Testimony before the U.S.-China Economic and Security Review Commission Hearing on What Keeps Xi Up at Night: Beijing's Internal and External Challenges

February 7, 2019

Greg Levesque

Managing Director, Pointe Bello

Beijing Crafting a 21st Century Industrial Policy

The Peoples Republic of China (PRC) is implementing an ambitious strategy to rapidly enhance its innovation capabilities to close the scientific and technological innovation gap with more advanced economies such as the United States. A number of internal and external factors are motivating this effort, but at a macro-level, PRC leaders assess that the world has entered a fast-moving technological revolution characterized by "informatization and intelligentization" [智能化·] with implications for global economic and military affairs. Simultaneously, and arguably coincidentally, the 2008 Financial Crisis created further strategic opportunities[1] for China to expand its influence amid anticipated shifts in the global balance of power. The convergence of this "technological moment" and "strategic moment" are resulting in rapid changes to PRC industrial, innovation, and military modernization policies and capture the underpinnings of Chinese competitive strategy.

General Secretary Xi outlined this perspective in a 2013 speech to the Politburo, stating:

> "*At present, from a global perspective, science and technology are increasingly becoming the main force driving economic and social development, and innovation is the general trend…Since the outbreak of the international financial crisis, major countries in the world have made great efforts to formulate new science and technology development strategies to seize the commanding heights of science and technology and industry. This trend deserves our high attention.*"[2]

PRC industrial policy emphasizing development of "core technologies" [核心技术][3] appear strongly influenced by internal assessments of the 2008 Financial Crisis, leading to shifts in policy across economic, diplomatic, and military domains. A comparative analysis of the global crises of the 1930s and post-2008 by a team of Chinese technocrats from NDRC headed by Vice Premier Liu He, a leading architect of the Xi administration's economic strategy, offers direct insight into Chinese strategic thinking and a framework for contextualizing policies such as "Made in China 2025" and Military-Civil Fusion.

---

[1] Communist Party of China doctrine since Deng Xiaoping also refer to the opening of economic and diplomatic relations with the United States in the 1970s as a historical opportunity.

[2] Xi Jinping's Speech at the 18th Central Political Bureau's Ninth Collective Study Session, September 30, 2013

[3] Also referred to by PRC government and tech sector documents "key core technologies," advanced technologies," "emerging technologies" or "disruptive technologies." For additional insight on official PRC perspectives on "core technologies" see, "Core Technologies Can't be Bought or Bargained for! Xi Jinping's Enlightening Remarks at the Academy of Sciences Meeting" [核心技术买不来讨不来!习近平院士大会这些金句振聋发聩], People's Daily website, May 28, 2018, accessed January 28, 2019 at http://app.peopleapp.com/Api/600/DetailApi/shareArticle?type=0&article_id=1778522

- Liu's team concluded that redistribution of relative power, not just wealth, of all nations follows global crises and that the 2008 Financial Crisis created a strategic window of opportunity for China to become a global superpower. The redistribution of power is directly associated with the scientific and technological capabilities of a country and, according to the study, this, combined with economic scale, led to the emergence of the United States as the dominant global power after 1945.[4]

- Given these factors, Liu recommends China adopt a similar approach—leverage its economic competitiveness to enhance its scientific and technological capabilities and begin shaping global institutions in China's interests.[5] While the final objective is left unsaid, Liu recommends China "make long-term preparations for structural changes resulting from a crisis."[6]

- Prior to 2008, PRC economic strategy emphasized overseas market expansion ("going-out") and attracting foreign investment to build China into a global manufacturing base. The study found that the crisis "changed the implications of our [China's] strategic opportunities" opening avenues to become a consumption driven economy, acquire technologies of developed countries, and invest in infrastructure while focusing on opportunities where Chinese and global interests align.[7]

21st Century Industrial Policy Enshrined as "Innovation Driven Development Strategy"

Responding to both the technological moment and strategic moment, Beijing has introduced an industrial policy focused on mastering core technologies and constructing requisite policies, incentives, and mechanisms to develop "original source innovation" [8] ecosystems that serve economic, social, and military development priorities. This policy is enshrined in Beijing's Innovation Driven Development Strategy (IDDS; [创新驱动发展战略]), mentioned in Communist Party of China (CPC) leader speeches at least as early as 2013. IDDS offers a long-term strategy for advancing China's stated objective of becoming a "science and technology innovation power" [科技创新强国] by 2050.[9] IDDS integrates what

[4] Liu He, "A Comparative Study of Two Global Crises" [两次全球大危机的比较研究], Frontiers of Economics in China, Higher Education Press, 2015, vol. 10(3), pages 396-413. See also, Liu He, "Overcoming the Great Recession: Lessons from China," Belfer Center, Harvard Kennedy School website, July 2014, accessed January 28, 2019 at https://www.belfercenter.org/sites/default/files/legacy/files/Comparative%20Crises%20final-web.pdf

[5] Ibid.

[6] Ibid. Liu highlights two low probability scenarios China should especially guard against: 1) huge external shocks from a deteriorating crisis and 2) wars waged by some countries to shift crisis-related disaster.

[7] Ibid.

[8] "Original source innovation" is the official PRC translation and hence English euphemism for a Chinse vernacular term which is more accurately translated as "China-origin innovation". However, the term speaks to the importance of introducing, digesting, assimilating, and re-innovating discoveries and inventions, a long-standing PRC government practice. It is not accurate to think of foreign knowhow-assisted innovation as separate from PRC use of the term "indigenous innovation" or "original source innovation". See "Li Zhimin: Independent Innovation is Mainly Integrated Innovation and Digestion and Re-Innovation" [李志民：自主创新主要是集成创新和消化吸收再创新], February 26, 2018, China Education and Research Network, observed January 17, 2019 at: http://www.edu.cn/rd/special_topic/zbwjt/201802/t20180226_1586652.shtml

[9] "Central Committee of the Communist Party of China and the State Council Release the Outline of the Innovation-Driven Development Strategy" [中共中央 国务院印发(国家创新驱动发展战略纲要)], May 19, 2016, Xinhua News Agency, accessed January 24, 2019 at http://www.xinhuanet.com/ politics/2016-05/19/c_1118898033.htm

had been vague "indicative planning" industry development programs initiated around 2006 with the release of the Medium-to-Long Term Plan for Science and Technology, which introduced the term "indigenous innovation," into a unified plan to elevate the development of core technology sectors to a national strategy. In this way, IDDS integrates disparate technology industry and military modernization plans to include Strategic Emerging Industries, Made in China 2025,[10] the Internet Plus Plan, Military-Civil Fusion, and the Artificial Intelligence Plan, among others.

- General Secretary Xi outlined the strategic nature of IDDS in a 2015 speech to the Central Committee of the CPC calling for elevating "scientific and technological innovations in important areas" to a "more prominent position" to support China's pioneering major key core technologies in the field of strategic competition. [11]

- IDDS calls for placing innovation at the core of "overall development of the manufacturing industry, improvement of the institutional environment conducive to innovation, promotion of cross-disciplinary and cross-industry collaborative innovation, breakthroughs in a number of core technologies in key areas, [and] promotion of the digitalization of manufacturing…"[12]

- Broadly speaking, IDDS aims to clarify the main focus of innovation and development in China to form competitive advantages, deepen reforms to build an institutional environment conducive to innovation, strengthen incentives to attract top talent, and expand the country's opening to maximize the use of global innovation resources and position China to become a leader formulating international rules.[13]

- Compared to previous state planning, IDDS promotes a more nuanced "market led, government guided" [市场主导, 政府引导][14] approach to innovation development that is objective driven and inherently opportunistic. In this sense, the government identifies the priorities (e.g. technology) while allowing for experimentation at the operational level. In practice, it is a "by any means necessary" approach to S&T development. For example, if a foreign acquisition

[10] Note that IDDS is the foremost guiding policy listed in the Made in China 2025 plan. See "Notice of the State Council on Printing and Distributing 'Made in China 2025'" [国务院关于印发《中国制造 2025》的通知 国发〔2015〕28 号], May 2015, State Council of the People's Republic of China [国务院], accessed October 12, 2018 at http://www.gov.cn/zhengce/content/2015-05/19/content_9784.htm

[11] "Proposal of the Central Committee of the Communist Party of China on Formulating the Thirteenth Five-Year Plan for National Economic and Social Development," October 26, 2015

[12] "Central Committee of the Communist Party of China and the State Council Release the Outline of the Innovation-Driven Development Strategy" [中共中央 国务院印发(国家创新驱动发展战略纲要)], Xinhua News Agency, May 19, 2016, accessed January 24, 2019 at http://www.xinhuanet.com/ politics/2016-05/19/c_1118898033.htm

[13] Ibid

[14] This terminology is found across PRC policy and statements surrounding innovation. Examples include "Made in China 2025" and even descriptions of the National Integrated Circuit Industry Fund by the Ministry of Finance. See "Notice of the State Council on Printing and Distributing 'Made in China 2025'"; and Ministry of Finance, Economic Construction Division, "The operation and investments of the National Integrated Circuit Industry Fund are running smoothly" [国家集成电路产业投资基金投资运营顺利], Ministry of Finance website, September 11, 2015, accessed January 29, 2019 at http://jjs.mof.gov.cn/zhengwuxinxi/gongzuodongtai/201508/t20150828_1438798.html

proves unsuccessful, the approach could instead shift to (or be combined with) poaching talent or undermining the competition.

PRC leaders judge that achieving the ability to independently innovate in science and technology is critical to "core national power" [国家力量的核心] and the realization of the "great rejuvenation of the Chinese nation [中华民族伟大复兴], and thus a national security imperative."[15] Moreover, Beijing hopes that by positioning China to ride this latest technological revolution it can generate new drivers of economic development, as traditional drivers are weakening.[16]

- In a 2013 speech, General Secretary Xi attributed gaps in PRC technological capabilities as "the root cause of backwardness" adding that "due to backward technology and low industrialization levels, China has been repeatedly defeated by countries with much smaller economies in recent years."[17]

- More recently, General Secretary Xi, in July 2018, described "key core technologies" as "a national heavy weapon, which is of critical significance to promoting the high-quality development of China's economy and safeguarding national security. It is necessary to effectively improve China's key core technological capabilities and firmly grasp the initiative of science and technology development in our own hands and provide strong technical support for China's development."[18]

As a blueprint for building a national innovation system [国家创新体系], IDDS policies turbocharge foreign technology acquisition programs, introduce new tools for supporting innovation and more effectively channeling state, non-state, and foreign capital into priority emerging technology sectors to wrest dominance from foreign innovation leaders. In a relatively short period of time, an increasingly sophisticated innovation infrastructure is taking shape in the PRC under IDDS.

- New state financing mechanisms, specifically Government Guidance Investment Funds (GGIFs;[政府引导投资基金]), have grown rapidly in recent years—as of Q2 2018, the value of GGIFs totaled 10.3 trillion RMB ($1.5 trillion).[19]

[15] Ibid. (Original text: 国家力量的核心支撑是科技创新能力. 实现中华民族伟大复兴的中国梦，必须真正用好科学技术这个最高意义上的革命力量和有力杠杆)

[16] Ibid.

[17] Xi Jinping's Speech at the Joint Meeting of the Association for Science and Technology of the 12th Session of the National Committee of the Chinese People's Political Consultative Conference, March 4, 2013

[18] The PRC's official news agency Xinhua, "Xi Jinping: Improving innovation capability in key core technologies to provide strong technical support for China's development [习近平：提高关键核心技术创新能力 为我国发展提供有力科技保障]," Xinhua News website, July 13, 2018, accessed January 17, 2019 at http://www.xinhuanet.com/politics/2018-07/13/c_1123123961.htm

[19] Data collected from Zero2IPO. Total value is reflective of the total fundraising scope of each GGIF, not actual capital flows. Also, see "China Government Fund Ranking," China Money Network, (undated, 2018), accessed January 28, 2019 at https://www. chinamoneynetwork.com/china-government-fund-ranking

- The PRC Ministry of Finance leads the GGIF program, issuing policy guidance on their formation and providing capital for central-level GGIFs.[20] GGIFs aim to more effectively channel state, non-state, and foreign capital and subsidize investment in priority sectors by providing interest free capital, matching funds, "signaling" to attract other investors following direct investments by GGIFs, and explicit and implicit guarantees for investors.

- GGIF investment strategies align with national industrial policy priorities, notably "high-tech" sectors and "new growth drivers."[21] The vast majority of GGIFs are controlled at the local level—1,335 local GGIFs have been announced with an average value of 10 billion RMB ($1.45 billion).

State-Industry Innovation Alliances (SIIAs, referred to in PRC media as industrial innovation alliances; 产业创新联盟]) are emerging platforms for PRC government agencies, scientific research institutes, military industrial groups, academia, and non-state-owned enterprises, as well as foreign companies in some cases, to coordinate and collaborate to implement government technology and industry development priorities.

- SIIAs serve as a bridge between the PRC government, companies, and the market to catalyze implementation of industrial development plans (e.g. Internet Plus, AI) and national policies such as military-civil fusion.

- For example, the Commercial Small Satellite Industry Innovation Alliance ["Smallsat Alliance"; 国商业小卫星产业创新联盟], established in July 2018, organizes and guides member activities to promote investment cooperation and development in the commercial aerospace industry.[22]

- The Smallsat Alliance has more than 100 members.[23] It prioritizes projects in regions under "One Belt, One Road", organizes technical docking activities, serves as a bridge between the government, members, and the market, and "improves the efficiency of technology conversion" to accelerate the development of China's aerospace engineering.[24]

- Another example includes the "China Artificial Intelligence Industry Development Alliance (AIIA; [中国人工智能产业发展联盟在京成立]) formed in October 2017 boasts more than 200-

[20] "Finance Ministry Notifications Regarding Provisional Management Measures for Government Guidance Funds" [财政部关于印发《政府投资基金暂行管理办法》的通知], PRC National Government Public Information Website, November 12, 2015, accessed January, 28, 2019 at http://www.gov.cn/gongbao/content/2016/ content_5051233.htm

[21] A random sampling of GGIF composition using data collected from Zero2IPO found that roughly two-thirds of funds focused their investments in sectors prioritized by central-level industrial policies such as SEIs and Made in China 2025.

[22] "China Commercial Small Satellite Industry Innovation Alliance established" [中国商业小卫星产业创新联盟成立], People's Daily, July 12, 2018, accessed January 19, 2019 at http://scitech.people.com.cn/n1/2018/0713/c1007-30145948.html

[23] Members include the Ministry of Commerce Investment Promotion Bureau, China Spacesat Co. [中国东方红卫星股份有限公司], a subsidiary of China Aerospace Science and Technology Co., and the Beijing Institute of Space Science and Technology.

[24] See "China Commercial Small Satellite Industry Innovation Alliance Established" [中国商业小卫星产业创新联盟成立], China Military Network website, July 13, 2018, accessed January 19, 2019 at http://www.81.cn/jfjbmap/content/2018-07/13/content_210835.htm

member companies including Alibaba, Tencent, and Baidu.[25] AIIA operates under the guidance of the National Development and Reform Commission, Ministry of Science and Technology, the Ministry of Industry and Information Technology (MIIT), the Central Network Security and Informatization Leading Group Office.[26]

In addition, a new wave of "Silicon Valley-like" high-tech zones are rolling out across the country, combining talent acquisition programs, local economic and defense development policies, and venture capital-like financing mechanisms to fuel PRC start-ups and research institutes developing cutting-edge technologies, most often acquired from abroad.[27]

- Eight regional "Comprehensive Innovation Reform Experiment Zones" [全面创新改革试验区][28] and 120 "Double Innovation Demonstration Bases" [双创示范基地] were designated between 2015 to 2017 to serve as testing grounds for new innovation policies and pursue reform measures in talent acquisition, S&T research, economic development, and military-civil fusion. [29]

- Double Innovation Demonstration Bases provide state-supported environments for "indigenous innovation" by offering "new service-driven models of government" to help central government policies bridge "the final kilometer" of implementation.[30] A 2016 State Council notice describes the thinking behind Double Innovation Demonstration Bases:

  > *…[We must] effectively gather universities, scientific research institutes, and enterprises together with financial capital, IPR services, and the strength of social organizations…in order to implement a set of double innovation policy measures, supporting building a*

[25] "China Artificial Intelligence Industry Development Alliance established in Beijing" [中国人工智能产业发展联盟在京成立], Xinhua News website, October 13, 2017, accessed January 27, 2019 at http://www.xinhuanet.com/2017-10/13/c_1121801129.htm

[26] Ibid.

[27] "The CPC Central Committee Office and the State Council Office Publish 'General Plan for Advancing Comprehensive Innovation Reform Experimentation in District Systems'" [中共中央办公厅、国务院办公厅印发《关于在部分区域系统推进全面创新改革试验的总体方案》], PRC National Government Public Information Website, September 7, 2015, accessed January 27, 2019 at http://www.gov.cn/zhengce/2015-09/07/content_2926502.htm

[28] The eight zones include: 1) Jing-Jin-Ji (Beijing, Tianjin, and some surrounding areas of Hebei Province); 2) Shanghai; 3) Guangdong Province; 4) He-Wu-Beng (Hefei, Wuhu, and Bengbu); 4) Cheng-De-Mian (Chengdu, Deyand, and Mianyang); 5) Wuhan; 6) Xian; 7) Shenyang. See "The CPC Central Committee Office and the State Council Office Publish 'General Plan for Advancing Comprehensive Innovation Reform Experimentation in District Systems'" [中共中央办公厅、国务院办公厅印发《关于在部分区域系统推进全面创新改革试验的总体方案》], September 7, 2015, PRC National Government Public Information Website, accessed January 27, 2019 at http://www.gov.cn/zhengce/2015-09/07/content_2926502.htm

[29] The "Double" [双] refers to "innovation in technology" and "innovation in business" (*aka* "entrepreneurship"), which both begin with the same character in vernacular Chinese. Double Innovation Demonstration Bases fall under three categories: 1) Regional S&T Demonstration Bases (62 designated); 2) University and Scientific Research Institute Demonstration Bases (30 designated); and 3) Enterprise Demonstration Bases (28 designated)

[30] "State Council Office Opinions Regarding the Implementation of Mass Pioneering Work and Mass Innovation Model Bases" [国务院办公厅关于建设大众创业万众创新示范基地的实施意见], PRC National Government Public Information Website, May 12, 2016, accessed January 28, 2019 at http://www.gov.cn/zhengce/content/2016-05/12/content_5072633.htm

group of double innovations support platforms, and explore the formation of different types of demonstration models [for technology development]."[31]

PRC Still Reliant on Foreign Knowhow Despite Rapid Policy, Infrastructure Development

Despite rapid advances in rolling out new innovation-driven policies, regulations, and financing mechanisms, the PRC remains reliant on foreign innovation systems, particularly the United States and Japan, for what it considers key core technologies.

- This reliance is well understood by PRC leaders and Chinese S&T professionals and has been made even more glaring by the U.S.-China "trade war", notably the U.S. government's initial decision to sanction PRC technology firm ZTE, essentially crippling its operations.[32]

- According to a July 2018 Central Financial and Economic Leading Group meeting, "China's scientific and technological development level, especially in key core technology innovation capabilities, is still far behind the international advanced level and still far from meeting the requirements for achievement of the goals of 'the one-hundred-year [marathon] struggle'". [33]

- The PRC's realization of "original source" innovation—or even effective mass production of appropriated foreign technology at its original foreign standards—continues to be hampered by structural flaws in governance and administration, notwithstanding efforts to address these systemic issues.[34]

- A group of prominent PRC S&T professionals from the Chinese Academy of Sciences assess that the pursuit of "key core technologies" is "choked" by "foreign blockades of technology", as well as persistent domestic institutional shortcomings, including administrative rigidities, immaturity of industry innovation ecosystems, and a lack of robust domestic supply chains.[35] In addition, Beijing openly acknowledges that it currently lacks leading and highly skilled talent at scale.[36]

---

[31] Ibid. (Original text: "依托双创资源集聚的区域… 有效集成高校、科研院所、企业和金融、知识产权服务以及社会组织等力量，实施一批双创政策措施，支持建设一批双创支撑平台，探索形成不同类型的示范模式。")

[32] For example, see Wu Yimian, "China Calls for Semiconductor Self Reliance Amid ZTE Import Ban," China Money Network, April 18, 2018, accessed January 29, 2019 at https://www. chinamoneynetwork.com/2018/04/18/chinese-media-calls-for-semiconductor-self-reliance-amid-zte-import-ban

[33] "Xi Jinping: Improving innovation capability in key core technologies to provide strong technical support for China's development [习近平：提高关键核心技术创新能力 为我国发展提供有力科技保障]," Xinhua News website, July 13, 2018, accessed January 17, 2019 at: http://www.xinhuanet.com/politics/2018-07/13/c_1123123961.htm

[34] An investigation by Former Minister of Science and Technology Xu Guanhua, former Deputy director of the State Council's Development Research Center Chen Qingtai, and renowned economist and former research fellow at the Development Research Center highlighted that the common obstacles to "original source innovation" are due to gaps in China's national strategies and policies. See "Introduction to the Committee of Radical Innovation 100" [中国源头创新百人会], Tsinghua University Institute for Innovation and Development, undated, accessed on January 18, 2019 at http://www.iid.tsinghua.edu.cn/p-60.html

[35] "Key core technology: why are we "like choking on a fish bone caught in the throat" [关键核心技术，我们为什么"如鲠在喉"], China Science Daily Website, November 19, 2018, accessed January 17, 2019 at http://news.sciencenet.cn/htmlnews/2018/11/420092.shtm

[36] "Central Committee of the Communist Party of China and the State Council Release the Outline of the Innovation-Driven Development Strategy" [中共中央 国务院印发 (国家创新驱动发展战略纲要)], Xinhua News Agency, May 19, 2016, accessed January 25, 2019 at http://www.xinhuanet.com/politics/2016-05/19/c_1118898033.htm

More recently, Miao Wei, Minister of MIIT, identified four specific areas hindering China's innovation potential.[37] First, investment in basic research among PRC companies remains far behind advanced economy levels. Moreover, this investment focuses primarily on the application of technologies. Second, the supply of common technologies described as "basic, related, systematic, and open" and often inputs in core technologies are lacking. The issue is compounded by a lack of common technology R&D systems, insufficient funding, and uncoordinated policies. Third, structures supporting collaboration between industry and academia to accelerate technological breakthroughs are not in place. Finally, while China's labor force is abundant, it faces a shortage of "high-tech talents" engaged in R&D on core technologies, especially in the manufacturing industry.

IDDS Supporting Advances in PRC Integrated Circuit Industry

Beijing's intent to construct a self-sufficient integrated circuit (IC) industry demonstrates how new tools introduced under IDDS are enabling China to quickly mobilize to become a contender in emerging technology sectors. Formed in October 2014 by the Ministry of Industry and Information Technology (MIIT), the National Integrated Circuit Industry Investment Fund ("National IC Fund")—the first and largest GGIF—is mandated to spend a massive amount of money to implement government IC industrial policies. The fund has already fully spent the money raised in its first round of fund-raising, committing nearly $18 billion and deploying 81.8 billion RMB ($11.8 billion) in at least 67 projects by mid-2018.[1] A second round of fund-raising set at 150 billion RMB ($23 billion) was launched in mid-2018.to date with plans to raise a second $31.2 billion fund.[38]

- The National IC Fund is a "growth fund" investing in all stages of the IC production chain, including new chip fabs, chip design, packaging and testing, equipment and materials, and IC applications. It also funds industry consolidation through M&A.[39]
- Though the PRC's IC Industry lags foreign competitors, the National IC Fund has played a crucial role in advancing industry growth targets and the industry will likely continue to reduce foreign dependency as government policies and investments mature and encourage technological advances.

[37] "Miao Wei (Qiushi) Article: Strengthen efforts to master core technologies; promote the development of high quality manufacturing,"[苗圩《求是》撰文：加强核心技术攻关 推动制造业高质量发展], MIIT website, July 16, 2018, accessed January 29, 2019 at http://www.miit.gov.cn/n1146285/n1146347/n1147601/n1147604/c6260533/content.html

[38] Total invested dollars were calculated using PRC corporate records data. See "Second Phase of National Integrated Circuit Industry Fund, 100 Billion for Integrated IC Industry Chain" [国家大基金二期正募集 千亿布局集成电路产业链], Xinhua News website, April 5, 2018, accessed on January 25, 2019 at http://m.xinhuanet.com/ln/2018-05/04/c_1122781205.htm

[39] Information on the National IC Fund's investment activities collected from an analysis of PRC corporate records data.

- 2017 IC industry revenues in China grew nearly 20 percent year-on-year (in-line with the national target) with similar estimates being put forward for 2018.[40] This is compared to an average revenue growth in the IC industry worldwide of 3.4 percent.

IDDS Systematically Tapping Foreign Innovation Ecosystems

Beijing's increasing effort to establish inroads in foreign innovation hubs (e.g. Silicon Valley, Boston, Tel Aviv) provides an example of PRC reliance on foreign innovation ecosystems. These inroads encompass the physical establishment of operations in a foreign country, as well as research partnerships with universities that facilitate the transfer of technology and know-how. The Shenzhen-based "Committee of Radical Innovation 100" ("CRI 100"; [中国源头创新百人会]],[41] founded in 2015, spearheads the combined efforts of PRC government, corporations, and academia to identify and absorb cutting-edge foreign research, technology, and talent in support of national S&T priories.

- Comprised of former and current PRC central and local government officials, technology entrepreneurs, finance executives, and academics, CRI 100 serves as a "platform for exchange, services and resource integration" among China's innovation forces to "promote the theory and practice of "Chinese original source innovation."[42]

- CRI 100's stated mission is to connect overseas innovation resources [海外源头创新资源] with China's industrial demand, advancing S&T development through what it describes as a "new international cooperative innovation model" [国际协同创新的新棋局].[43]

To advance this mission, CRI, an affiliated organization of CRI 100, is forming overseas innovation centers in the United States, Israel, and Europe and pursuing collaborations with universities such as MIT, the University of Michigan, Carnegie Mellon and Oxford University.[44]

---

[40] "Total Revenue of China's IC Industry to Grow Above Global Average at Annual Rate of 19.86% for 2018, Says TrendForce," Business Wire website, November 9, 2017, accessed January 25, 2019 at https://www.businesswire.com/news/home/20171109005547/en/Total-Revenue-China%E2%80%99s-IC-Industry-Grow-Global

[41] The use of the term "radical" comes from the official English translation provided by CRI 100. Another translation of the vernacular Chinese name of the organization might be "The Committee of Original Source Innovation 100".

[42] Founding members include Tsinghua University Institute of Innovation and Development, China Association for Strategic Development Research Institute, Shenzhen Huada Gene Institute, Shenzhen Guangqi (Kuangchi) Institute of Advanced Science and Engineering, Shenzhen Space Science and Technology Southern Institute, and the Shenzhen City Peng Rui Investment Group Co. Ltd. Also, Chinese original source innovation is defined by CRI 100 as basic research in pursuit of new scientific discoveries and innovative activities that enhance national competitiveness. See

Zhao Qinghui, "Zhou Luming: The Method of Source Innovation Must Change, the Future will Focus on Artificial" [周路明：源头创新方式需要改变，未来会关注人工智能 | CCF-GAIR 2017], Leifeng Online, July 5, 2017, accessed January 27, 2019 at https://www.leiphone.com/news/201707/GrtWoD6GEEtkr3d6.html

[43] "Committee of Radical Innovation 100 will be Established in Shenzhen" [中国源头创新百人会在深圳成立], Shenzhen municipal government website, July 29, 2015, accessed January 29, 2019 at http://www.sz.gov.cn/cn/xxgk/zfxxgj/zwdt/201507/t20150729_5302689.htm

[44] See "Cooperation Partners," CRI Offshore Center website, accessed January 29, 2019 at http://www.crioc.org/index.php?s=/sys/index/partner.html

- In May 2017, CRI established the "Radical Boston Innovation Center" [源创力波士顿创新中心] to "link China's industry, applications, and demands to source innovation in developed countries" focusing on advances in IT, intelligent and new energy vehicles, high-end manufacturing, and healthcare.[45]

- The Radical Boston Innovation Center is part of the China Association of Science and Technology (Shenzhen) Overseas Talent Offshore Innovation and Entrepreneurship Base [中国科协(深圳)海外人才离岸创新创业基地], a joint initiative between the Shenzhen municipal government and CAST under its "Help Our Motherland Through Elite Overseas Intellectual Resources Program ["HOME Program"; 海外智力为国服务行动计划].[46]

Military-Civil Fusion: Turning Economic Scale into Military Might

Beijing's Military-Civil Fusion program is a key component of IDDS and leading driver of PRC defense science, technology, and industrial (DSTI) system reforms under General Secretary Xi Jinping.[47] Often misinterpreted as a purely military modernization play, MCF is a creative gamble to turn the classic macroeconomic "guns versus butter" model on its head—into a dual-use "guns ***and*** butter" model—by synchronizing PRC industrial and defense planning. PLA military strategist Jiang Luming [姜鲁鸣], a leading MCF expert at the PLA National Defense University, describes MCF as "…the comprehensive planning of the two major systems of military and civilian resources, brings about a compatible economic and technical foundation for [resource] sharing, transforms limited social resources into bidirectional and interactive combat power and production power, and achieve multiple types of production from a single investment."[48]

---

[45] "About Us Section", CRI Offshore Center website, accessed January 29, 2019 at http://www.crioc.org/about.html. [Original text: 我们的逻辑是连接中国的产业端、应用端、需求端和发达国家源头创新端]; and Shenzhen Source Innovation Offshore Center [深圳市源创力离岸创新中心] organization profile, accessed January 29, 2019 at http://company.zhaopin.com/CZ715693340.htm. For additional detail on the role of PRC investments, incubators, and acquisitions in the U.S. aimed at tapping emerging technologies and talent, see Elsa B. Kania, "Testimony before the House Permanent Select Committee on Intelligence: China's Threat to American Government and Private Sector Research and Innovation Leadership," CNAS website, July 19, 2018 at https://www.cnas.org/publications/congressional-testimony/testimony-before-the-house-permanent-select-committee-on-intelligence

[46] Another translation of the vernacular Chinese name of the program is the "Overseas Intelligence for National Service Action Plan". See "China Association of Science and Technology (Shenzhen) Overseas Talent Offshore Innovation and Entrepreneurship Base Formally Set Up" [中国科协(深圳)海外人才离岸创新创业基地正式入驻], Shenzhen municipal government website, September 28, 2017, accessed January 27, 2019 at http://www.sz.gov.cn/kxjsxh/zxzx_89860/kxxw/201709/t20170929_8894627.htm

"Overview of Overseas Talents Offshore Innovation and Entrepreneurship Base" [海外人才离岸创新创业基地概述], CAST website, May 12, 2016, accessed January 27, 2019 at http://www.cast.org.cn/n200675/n202200/n202372/index.html

[47] For additional insights, see Tai Ming Cheung, "How China's Defense Innovation System Is Advancing the Country's Military Technological Rise," SITC Research Briefs, Series 10(2018-3), May 30, 2018, accessed January 29, 2019 at https://escholarship.org/uc/item/7c75995r#main

[48] Jiang Luming, "Comprehensively Planning an Overall Strategy for National Security and Development" [统筹国家安全和发展的总方略], PLA Daily, June 2, 2016, accessed January 29, 2019 at http://www.81.cn/gfbmap/content/2016-06/02/content_146372.htm

- MCF aims to enhance and introduce new "hard" and "soft" innovation capabilities to form a "national defense S&T industrial system with Chinese characteristics."[49] These include new policies to streamline standards among civilian and defense entities, encouraging civilian participation in the defense economy, creating new state financing vehicles for MCF development, and forming MCF industry clusters.[50]

- MCF prioritizes advances in maritime, space, cyberspace, biology, new power sources, and artificial intelligence while also introducing new modes of weapon and equipment procurement and talent development in support of national defense.[51]

- Additionally, MCF promotes the joint development and utilization of military and civilian infrastructure including scientific research institutes and labs, airports, ports, communications infrastructure, satellites, as well as joint exploration of the sea and outer space.[52]

China's DSTI system has historically relied on absorption and re-innovation of foreign technology and know-how.[53] By synchronizing civilian and defense resources, Chinese planners hope to encourage original advanced research and development in priority dual-use sectors that generate both economic and military returns. In order to do this, MCF calls for breaking down domestic institutional barriers limiting the PLA's access to the civilian economy and vice versa. These barriers currently create disadvantages against adversaries able to leverage "systemized capabilities" that more effectively aggregate civilian resources during a conflict, especially a protracted one. Said differently, Chinese military strategists assess that they "have resources but not aggregation [and] have strength without capabilities [有资源无聚合、有实力无能力]."[54]

Increasing civilian entities' participation, especially technology companies, in national defense S&T and weapons research and production—a concept referred to in vernacular Chinese as *mincanjun [民参军]*—and converting military technology (spin-off) into civilian use—a concept referred to in vernacular Chinese as *junzhuanmin* [军转民]—are important components of MCF and China's broader military reforms to develop cutting-edge defense technologies.[55]

---

[49] For more in-depth research on key factors supporting defense innovation, see Tai Ming Cheung, "Critical Factors in Enabling Defense Innovation: A Systems Perspective," SITC Research Briefs, Series 10(2018-2), May 30, 2018, accessed January 25, 2019 at https://escholarship.org/uc/item/170219mp#main

[50] "SASTIND Publishes 2017 Military Civil Fusion Special Action Plan" [国防科工局发布 2017 年军民融合专项行动计划], State Administration for Science, Technology and Industry for National Defense, June 23, 2017, accessed January 29, 2019 at http://www.gov.cn/xinwen/2017-06/23/content_5204695.htm#1

51 For additional information on MCF priority sectors, see Greg Levesque and Mark Stokes, "Military-Civil Fusion and the "Going-Out" of China's Defense Industry," Pointe Bello, December 2016 at https://pointebello.com/s/062017_Pointe-Bello_Military-Civil-Fusion-Report.pdf

52 "Full Text: China's Military Strategy," Ministry of National Defense of the People's Republic of China website, May 26, 2015 at http://eng.mod.gov.cn/Press/2015-05/26/ content_4586805_4.htm

[53] See Tai Ming Cheung, "How China's Defense Innovation System Is Advancing the Country's Military Technological Rise"

54 See Jiang Luming, "Comprehensively Planning an Overall Strategy for National Security and Development" [统筹国家安全和发展的总方略]

55 "Decision of the Central Committee of the Communist Party of China on Comprehensively Deepening the Reform of Some Major Issues" at the Third Plenary Session of the 18th CPC Central Committee in November 2013. "Interpretation of the

- *Mincanjun* calls for streamlining defense contractor licensing processes, military and civilian standards, and improving information exchange to encourage civilian entities (e.g. companies and universities) to participate in defense research and procurement thereby introducing competition and opening new avenues for the PLA to identify, capture, and develop disruptive technologies that could alter the rules of battle.[56]

- The State Administration of Industry for National Defense (SASTIND), a leading agency for MCF development and implementation, reports that civilian enterprises participating in the defense industry is increasing with "private" companies accounting for two-thirds of civilian entities who have obtained weapons and equipment research and production licenses to date, though it's unclear what these firms are doing with these licenses.[57] Additionally, civilian enterprises are reportedly increasingly involved in the development of weapons sub-systems and complete systems, as opposed to producing primarily ancillary products.[58]

- Civilian logistics and unmanned aerial vehicle (UAV) manufacturers have become a focal point of *mincanjun* under MCF. In a major development, the first PLA reserve unit focused on operating civilian UAV platforms for "counter-terrorism, search and rescue, and information gathering" was formed in cooperation with JD.com in Shaanxi in May 2018.[59] PLA engagement with civilian logistics and UAV manufacturers to date takes three primary forms:

    - subcontracting of logistics support to civilian UAV operators (e.g. JD.com and SF Express)[60];

Important Measures of the Third Plenary Session of the 18th CPC Central Committee" [党的十八届三中全会《决定》重要举措释义], CPC News Online website, November 22, 2013 at http://theory.people.com.cn

56 "Jiang Luming: A Scientific Guide to Promoting Deep Military-Civil Fusion [姜鲁鸣：推进军民深度融合发展的科学指南]," MIIT website, July 26, 2017, accessed January 29, 2019 at http://www.miit.gov.cn/n1146285/n1146352/n3054355/n3057613/n3057641/ c5741871/content.html (Original text: 我们只有推动军民深度融合，实施军民协同创新，及早从源头上识别、捕捉和开发能够改变作战规则和科技发展方向的重大颠覆性技术，才能大规模获取军民融合战略红利，争取主动、赢得未来); and

"SASTIND Publishes 2017 Military Civil Fusion Special Action Plan" [国防科工局发布 2017 年军民融合专项行动计划]

57 "SASTIND Holds Press Conference on the Situation of Military-Civil Fusion in the National Defense Science and Technology Industry" [国防科工局举行国防科技工业军民融合发展情况发布会], State Council Information Office website, December 6, 2017, accessed January 28, 2019 at http://www.scio.gov.cn/xwfbh/gbwxwfbh/xwfbh/hfkgw/Document/1612885/1612885.htm

58 Ibid.

59 "A Certain Shaanxi Reserve Anti-Aircraft Artillery Base Drives Ahead in Creating a UAV Support Unit" [陕西某预备役高炮师推进无人机保障分队建设], PLA Daily website, May 20, 2018, accessed January 30, 2019 at http://www.xinhuanet.com/mil/2018-05/20/c_129876747.htm; and

"Scouting, Search and Rescue, Delivering Materials -- The Military and JD.com Jointly Organize a UAV Military Reserve Unit" [侦查、搜救、送物资,军方联合京东组无人机预备役分队], Orient Today website, May 19, 2018, accessed January 30, 2019 at https://news.mydrivers.com/1/577/577427.htm

60 See Luo Yu and Gao Hongxia, "Breakthrough! UAVs From Rapid Delivery Companies Provide Exercise Services to the PLA For the First Time" [新突破！快递公司无人机在演习中首次服务解放军], People's Daily website, January 30, 2018, accessed January 28, 2019 at http://sc.people.com.cn/n2/2018/0130/c345527-31198409.html

- direct acquisition of UAVs from civilian manufacturers;[61] and
- joint ventures between state-owned defense groups and civilian UAV manufacturers to produce light armed UAVs for combined reconnaissance and strike functions.[62]

- As part of *junzhuanmin*, SASTIND, MOF, and the State Intellectual Property Office have issued at least three sections of a "National Defense Science and Technology Intellectual Property Transformation Guide" containing intellectual property from state-owned defense industry groups for use in the civilian sector.[63] In addition, the PLA in March 2017 declassified for the first time more than 2,300 dual-use technology patents to encourage civilian application.[64]

MCF industry funds, industry alliances, and technology parks are converging to promote MCF implementation, all as prescribed by the IDDS. The 30.2 billion RMB ($4.8 billion) Central Military-Civil Fusion Fund [国华军民融合发展基金], which is managed by CASC Aerospace Investment Corp, along with at least a combined $40 billion across local-level investment vehicles are helping to push forward MCF projects and initiatives.[65]

- MCF industry alliances coordinate MCF implementation among government, military, and defense industry stakeholders and provide S&T intelligence and policymaking support. Notable alliances include the China National Defense Industrial Enterprise Military-Civil Fusion Alliance [中国国防工业企业军民融合产业联盟] and the China Association of Science and Technology Military-Civil Fusion Alliance ("CAST MCF Alliance"; [中国科协军民融合学会联合体]).[66]

    - CAST MCF Alliance members include all state-owned defense industry associations as well as military research institutes, universities, and enterprises. Its mission involves supporting strategic decision-making and evaluation of major MCF policies, leveraging

[61] See "Special Interview with Central Aviation Knowledge's Vice-President: Walking Down the Innovation Road for China's Own UAVs" [专访中航智副总：走出中国人自己的无人机创新之路], November 4, 2016, accessed January 30, 2019 at http://mil.huanqiu.com/aerospace/2016-11/9635347.html

[62] See "Qingzhun Technology's 'Reconnaissance- Strike Combined UAV' Takes the Stage, Taking the Lead in Striding Forward Down the New Road of Military-Civil Fusion" [轻准科技"察打一体无人机" 亮相高交会 率先迈出军民融合新路], Shenzhen News Online, November 16, 2017, accessed January 30, 2019 at http://inanshan.sznews.com/content/2017-11/16/content_17773627.htm

[63] See "SASTIND, MOF, SIPO jointly issue 'Guiding Opinions on Defense Science and Technology Industry Promoting the Construction of Strong National Intellectual Property Rights'" [国防科工局、财政部、知识产权局联合印发《关于国防科技工业推进知识产权强国建设的指导意见》], SIPO website, November 28, 2017, accessed January 30, 2019 at http://www.sipo.gov.cn/gwyzscqzlssgzbjlxkybgs/bwdt_zlb/1097850.htm

[64] Pei Yin, "National Defense Patents are Declassified for the First Time, can the 'Treasure' be Successfully Awakened?" [国防专利首次解密，"宝藏"能否被成功唤醒?], China Military News Online website, June 26, 2017, accessed January 28, 2019 at http://www.81.cn/2017jj90/2017-06/26/content_7669742.htm

[65] Pointe Bello has identified at least 10 local-level MCF investment vehicles with a combined fund size of more than $40 billion established between 2012-2018. This does not represent an exhaustive list of MCF funds or the total amount of state capital being directed to MCF-related initiatives.

[66] "Introduction to the China Association of Science and Technology Military-Civil Fusion Association" [中国科协军民融合学会联合体简介], China Association of Science and Technology website, July 13, 2016, accessed January 20, 2019 at http://www.cast.org.cn/art/2016/7/13/art_558_39761.html

high-end scientific and technological talent, notably overseas returnees, and establishing a long-term mechanism for the conversion of military and civilian S&T achievements to serve the national economy and military modernization.[67]

MCF demonstration bases integrate defense and civilian basic research, R&D, production, capital, and talent to drive down costs and accelerate technological breakthroughs in production cycles. They also serve to combine military S&T requirements with local economic development plans.

- Since 2009, 36 national MCF demonstration bases across China have been established under the "National New Industrial Demonstration Base Initiative," [国家工业化产业标范基地], which is overseen by MIIT.[68] In addition, all major provincial and municipal governments have unveiled MCF industry development plans leading to the formation of local MCF research centers, bases, and parks.[69]

- For example, Zhongguancun Science Park leads the integration of military-civil science and technology resources in Beijing and has established platforms to directly link military requirements with zone-wide scientific and technological advancements.[70] Qingdao's West Coast New District, an important maritime defense hub, is accelerating MCF industry development in marine vessels, biomedicine, aerospace, IT, and new materials.[71] Meanwhile Chengdu announced four MCF aviation industry parks in mid-2016 and plans to construct six more and form a local MCF industry alliance.[72]

MCF blurs the lines between traditional notions of military, commercial, and academic activity creating challenges for U.S. policymakers, executives, and university administrators. For example, Beijing's use of "commercial" state-owned enterprises to assert its territorial claims in the South China Sea, including the construction of reclaimed islands and military installations, exemplify military-civil fusion in action. Additional examples include:

---

[67] Ibid.

"National Defense Industry Association: Establishes Five Service Platforms to Support Military Civil Fusion Development" [国防工业企业协会：建五大服务平台 助力军民融合发展], Xinhua News website, January 8, 2017, accessed January 30, 2019 at http://www.xinhuanet.com/politics/2017-01/08/c_129436654.htm; and "Introduction to the China Association of Science and Technology Military-Civil Fusion Association" [中国科协军民融合学会联合体简介]

[68] Launched in 2009, the National New Industrial Demonstration Base Initiative promotes the restructuring and development of six high-tech industrial sectors: equipment manufacturing, raw materials, consumer products, electronic information, military-civil fusion, and software and information services. For more, see "National New Industrial Demonstration Base Initiative [国家新型工业化产业标范基地], MIIT website, undated, at http://sfjd.miit.gov.cn/BaseInfoAction!findListindustry.action

[69] For example, see "Zhejiang Province Military-Civil Fusion Industry '13th Five-Year Plan' Plan" [浙江省军民融合产业"十三五"规划], Zhejiang Provincial Government website, undated, accessed January 30, 2019 at http://www.zjjxw.gov.cn/module/download/downfile.jsp?classid=0&filename=80a04fdc0dbd4ab18c32f1e623e53857.pdf

[70] Military-civil science and technology synergy becoming the engine of innovation development in Zhongguancun Demonstration Park [军民科技协同成为中关村示范区创新发展引擎], Zhongguancun Science Park website, January 8, 2019, accessed January 18, 2019 at http://zgcgw.beijing.gov.cn/m/dtq/gzdt5/181919/index.html

[71] "Qingdao West Coast New District Issues Opinions to Accelerate Promotion of Military-Civil Fusion Industry Development" [青岛西海岸新区出台意见 加快推进军民融合产业发展], Xingkong Observer Online website, April 28, 2018, accessed January 30, 2019 at http://xingkonggc.com/a/news/guona/2018/0428/460889.html

[72] "Chengdu in Advance Starts Four Military-Civil Fusion Industry Parks" [成都先期启动四个军民融合产业园], Sichuan Provincial Government website, July 26, 2016 at http://www.sc.gov.cn/10462/10778/13814/2 016/7/27/10389670.shtml

- The Aviation Industry Corporation of China (AVIC) since 2010 has acquired at least eight general aviation companies in the United States and Europe, including leading manufacturers of advanced piston engines with full-authority digital engine control.[73] These acquisitions led to domestic technological breakthroughs in modified gasoline and heavy fueled engines, electronic fuel injection technology, and turbocharging enhancing the performance and operability of PRC high-altitude UAVs.[74]

- The state-owned China Railway Rolling-Stock Co. (CRRC) acquisition of UK-based Dynex Corporation led to the transfer of high-tech semiconductors, notably insulated-gate bipolar transistors (IGBT), to China. CRRC's IGBT manufacturing facility in Zhuzhou now reportedly supplies the PLA and is being used in its 2nd generation aircraft carrier integrated propulsion system and rail gun programs.[75]

- Founded largely on U.S. Air Force funded research on metamaterials conducted at Duke University, Shenzhen-based Kuang-Chi Group is regularly referred to in PRC media as a "military-civil fusion enterprise" [军民融合企业].[76] The firm boasts close ties to the PLA and works with China Aerospace Science and Industry Corporation's Hunan Space Bureau (068 Base)—a R&D and production center for near space reconnaissance platforms.[77] In March 2018, Kuang-Chi

---

[73] For example, see "AVIC International Announces the Formation of Continental Motors Group and Expansion into China," Continental Motors website, April 10, 2014, accessed January 30, 2019 at http://www.continentalmotors.aero/xPublications/News%20Releases/AVIC%20International%20Announces%20the%20Founding%20of%20the%20Continental%20Motors%20Group/

[74] "Heart of Chinese UAV made in China: accurate targeting nets top US and German manufacturers" [中国无人机心脏国产:精准出手 收购美德顶级制造商] Phoenix Military News, December 6, 2016, accessed January 30, 2019 at http://news.ifeng.com/a/20161206/50370941_0.shtml

[75] See Minnie Chan, "China's aircraft carrier conundrum," South China Morning Post, November 19, 2017, accessed January 29, 2019 at http://www.scmp.com/news/china/diplomacy-defence/article/2120391/chinas-aircraft-carrier-conundrum-hi-tech-launch-system; and Mark Hookham and Richard Kerbaj, "Has China used British technology to build a rail gun?," The Times, March 4, 2018 at https://www.thetimes.co.uk/article/has-china-used-british-technology-to-build-a-railgun-n7blzkmdg; and "Strength Burst Forth! She is a core member of Ma Weiming's innovation team" [实力爆表！她可是马伟明院士创新团队的核心成员], China Naval Network website, March 7, 2018, accessed January 29, 2019 at https://mp.weixin.qq.com/s/pyQ3AZxg3mjqF3y8F90Neg?

[76] For more information on Kuang-Chi founder Liu Ruopeng's role in transferring metamaterials research to China while at Duke University see "Chinese Talent Programs: Counterintelligence Strategic Partnership Intelligence Note," Federal Bureau of Investigation, September 2015 at https://compliance.fiu.edu/documents/SPIN%20-%20Chinese%20Talent%20Program.pdf; and Neelesh Moorthy, "How one graduate student allegedly stole Duke research to create a billion-dollar Chinese company," The Chronicle, Duke University, October 29, 2017, posted at http://www.dukechronicle.com/article/2017/10/how-one-graduate-student-allegedly-stole-duke-research-to-create-billion-dollar-chinese-company. Also, see Shen Yiran, "Kuang-Chi's Liu Ruopeng: Every Step of Kuang-Chi's Development Practice Follows the General Secretary's Two Sentences" [光启刘若鹏：光启发展每一步都在践行总书记两句嘱托], Finance Sina website, December 28, 2017, accessed January 30, 2019 at http://finance.sina.com.cn/chanjing/gsnews/2017-12-29/doc-ifyqchnr6974026.shtml

[77] The agreement was signed by Shenzhen Guangqi Space Technology Co., Ltd. [深圳光启空间技术有限公司], a subsidiary of Kuang-Chi Science and Technology Co. [光启科学有限公司] providing big data, space wi-fi, and space exploration services. See "068 Base and 7801 Institute sign strategic framework agreement with Shenzhen KuangChi Space Technology Co., Ltd.," [068 基地 7801 所余深圳光启空间技术有限公司签订战略合作框架协议], 068 Base [068 基地], February 28, 2015, accessed January 30, 2019 at http://guba.eastmoney.com/news,002625,179107736.html

and Houston-based NanoRacks, which is located near NASA's Johnson Space Center and supports the International Space Station, announced a partnership leveraging Kuang-Chi's near space technology platform and NanoRacks' expertise in business development and marketing.[78]

MCF Gaining Steam, But Persistent Impediments Remain

The PRC's MCF system is increasingly optimized.[79] However, the PRC's DSTI system remains reliant on the absorption of foreign technology and know-how.[80] MCF development priorities released annually by SASTIND suggest that there remain ongoing challenges to achieving independent military S&T advances, *mincanjun*, information exchange between the military and civilian entities, as well as weapons and equipment mobilization.[81] A lack of institutional guarantees, tax policies, problems exchanging information between the military and commercial entities, high barriers to entry, and licensing issues are also regularly cited as issues inhibiting civilian participation in defense contracting.[82] Longstanding institutional barriers and vested interests among state defense industry groups appear to be impeding MCF progress. According to SASTIND chief engineer Long Hongshan, four factors ("four insufficients"; 四个不够) in particular are hampering MCF progress:[83]

- Insufficient top-level coordination—MCF S&T industry direction and policies are decentralized hindering resource allocation and administrative effectiveness.

- Insufficient opening—high barriers to defense industry entry remain. Lack of collaboration with non-traditional defense entities by state owned defense enterprises. Difficult for civilian entities to obtain defense RD&A licenses and contracts.

- Insufficient sharing—Information exchange is lacking and a mechanism for sharing and using military and civilian resources has not yet been formed.

- Insufficient transformation—military technology spin-off remains low compared to other militarily powerful countries.

---

[78] "Kuang-Chi and NanoRacks Announce Agreement on Near Space 'Traveler' Program," NanoRacks, March 22, 2018, accessed January 30, 2019 at http://nanoracks.com/near-space-traveler-program/

[79] For example, see Dong Qiang et al, "2018: What New Changes Will Occur in China's Military-Civil Fusion Deep Development" [2018 年: 我国军民融合深度发展将会呈现哪些新变化], China Military Network website, January 27, 2017, accessed January 30, 2019 at http://www.81.cn/jmywyl/2018-01/27/content_7923020.htm

[80] In "Critical Factors in Enabling Defense Innovation: A Systems Perspective," Tai Ming Cheung notes that the primary types of innovation outcomes in China's defense innovation system "are advanced imitation and incremental innovation, although there are growing signs of higher levels of innovation outcomes and crossover and architectural innovation."

[81] For example, see "SASTIND Publishes 2017 Military Civil Fusion Special Action Plan" [国防科工局发布 2017 年军民融合专项行动计划]

[82] "Military-Civil Fusion: Lowering the Threshold for Mincanjun, Breaking Through the Defense Conversion Barrier" [军民融合：降低民参军门槛 破除军转民障碍], Xinhua News website, December 10, 2017, accessed January 30, 2019 at http://www.xinhuanet.com/2017-12/10/c_1122085690.htm

[83] See "SASTIND Holds Press Conference on the Situation of Military-Civil Fusion in the National Defense Science and Technology Industry" [国防科工局举行国防科技工业军民融合发展情况发布会]

Addressing systemic impediments and advancing MCF priorities has taken on a greater sense of urgency since the 19th Party Congress, judging from authoritative PRC media reports.[84] Most notably, this includes the creation of the Central Military-Civil Fusion Development Committee (CMCFDC; [中央军民融合发展委员会]), a Communist Party of China (CPC)-led body formed in mid-2017 headed by General Secretary Xi.[85] As the highest level "decision-making and coordination mechanism" for MCF development, the CMCFDC reflects the importance of MCF to top PRC leaders and their commitment to harnessing the collective force of the CPC to break down institutional barriers to MCF progress across the government, military, and industry.[86]

- The CMCFDC has sought to tackle systemic impediments head on, quickly expanding MCF strategic guidance to provide "top-level coordination" amongst CPC, government, military, and industry stakeholders. In turn, provincial and municipal MCFDCs have been formed providing an interlocking CPC-led mechanism for MCF implementation from central to local levels.[87]

- Since its first plenum meeting in June 2017, the CMCFDC has approved 11 MCF policies defining near-term work priorities, establishing local-level leadership and work structures, and even new strategic guidelines for MCF development.[88]

- Statements by General Secretary Xi at CMCFDC meetings demonstrate a sense of urgency in implementing MCF as PRC leaders see the near-term period as critical to constructing a national MCF architecture.[89] Additionally, CMCFDC meetings focus on mobilization and applying MCF in infrastructure to support national defense.[90]

---

[84] "Xi urges efforts to boost integrated military and civilian development," Xinhua News website, June 21, 2017, accessed January 30, 2019 at http://www.xinhuanet.com/english/2017-06/21/c_136381507.htm

[85] "Military-Civil Fusion Development Committee Established" [军民融合发展委成立], Xinhua News website, January 23, 2017, accessed January 30, 2019 at http://www.xinhuanet.com/2017-01/23/c_129458492.htm;

[86] "The Central Committee Political Bureau Holds a Meeting" [中共中央政治局召开会议], Xinhua News website, January 22, 2017, accessed January 30, 2019 at http://www.xinhuanet.com//politics/2017-01/22/c_1120363831.htm

[87] For example, the Zhejiang Provincial Military-Civil Fusion Development Committee held its first meeting in November 2017. See "Che Jun Presided Over the First Meeting of the Zhejiang Military-Civil Fusion Development Committee" [车俊主持召开浙江省军民融合发展委员会第一次会议], People's Daily website, November 22, 2017, accessed January 29, 2019 at http://cpc.people.com.cn/n1/2017/1122/c117005-29661492.html

[88] Notable CMCFDC-approved policies include the Strategic Doctrine of Military Civil Fusion Development [军民融合发展战略纲要], the 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], and the Law for Managing National Defense Requirements and Joining Programs in Economic Buildup and National Defense—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]

[89] For example, at the first CMCFDC plenum meeting General Secretary Xi called on members to "do better, faster" [更好一些、更快一些] to push forward MCF priorities. See

"Xi Jinping Chairs the Central Military-Civil Fusion Development Committee's First Plenum Meeting" [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 News website, June 20, 2017, accessed January 30, 2019 at http://www.xinhuanet.com/politics/2017-06/20/c_1121179676.htm

[90] See "Opinions on Advancing and Deepening Implementation of MCF in Military Logistics 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], National Development and Reform Commission and CMC Strategic Planning Office website, December 27, 2017, accessed January 30, 2019 at http://www.ndrc.gov.cn/zcfb/gfxwj/201801/W020180109331797564216.pdf

In short, MCF represents an all-in gamble on Beijing's part to introduce new concepts challenging traditional notions of centralized economic and defense planning to enhance its national competitiveness. In the minds of PRC leaders, achieving a full scope MCF innovation system [军民融合创新体系] is critical to strategic competition and securing China's future as not only an economic, but also a military superpower. Jiang Luming makes these stakes clear, stating:

> "*In this competition, not moving forward—or proceeding slowly—means falling behind and failing to carry out fusion—or doing so slowly or superficially—will lead to failure. If the military-civil fusion development strategy is unable to be deeply implemented, our country's predicament of following an imitation-style development model cannot be fundamentally altered, and national security development will lose its most central supporting power; if we are defeated in this particular competition, an entire era will be lost.*"[91]

Conclusion and Recommendations

PRC leaders perceive a window of strategic opportunity to revamp China's innovation system, enabling it to become a global superpower second to none. PRC national strategies such as IDDS and military-civil fusion—which are long-term plans—are still in relatively early stages. These strategies invariably take form slowly, often in a seemingly uncoordinated manner, gaining momentum as they proliferate across the system. More importantly, these are not static dictates.

- National strategies evolve quickly as Chinese policymakers adapt and successful outcomes are replicated. Moreover, the total volume of resources going into China's industrial policy is accelerating rapidly.

- Ultimately, the outcome of China's industrial policy will significantly impact the direction of PRC economic and military power over the next 20-30 years with potentially profound implications for global innovation and power dynamics.

Just as Beijing sees a window of strategic opportunity, Washington and its allies have a window of opportunity to meaningfully respond to PRC activities that present national security and economic threats. At the moment, Beijing's reliance on foreign S&T make it vulnerable to stepped-up enforcement of U.S. law. An effective competitive strategy should adopt a dynamic threat management process that includes allies and builds persistent scrutiny, discovery, and access prevention into existing processes without compromising U.S. core principles. More specifically, Congress might consider:

- **Creating a "claw back" mechanism—**Conducting reviews of past U.S. government approved scientific and technology exchanges with PRC government, corporate, and academic entities to protect cutting-edge research and talent. This review should include science and technology

[91] See Jiang Luming, "Comprehensively Planning an Overall Strategy for National Security and Development" [统筹国家安全和发展的总方略]. (Original text: 如果不能深入实施军民融合发展战略，就不可能根本改变我国跟踪模仿型发展模式的困境，国家安全发展就将失去最核心的支撑力，一旦我们在这场特殊竞争中败下阵来，输掉的将是整整一个时代)

collaboration under the U.S. Department of State managed U.S.-China Consultation on People-to-People Exchange (2009-2017).

- **Establishing an interagency team on China with support from private sector, academia—**Form a cross-functional interagency team supported by stakeholders from the private sector and academia to monitor, assess, and report to Congress adaptations in PRC strategy and tactics to inform U.S. government actions.

- **Tightening U.S. government funding provisions—**Introduce provisions enhancing the ability of U.S. government sponsors to protect tax payer dollars and ensure the requiring recipients of U.S. government funding for basic research or start-ups in emerging technologies to report investment by PRC-connected entities

- **Expanding SEC reporting requirements—**Require publicly listed companies to report participation in PRC core technology development programs, SIIAs, MCF programs, physical operations within MCF bases, and the potential for technology diversion to PRC military entities.

- **Reviewing rules of engagement—**Military-civil fusion blurs the lines between traditional notions of military, commercial, and academic activity. This blurring has serious implications for the U.S. Department of Defense and requires an evaluation of U.S. military rules of engagement within a MCF context.

- **Enhancing public awareness of PRC strategy and tactics**—Increase resources for open source research and analysis within and outside of government to drive public awareness and understanding of the asymmetry in U.S.-China systems.