irvine, "The Chinese Swarming Programme."

430 Kania, "New Frontiers of Chinese Defense Innovation." Kania, "Is China Seeking "Quantum Surprise?"

431 Kania and VornDick, "China's Military Biotech Frontier: CRISPR, Military-Civil Fusion, and the New Revolution in Military Affairs."

432 Kania and VornDick, "Weaponizing Biotech."

433 Wortzel, "The Limitations of Military-Civil Mobilization: Problems with Funding and Clashing Interests in Industry-Based PLA Reserve Units."

434 Kania, China's Threat to American Government and Private Sector Research and Innovation Leadership.

435 Kania, "Battlefield Singularity: Artificial Intelligence, Military Revolution, and China's Future Military Power." Kania, Technology, Trade, and Military-Civil Fusion: China's Pursuit of Artificial Intelligence, New Materials, and New Energy.

436 Levesque, "Military-Civil Fusion: Beijing's 'Guns AND Butter' Strategy to Become a Technological Superpower."

437 Layton, "China Expert Applauds Trump's Hard Line on China. Says Congress, CEOs, And Media Need To Do More."

438 Cheng, "For Science, or the 'Motherland'?"

439 Chang, "U.S. Must Put a Ban on Google Helping China Develop a Global Digital Dictatorship."

440 Flournoy and Hochman, "U.S. Tech Companies Should Embrace Export Controls to China - Bloomberg."

441 Kania, Technology, Trade, and Military-Civil Fusion: China's Pursuit of Artificial Intelligence, New Materials, and New Energy. Kania, "Battlefield Singularity: Artificial Intelligence, Military Revolution, and China's Future Military Power."

442 Ignatius, "Opinion | How Xi Overplayed His Hand with America."

443 Kania, "China's AI Giants Can't Say No to the Party." Linn, "Race to Develop Artificial Intelligence Is One between Chinese Authoritarianism and U.S. Democracy."

444 Kania, Technology, Trade, and Military-Civil Fusion: China's Pursuit of Artificial Intelligence, New Materials, and New Energy.