CHAPTER 15

KEEPING UP WITH THE *JUNDUI*

Reforming the Chinese Defense Acquisition, Technology, and Industrial System

By Tai Ming Cheung

Xi Jinping has established strong control over the People's Liberation Army (PLA) since becoming its commander in chief and the country's paramount leader in 2012. He has used this authority to press ahead with an ambitious and bone-crunching reform agenda to make the defense establishment more politically loyal, less corrupt, and better able to fight and win future wars.

One area of particular attention for Xi is the defense acquisition, technology, and industrial (DATI) system, which covers the defense technology and industrial apparatus and PLA agencies overseeing acquisition matters. The central goal of these reforms is to transform the DATI system from a predominantly absorptive development model toward a system better able to engage in original higher end innovation. Among the key requirements necessary for this upgrading are building a more advanced R&D base, developing an operating culture that is more risk-tolerant, greater market competition, and closer integration between the civilian and military segments of the national economy. This chapter examines the reforms that are currently taking place within the Chinese DATI system and what can be expected in the near-, medium-, and long-term future.

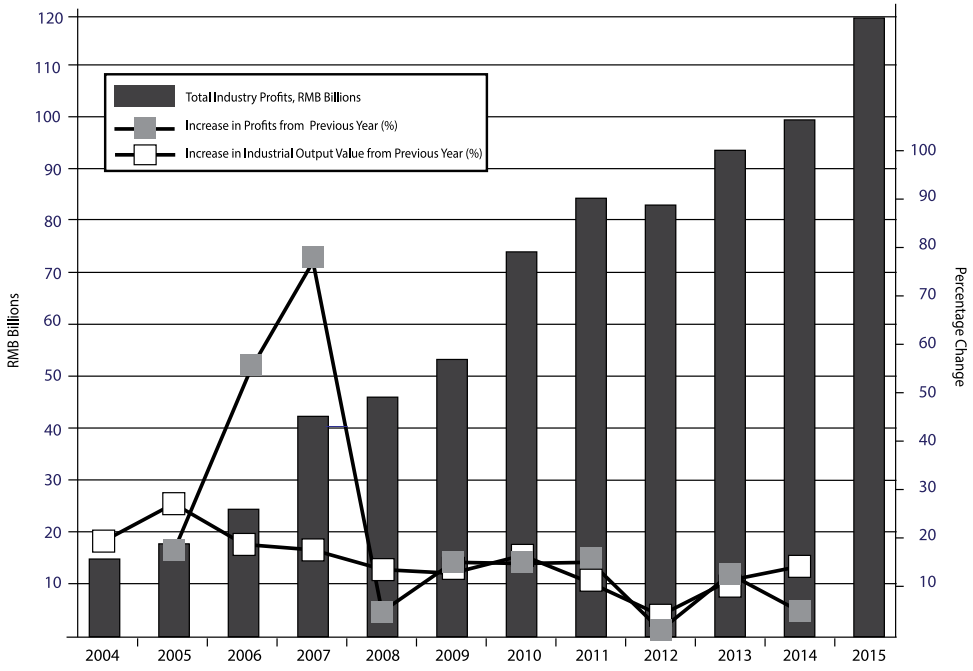
The State of the Chinese Defense Industry in the Mid-2010s

The Chinese defense industry in the mid-2010s is enjoying a golden age of record revenues and profits. Driven by leadership concerns of mounting challenges to the country's external security environment and rapid advances in the global technological order, investment into research, development, and acquisition has soared, greater efforts are being made to acquire and absorb foreign technologies, and the existing defense innovation system is being remade.

This has resulted in significant improvements in technological, economic, and industrial performance. The country's 10 major state-owned defense corporate groups, which together control the defense industry's six sectors, have enjoyed nearly double-digit annual growth in revenues and profits over the past decade. Between 2004 and 2015, total profits of the big 10 increased from Rmb 15 billion to Rmb 120 billion (see figure 1). The ordnance, space, electronics, and aviation industries were the most profitable sectors, while the shipbuilding industry has struggled because of a severe global downturn. While the robust expansion of the defense industry is a bright spot amid slowing growth in the rest of the Chinese economy, its future prospects depend on continuing defense budget increases that now appear to be slowing. The rate of increase for the 2016 defense budget was only 7.6 percent, which may mark the end of the double-digit budget increases that began in the early 1990s.[1]

However, the official defense budget represents only one source of funding for the defense industry, which has access to funding and resources from a diversified array of sources. Funding for defense-related research and development, for example, comes primarily from other areas of the central government budget, most notably those allocated to the State Administration for Science, Technology, and Industry for National Defense (SASTIND), which is not included in the official defense budget. Moreover, around half of the defense industry's revenue and profits comes from civilian business, and in some sectors like ordnance and nuclear this could be as high as 80 to 90 percent.[2] In addition, since 2013, the defense industry has

Figure 1. Financial Performance of the Chinese Defense Industry, 2004–2015



Notes:
Total profit data is incomplete for 2014. No 2014 figure was available for CNEC as of March 1, 2016.
Total profit data is incomplete for 2015. No 2015 figures were available for CNEC and CSIC as of March 1, 2016.

Sources: Information obtained from annual reporting of the 10 defense corporations. See also *China Civil-Military Integration Development Report 2015*[中国军民融合发展报告2015] (Beijing: National Defense University Press［国防大学出版社], 2015), 61.

been allowed to seek investment funding from capital markets that provide access to large pools of financial resources, including shareholder funds, bank loans, and bonds, which will be discussed later in this chapter. These different sources will allow the defense industry to mitigate the impact of slowing official defense budget increases.

The aviation sector, for example, is simultaneously engaged in the development or production of more than half a dozen combat and transport aircraft. The shipbuilding industry has at least four active nuclear and conventional submarine programs along with research, development, and construction of aircraft carriers, destroyers, and numerous other surface warships. The PLA Navy is estimated to have laid down, launched, or

commissioned more than 60 naval ships and smaller craft in 2014 alone, with the same number expected in 2015.[3]

An important new trend is also becoming apparent in the performance of the shipbuilding industry. Until the mid-2000s, Chinese naval shipyards relied heavily on the importation of foreign, primarily Russian, technology transfers for their industrial development. As Chinese shipbuilders absorbed these transfers, they have been able to substantially reduce their foreign reliance in the past decade. The U.S. Office of Naval Intelligence (ONI) notes that since the beginning of the 2010s, the PLA Navy's "surface production shifted to platforms using wholly Chinese designs and that were primarily equipped with Chinese weapons and sensors (though some engineering components and subsystems remain imported or license produced in country)."[4] These include the *Jiangkai*-class (Type 054A) frigate series, *Luyang*-class (Type 052B/C/D) destroyer series, and the upcoming new cruiser (Type 055) class, which ONI considers to be "comparable in many respects to the most modern Western warships."[5]

The space and missile industry has also been among the leaders in promoting technological self-reliance in the defense industry. Chinese authorities were especially keen to signal the industry's potency in offensive missile capabilities at a military parade in September 2015 to celebrate the 70th anniversary of the end of World War II, with more than half a dozen short-, medium-, and long-range ballistic missiles and cruise missiles on display. These included the DF-15B short-range ballistic missile, DF-21D and improved DF-26 medium-range antiship ballistic missiles, and DF-5B and DF-31A intercontinental ballistic missiles.

The accelerating pace of output of the Chinese defense economy is taking place at the same time as it is confronted with deep-seated structural problems. The principal constraints and weaknesses that the Chinese defense economy faces stem from its historical foundations and the uncertain efforts to overcome the corrosive legacy of its difficult past. The institutional and normative foundations and workings of the Chinese

defense industry were copied from the former Soviet Union's command defense economy and continue to exert a powerful influence.

The PLA and defense industrial regulatory authorities are seeking to replace this outdated top-down administrative management model with a more competitive and indirect regulatory regime, but there are strong vested interests that do not want to see any major changes.

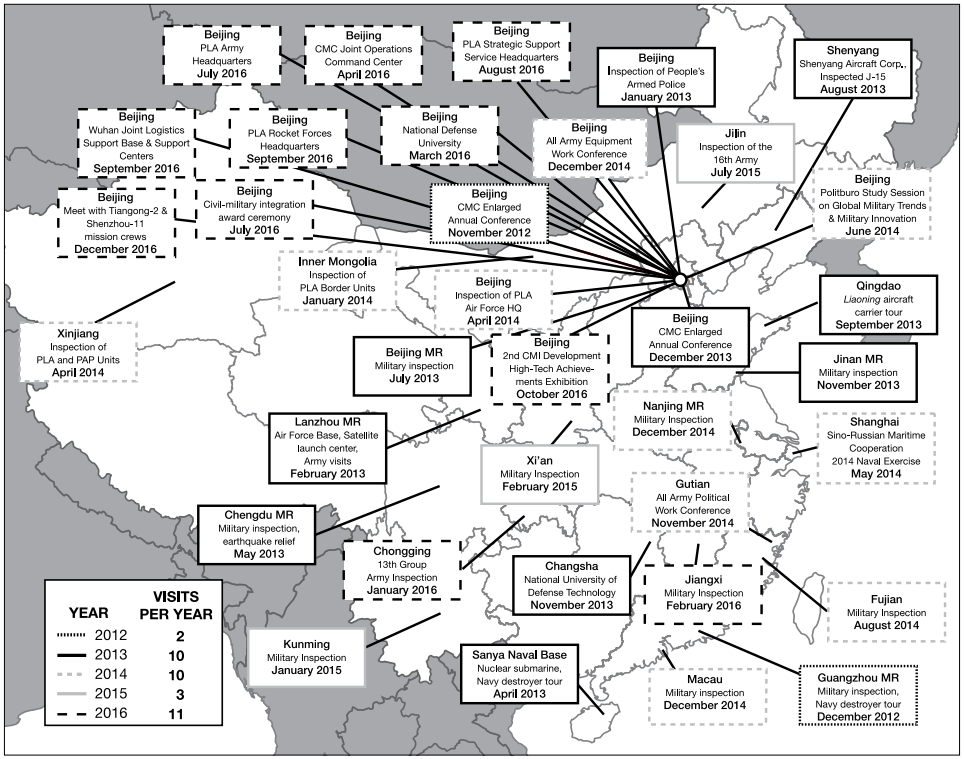
High-Level Leadership Support

High-level and sustained support and guidance from Chinese Communist Party, state, and military leadership elites have been essential in the defense industry's transformation efforts. Leadership backing and intervention have been vital in addressing entrenched bureaucratic fragmentation, ensuring adequate resource allocations, and tackling chronic project management problems. Without high-level leadership engagement, much of the recent progress of the defense industry probably would not have happened.

Leadership involvement in the defense industry often occurs through small groups and special committees. The committed involvement of the country's top leaders is especially critical, and the DATI system has been fortunate that Xi Jinping has taken a keen and active interest in defense science, technology, and innovation issues. Between November 2012 and October 2016, Xi took part in more than 30 publicly reported events related to PLA and DATI issues, which is considerably higher than his predecessors such as Hu Jintao or Jiang Zemin (see figure 2). Activities that signal his interest on defense S&T issues include:

- Inspection of the Liaoning aircraft carrier and J-15 carrier fighter plant in Liaoning Province in September 2013: within his first year as Central Military Commission (CMC) chairman, Xi made a high-profile visit to tour the Liaoning aircraft carrier in Dalian and look at the progress in the development of the J-15 fighter aircraft at Shenyang Aircraft Corporation. This was a clear demonstration of Xi's keen interest in China's naval airpower capabilities.

Figure 2. Publicly Reported Visits to Military and Defense Science and Technology–Related Facilities by Xi Jinping, November 2012–October 2016



- Tour of National University of Defense Technology in Changsha, Hunan, in November 2013: Xi has emphasized on his military visits that the defense science and technology (S&T) establishment's duty is to serve the needs of warfighters. He noted during an inspection at the National University of Defense Technology, the military's leading high-tech R&D establishment, that the work of defense scientists and engineers should be "closely linked with real combat and army service."[6] This fits with Xi's calls to the PLA to strengthen its preparations for "military struggle," which means enhancing combat readiness.
- Convening a Politburo study session on military innovation: Xi chaired a study session of the full Politburo in August 2014 devoted to the examination of global trends in military innovation. Xi pointed out that a global revolution in military S&T affairs is currently taking place "at a

speed so fast, in a scope so wide, at a level so deep, and with an impact so great that it has been rarely seen since the end of World War II."[7] Xi stated this represented both a challenge and opportunity that required China's defense establishment "to vigorously promote military innovation."

- Keynote speech at the All-Army Armament Conference in Beijing in December 2014: With the leaderships of the PLA's armament apparatus and defense industry in attendance, Xi affirmed the "historical achievement" in the PLA's weapons development, and urged accelerating the pace of construction. He emphasized the importance of "unifying thinking" and "gathering consensus," which may have been hints of policy differences over the Third Plenum reform issues.

Preparing for the Next Stage of Defense Industrial Advancement

The Xi administration signaled its intention to carry out a major overhaul of the defense industry as part of an ambitious national program of economic and military reforms at the Third Plenum of the 18th Party Congress in 2013. A flurry of activity since then by defense industrial decisionmakers has produced new medium- and long-term defense industrial development strategies, plans, and institutional arrangements that collectively represent a potentially key turning point in the defense industry's evolution from an innovation follower to becoming an original innovation leader.

The reform planning effort began in earnest in March 2014 when the CMC established a leading group on national defense and military reform. This group was headed by Xi Jinping and acted as the command headquarters for designing reform plans, coordinating work among different departments, and implementing policy.[8] The leading group conducted more than 800 forums and seminars involving 690 military units. After almost 2 years of investigation, a reform plan titled the Proposal on Deepening Defense and Military General Reform Plan was approved at the leading group's third meeting in July 2015. The plan was subsequently released at the CMC Working Conference on Reform in November 2015, which marked the formal start of the implementation of the most far-reaching structural reform of the PLA in its history.[9]

While the reforms focused on the PLA's central management, military regions, and services, they also had important implications for the armament management system, which plays a highly influential role in defense science, technology, and industrial matters. At the end of 2015, the PLA's armament system underwent a far-reaching reorganization:[10]

- The PLA General Armament Department (GAD) was reorganized into the CMC Equipment Development Department (EDD) [*zhuangbei fazhan bu*, 装备发展部] and given responsibility for "centralized unified management" [*jizhong tongguan*, 集中统管] of the military armament system.[11] One of the now-defunct GAD's chief roles was to oversee the armament development of the ground forces. GAD units responsible for this function have been transferred to the newly created PLA Army headquarters.
- The GAD Science and Technology Committee was elevated to a commission-level rank reporting directly to the CMC and renamed as the CMC Science and Technology Committee (CSTC) [*kexue jishu weiyuanhui*, 科学技术委员会].

Although it will take some time before these reforms are fully implemented and can be adequately assessed, some initial speculative thoughts can be offered. First, the promotion of the CSTC from the GAD to the CMC demonstrates that Chinese military authorities, especially Xi, are serious about engaging in higher end science, technology, and integration (STI) activities and establishing a high-level coordinating mechanism through the CSTC to provide operational leadership and guidance. Lieutenant General Liu Guozhi, who was the GAD S&T Committee director, will lead the CSTC. He has spent much of his career engaged in high-tech R&D. Liu has a doctorate in physics from Tsinghua University, is a member of the Chinese Academy of Sciences, and has technical expertise in accelerator physics and high-power microwave technology.[12]

Second, the ability of the EDD to carry out its mandate of providing centralized management of the armament system looks to have a greater chance of success than the GAD, which was hamstrung by its institutional

bias toward the ground forces. The nature of the relationship between the EDD and the armament departments belonging to the service arms will be critical in determining how much jointness versus compartmentalization will be present in PLA armaments development. The authority and influence of the EDD initially benefited from the appointment of GAD Director General Zhang Youxia as its head. Zhang reportedly has close ties with Xi through princeling-related links and was subsequently promoted to be a CMC vice chairman in October 2017.[13] The new EDD director is Lieutenant General Li Shangfu, who spent much of his career working in the space launch system before serving as a deputy director of the GAD and then as a deputy director of the Strategic Support Force.[14]

In parallel, the state defense industrial bureaucracy formulated new strategies and plans for a less ambitious but still significant adjustment to the defense industry as well as to chart its medium- and long-term transformation. One of these key plans is the 13th Defense Science, Technology, and Industry Five Year Plan (13th Defense S&T FYP). This plan was issued at the beginning of 2016 and sets out six key tasks through 2020:

- facilitating leapfrog development of weapons and military equipment
- enhancing innovation capabilities in turnkey areas
- improving overall quality and efficiency
- optimizing the structure of the defense industry and vigorously promoting civil-military integration (CMI)
- accelerating the export of armaments and military equipment supporting national economic and social construction
- supporting national economic and social construction.[15]

Compared to its predecessor, the 13th Defense S&T FYP has a stronger focus on the development of high-tech weaponry and civil-military integration. It also signals a significant shift in the direction of defense industry development from absorption and reinnovation to greater emphasis on original innovation. The 13th FYP also shows that China is seeking to build on the inroads it has been steadily making in the international arms market.

Chinese arms sales have almost doubled over the past 5 years, according to the Stockholm International Peace Research Institute.[16] China now supplies arms to 37 countries, with three-quarters of the exports to customers within the Asia-Pacific region, led by Pakistan, Bangladesh, and Myanmar.[17]

A longstanding Achilles' heel of the Chinese defense industry being addressed by defense planners is a lack of higher end manufacturing capability. In 2015–2016, SASTIND put together the Defense S&T Industry Strong Basic Engineering Project 2025 that is aligned closely with the national-level Made in China 2025 Advanced Manufacturing Plan aimed at lifting the overall level of the country's industrial equipment manufacturing base and curtailing excessive dependence on foreign core technology and products. The defense industry features prominently in the Made in China 2025 plan, especially in the space and aviation sectors.[18]

In a further signal of Chinese leaders' efforts to chart a long-term course for the country's defense S&T development, SASTIND announced in June 2015 that it was establishing a defense S&T Development Strategy Committee to conduct research and provide policy input that would help the country's leadership in its decisionmaking on long-term defense R&D over the next 20 to 30 years. The key goals of this committee are to implement the Communist Party leadership's strategic decisions and plans; focus on strategic, comprehensive, and forward-looking studies; and provide policy recommendations and consultation on defense S&T development and innovation.

This Development Strategy Committee is headed by the SASTIND director and its membership features many prominent figures in the Chinese national and defense scientific community, including 10 academicians from the Chinese Academy of Sciences and Chinese Academy of Engineering.[19] In addition, there are officials from a range of other governmental agencies such as the National Development and Reform Commission, Ministry of Education, Ministry of Science and Technology, Ministry of Finance, and PLA armament units.

Targeting Breakthroughs in Core Technological Capabilities

Another trend in the Chinese national and defense S&T system in the Xi era is a stronger emphasis on making breakthroughs in core technological capabilities, also referred to as turnkey technological capabilities. A key reason behind the focus on promoting breakthrough science and technology is Xi Jinping's belief in the critical role of advanced technology in enhancing China's competitiveness and acquiring international political power. Xi has commented that the previous IDAR (introduction, digestion, assimilation, and reinnovation) development strategy pursued by Hu Jintao's administration is no longer as effective today, since it has become much more difficult and often impossible for China to purchase core technologies from foreign countries. Those technologies can only be developed through original innovation.[20]

Hand in glove with this shift, in 2016 the Chinese leadership formally promulgated an "innovation-driven development" strategy, which aims to strengthen the country's original innovation capacity and enable China to move up the innovation ladder.[21] Identifying and making breakthroughs in turnkey technology areas is a key component of this new development strategy.

At the 5th Plenum in November 2015 that discussed the 13th FYP, Xi Jinping stressed that there must be more "serious prioritization" of "technological innovation in key sectors and implementation of important technological projects that affect the national big picture and long-term future"—a point he has made previously in multiple other venues. Xi also called for China to pursue an asymmetric strategy to catch up with developed countries, stating that "China should develop its own strengths and explore 'asymmetric' measures in core technologies that would otherwise be unlikely for China to catch up by 2050. More efforts should be put into these critical, bottleneck fields."[22]

A number of technological fields have been designated as turnkey for short-, medium-, and long- term development, and this is reflected in the selection of major projects. In his speech at the National Science

and Technology Conference in June 2016, Xi confirmed that China has decided to speed up implementation of 16 megaprojects, such as high-end all-purpose chips, integrated circuit equipment, broadband mobile communication, high-grade numerical machinery, nuclear power plants, and new drugs.[23] Many of these projects were included as high-priority developments in the 2006–2020 Medium- and Long-Term Science and Technology Development Plan.

Additionally, China is adding a new round of megaprojects that "embody national strategic intentions" with a timeframe of achieving breakthroughs in the industries by 2030. This new initiative is part of a new program called Science, Technology, and Innovation 2030 that was announced in the national 13th FYP. Projects selected for this program include aero-engine and gas turbines, quantum communication, information network and cyber security, smart manufacturing and robotics, deep-space and deep-sea exploration, key materials, neuroscience, and health care. To support this initiative, the Ministry of Science and Technology (MOST) requested proposals for its new National Key Research and Development Program in early 2016 in fields that are aligned with the 2030 Program.

Chinese authorities also announced plans in 2015 to establish large-scale national laboratories modeled on U.S. and foreign entities such as Los Alamos and Lawrence Berkeley national laboratories to support the pursuit of breakthroughs in big science endeavors. Xi Jinping has pointed out that "national laboratories are important vehicles in which developed countries seize the high ground in technological innovation."[24] For China, these national laboratories are viewed as critical platforms to accelerate fundamental and applied research that will enable it to reach the global frontier.[25]

The idea to establish national laboratories dates back to 2000, when MOST started an experiment to build seven national laboratories over 3 years.[26] Progress was very slow, however, and only two laboratories in Shenyang and Qingdao were established. Despite measured initial progress made by those pilot national laboratories in improving China's innovation

capability, their future prospects are unclear because of unstable financial support and divided opinions about the contributions of the laboratories to basic research.

However, as the new national laboratories initiative is labeled a key priority in the 13th FYP and has Xi's strong endorsement, this situation is expected to change. Xi stated that China

> urgently needs to establish comprehensive integrated national laboratories of greater dimensions and greater cooperation among disciplines, driven by national objectives and strategy and aimed at international technological frontiers to optimize the distribution and arrangement of talent and material resources and form a new structure of coordinated innovation.[27]

A series of national laboratories will be established in new sectors that create "important strategic innovation power that can take the international technological high ground."

As such, the old development model for pilot national laboratories will be abandoned. According to MOST officials, a new development plan is being drafted where MOST, the Ministry of Education, Chinese Academy of Sciences, and Chinese Academy of Engineering jointly study the national laboratory construction plan and the Ministry of Finance and the National Development and Reform Commission work on institutional mechanisms.[28] Though it is still too early to tell where this initiative will lead, the building of national laboratories will "represent major transformation of China's R&D system," according to Chinese Academy of Sciences president Bai Chunli.[29]

The new national laboratories will be significantly different from the existing pilot laboratories, both in scope of focused areas and development model. Instead of targeting single subjects, the new national laboratories will be multidisciplinary and will work in both civilian- and defense-related fields. It is not yet clear which technological sectors these national laboratories will be focused on, but if they are modeled on the U.S. system, then high-tech weapons R&D may be an important consideration. In addition

to these national laboratories, SASTIND has called for building defense laboratories and defense science, technology, and industry innovation centers to further support China's national defense S&T innovation system.[30]

Vigorously Promoting Civil-Military Integration

CMI has been promoted in China since the early 2000s but with little tangible success because of limited leadership engagement, unclear strategy, ineffective implementation, and weak civil-military coordination. Despite the weak progress, Chinese civilian and military authorities see CMI as essential in the drive for original innovation and defense modernization.

Efforts to promote CMI have focused primarily on reforms of state-owned defense conglomerates and on the implementation of policies, platforms, and other mechanisms by which private-sector technology can flow smoothly into defense projects.[31] Each of the half a dozen sectors that make up the Chinese defense industry is controlled by one or two defense corporations. Efforts to promote competition in the late 1990s by dividing these monopolistic behemoths into competing entities were largely a failure because of poor institutional design. Consequently, Chinese authorities began to remerge these firms, especially so they could compete with much larger foreign firms on the global arms market. This began in the late 2000s with the consolidation of the aviation sector, but there was a long hiatus before the next merger took place at the beginning of 2018 between the two principal firms in the nuclear sector, China National Nuclear Corporation and China National Engineering Corporation. The shipbuilding industry appears next in line for restructuring as one of its two dominant conglomerates, China State Shipbuilding Corporation, has been adversely affected by a sharp downturn in the global civilian shipbuilding market.

The transfer of state-owned defense technology to the private sector also receives strong emphasis in the plan and is important to support China's "innovation-driven development" and the financing of China's defense industry. China's efforts to increase its high-tech industrialization through programs such as the Made in China 2025 plan also feed directly into CMI,

and efforts have been made to coordinate these programs to emphasize areas that will directly benefit China's defense industry.

In 2007, Hu Jintao attempted to broaden CMI's scope and push for deeper implementation, although with only limited success. Ultimately, Hu's aim to implement "overall coordination" [*tongchou guihua*, 统筹规划] stalled due to persistent obstacles such as poor coordination among top-level decisionmaking bodies, insufficient regulatory structures to allow transfer of technology between civilian and military entities, poor intellectual property rights (IPR) protection, especially for defense industry–originated IPR, and lack of universal industry and technology standards across civilian and military sectors. While Hu's attempt at top-down leadership support should have been enough to catalyze CMI implementation, it proved insufficient to mobilize all the needed actors and agencies.

Two modest successes of Hu's push include broadening the thinking on CMI away from its former limited understanding of "combining the civilian and military sectors" [*junmin jiehe*, 军民结合] to an understanding more reflective of the deep implementation required through "integration of civilian and defense sectors"; and broadening the scope of CMI to include all available economic resources in the promotion of the defense industry, including capital, technology, human capital, facilities, and information.[32]

The Xi administration has made a renewed push to make CMI a viable policy tool. CMI has been relabeled as military-civil fusion (MCF) [*junmin ronghe*, 军民融合] to distinguish the new approach. To address deficiencies in the previous CMI strategy that was ad hoc, structurally misaligned, and of low policy importance, Xi designated MCF as a national priority in 2015 and defined it as a development strategy. According to Xi, a central goal of the MCF strategy is to build an "integrated national strategic system and strategic capabilities." The development of such a strategic system and capabilities will allow China to "implement key science and technology projects and race to occupy the strategic high ground for science and technology innovation."[33]

Key elements of this national strategic system are detailed in some of the MCF implementation plans that have been formulated since the

adoption of the MCF strategy. This includes the 13th 5-Year Special Plan for Science and Technology MCF Development issued in 2017 by the CSTC and MOST. This plan detailed the establishment of an integrated system to conduct basic cutting-edge R&D in artificial intelligence, biotechnology, advanced electronics, quantum, advanced energy, advanced manufacturing, future networks, and new materials "to capture commanding heights of international competition."[34] This plan also noted the pursuit of MCF special projects in areas such as remote-sensing, marine-related technology, advanced manufacturing, biology, and transportation.

The political significance of MCF gained even more prominence with the formation of the "Commission for Integrated Civilian-Military Development" (CICMD) [*zhongyang junmin ronghe fazhan weiyuanhui*, 中央军民融合发展委员会] in January 2017. The importance of this organization in leading MCF policymaking and implementation was made clear with the appointment of Xi as its chair and Premier Li Keqiang as a vice chair. At the CICMD's first meeting in June 2017, Xi stated that there was a "short period of strategic opportunity" to implement MCF, pointing out the most fruitful areas that included infrastructure, equipment procurement, training, military logistics, and defense mobilization.[35] In its September 2017 meeting, the CICMD issued a series of plans and guidelines tied to the 13th Five Year Plan on MCF that covered defense industrial development and military logistics.[36]

Supporting High-Tech Defense Industrialization

The Chinese authorities are currently engaged in a comprehensive effort to boost advanced manufacturing capabilities in high-tech industries, of which defense and dual-use capabilities are a central priority. Led primarily by civilian agencies, this effort aims to support China's innovation-driven development strategy that focuses on broader economic growth. For the defense industry, directing China's overall plans to develop its high-tech industries with particular emphasis on CMI-related industries is a key factor that will enable it to produce innovation at higher levels.

Chief among China's actions to develop its manufacturing base is the Made in China 2025 plan issued in May 2015. The plan outlines a three-step strategy for China to comprehensively upgrade its industrial economy and achieve its goal of becoming a world-leading manufacturer by 2049.[37] The plan outlines policies to deepen institutional reforms, strengthen financial and tax support, complete a talent training system, and also introduces five sub-plans intended to facilitate government involvement when market mechanisms alone are insufficient.[38] The plan also prioritizes 10 industrial sectors for policy and funding support:

- new-generation information technology
- automated machine tools and robotics
- space and aviation equipment
- maritime equipment and high-tech shipping
- modern rail transportation equipment
- new energy vehicles and equipment
- power generation equipment
- agricultural equipment
- new materials
- bio-pharmaceutical and advanced medical products.

Close coordination took place between civilian and defense agencies in drafting the Made in China 2025 plan to emphasize CMI priorities, including space and aviation equipment, high-tech shipping, and new materials. SASTIND continues to be closely involved in the implementation of the plan. In June 2015, the State Council established a "State Strong Manufacturing Power Building Leading Small Group" [*guojia zhizao qiangguo jianshe lingdao xiaozu*, 国家制造强国建设领导小组] led by Vice Premier Ma Kai and administered by Ministry of Industry and Information Technology (MIIT) to oversee Made in China 2025. SASTIND Director Xu Dazhe sits as 1 of 20 representatives on the leading small group, as do many other leaders of major agencies with a vested interest in CMI development.[39] The body also directs the work of other subgroups, such as the " Manufacturing Power

Building Strategy Advisory Group" [*zhizao qiangguo jianshe zhanlüe zixun weiyuanhui*, 制造强国建设战略咨询委员会], which also includes SASTIND representatives, and is tasked with issuing a technical "green paper" every 2 years to act as an update to the 10 original sectors in the Made in China 2025 plan.[40] All indicators are that CMI-related industries will continue to receive priority attention in these plans. SASTIND is also preparing a Defense S&T Industry 2025 plan that will set additional goals toward development of CMI-related industries. Information on this plan has been scarce, but there is a large expectation that turbo-fan engines will receive significant focus.[41]

Outside of Made in China 2025, many additional efforts are being made to strengthen China's high-tech industrialization. One such industry receiving attention from many fronts is the integrated circuit (IC) industry, which has been the focus of a new State Council plan titled Guidelines on Developing and Promoting the National Integrated Circuit Industry,[42] a new leading small group named the "Leading Small Group for IC Industry Development" [*jicheng dianlu chanye fazhan lingdao xiaozu*, 集成电路产业发展领导小组],[43] and an approximately $25 billion National Integrated Circuit Industry Investment Fund.[44] MIIT's Special Action Implementation Program calls for creating military IC products and the promotion of civil-military IC production lines, and the 2016 SAP states that a Civil-Military Dual-Use Integrated Circuit Development Special Action Plan will be drafted along with a document outlining "high-level plans and programs" for the IC industry development in CMI areas.[45] These efforts—and continued movements as China deepens CMI implementation—are intended to produce a defense R&D base more capable of sourcing prime technology domestically.

Restructuring the Defense Research Institute System

Although the Chinese defense industry has made significant progress transitioning from centralized planning to a market-oriented modern enterprise system, one overlooked area has been the status of research institutes (RIs) that belong to or are affiliated with the big 10 defense corporations. While

these RIs are a core component of the R&D capabilities of the defense firms, they are designated as "government-affiliated institutions" [*shiye danwei*, 事业单位], which means they are subject to state ownership restrictions and cannot be restructured into listed entities.

Many defense RIs have developed advanced technologies that are potentially lucrative and are viewed as cash cows by their parent defense corporations. For example, 30 percent of the profits of the China Shipbuilding Industry Corporation in 2014 reportedly came from its 28 RIs.[46] The barriers in listing defense RIs have become a major bottleneck for the defense industry's ongoing efforts to securitize their assets on the capital markets. Besides the ownership problem, the corporate restructuring of defense RIs has also run into difficulties in other areas. The issues include asset management, personnel placement, income distribution, social welfare, taxation, and secrecy considerations.

However, the restructuring of defense RIs is viewed as critical to overall efforts to reform the defense industry and to improve innovation capacity.[47] Consequently, in 2016, Chinese authorities began tackling defense RI reform and drafted a number of reform policies. These include the Scheme on Classification of Defense Research Institutes, Defense Research Institutes Classified Reform Implementation Plan, and Supporting Policies on the Restructuring of Defense Research Institutes under Public Institution Reform. In the latter document, SASTIND drafted a total of 31 policies on party-building, personnel placement, income distribution, social welfare, and security and secrecy issues.[48] In addition, defense RIs will be divided into three categories that will determine the nature of their ownership structures.[49] These proposals were then sent to the major defense corporations for comments, and it now appears that the long-awaited RI restructuring process may begin.[50] Defense corporations with the largest number of RIs, such as the two space and missile conglomerates China Aerospace Science and Technology Corporation and China Aerospace Science and Industry Corporation, will be allowed to take the lead in reform implementation.[51]

Chinese authorities hope that a successful restructuring of the defense RIs will be a colossal boost for the defense industry. Analysts argue that this will significantly promote innovation, optimize resource allocations, increase the efficiency in state investment, facilitate civil-military integration, and bring in more investment for defense R&D from the capital markets.[52]

In addition to the reform of the defense RI system, the country's civilian R&D apparatus is being overhauled to make it more capable and effective in producing higher end innovation. One major initiative is the consolidation of S&T plans operated by numerous state agencies into just five plans. This streamlining is intended to address structural problems such as duplication, nontransparency, and corruption that have caused widespread waste and inefficiency. Key plans that have or will be merged include the 863 Plan, the 973 Plan, and the National Science and Technology Infrastructure Plan that is managed by MOST. Research plans administered by the National Development and Reform Commission and MIIT will also be affected. The five new comprehensive S&T plans will be:

- National Natural Science Fund
- National Major Science and Technology Plan
- National Key R&D Project (NKRDP)
- Special Fund for Technology Innovation and the R&D Base
- Professional Special Plan.[53]

The NKRDP is by far the largest and most important of these five new plans and was officially established in February 2016. It is designed to be as wide-ranging and inclusive, supporting research and development in areas such as agriculture, health care, energy, environment, industrial competitiveness, innovation, and national security.[54] Unlike the legacy programs that the NKRDP replaces, which were divided according to their position on the R&D spectrum from basic research to engineering development, the new plan covers all phases from research to development and production with the goal of improving commercialization rates.[55] The other four

remaining plans were expected to be launched at the end of 2016, although full-scale implementation was not scheduled until 2019.[56]

Leveraging Capital Markets for Defense Investment

The defense industry is being opened up to the capital markets, and the big 10 state-owned defense corporations are seeking to take advantage of the lucrative financial opportunities that this may offer for them to better manage and leverage their assets. With enough recent orders to keep production lines churning, a pipeline full of new generations of equipment under development, and plenty of high-level leadership support, the defense industry is attracting plenty of interest from a growing proliferation of domestic investment vehicles that has appeared in the past couple of decades, and especially in the past few years.

While defense companies have been allowed to list subsidiaries on stock markets in China and Hong Kong since the early 1990s, this was limited to their civilian operations. Chinese authorities—led by the Commission for Science, Technology, and Industry for National Defense—began to prepare defense firms to tap into the capital markets from the mid to late 2000s by establishing a regulatory framework to ensure a secure and orderly process (see table for details). Detailed procedures were promulgated in 2007 that emphasized three principles: allow nonpublic capital to enter the defense industry, encourage the defense industry to make increased use of capital markets, and encourage the defense industry to diversify investments and ownership.[57] An initial round of deals were allowed to take place in 2007 in the shipbuilding and aviation sectors.[58] Additional guidelines followed that encouraged further opening up to capital markets by the defense industry.

Table. State Guidelines Promoting Diversification of Investments and Use of Capital Markets by Defense Industry			
February 2007	Guiding Opinions from COSTIND Regarding Non-Public Ownership Economic Participation in Construction of Defense S&T Industry[1]	COSTIND	Encourage and guide non-public capital to enter defense S&T industries; encourage non-publicly owned enterprises through purchasing shares, shareholding, and mergers and acquisitions to participate in developing civil-military dual-use products that emphasize nonmilitary uses.
March 2007	Guiding Opinions Regarding the Development of Defense S&T Industry for Civilian Industry[2]	COSTIND	Fully utilize capital markets to promote industrial development; encourage introduction of capital into military and civilian enterprises through acquisitions, asset swaps, and joint ventures; encourage companies that sell military products approved for nonmilitary production to list.
March 2007	Certain Opinions Regarding Deepening Reform of Investment System for Defense S&T Industry[3]	COSTIND	Promote diversification of investment and ownership in defense S&T enterprises; expand investment from the social sphere in defense S&T industry to implement management of different classes divided into open, restricted, and prohibited classes.
May 2007	Guiding Opinions Regarding Promoting Shareholding System Reform for Defense S&T Industry[4]	COSTIND	Complete shareholding reform for qualified military industrial enterprises; diversify investments; promote the establishment of modern enterprise structures and modern ownership structures by military industrial enterprises.
November 2007	Interim Measures for Implementation of Shareholding Reform for Defense Enterprises[5]	COSTIND	Allow domestically listed companies to reacquire military industrial enterprises.
October 2010	Certain Opinions Regarding Establishment and Improvement of Civil-Military Integration of Weapons and Equipment Research and Production Systems[6]	COSTIND	Promote shareholding reform through asset restructuring, listing, mutual shareholding, mergers and acquisitions; actively and steadfastly promote the reform of military research institutes and actively promote the applied research institutes to restructure along the commercial basis; establish modern enterprise systems or convert into large corporate R&D centers.
March 2011	"Guiding Opinions Regarding Categorically Promoting Reform of Public Institutions"[7]	COSTIND	Promote the reform of public institution, and particularly for scientific institutions, promote the reform of production activities.
June 2012	"Implementation Opinions for Encouraging and Guiding Private Capital in Entering Defense Industries"	COSTIND	Encourage and guide private capital in entering defense industries; allow private companies to undertake R&D and production tasks for weapons and equipment; guide and support the involvement of private capital in restructuring of military enterprises; encourage private capital to undertake R&D for technologies fit for both military and civil uses.
August 2013	Rules for Defense S&T and Industry Fixed Assets Investment Program Management	COSTIND	Allow defense corporations to undertake large-scale share placements using military assets as securitization.
April 2014	Guidelines on Promoting Civil-Military Integration	COSTIND	Make new progress in giving private capital access to the defense industry.
January 2016	Related Issues for Non–State Owned Enterprises Applying for Military Industrial Fixed Assets Investment Programs	COSTIND	Outlines methods by which non–state owned actors can invest in fixed assets of defense industry.

Key: COSTIND: Commission for Science, Technology, and Industry for National Defense; CMC: Central Military Commission; R&D: research and development; S&T: science and technology; SASTIND: State Administration for Science, Technology, and Industry for National Defense.

Notes

[1] "Guiding Opinions from COSTIND Regarding Non-Public Ownership Economic Participation in Construction of Defense S&T Industry" [关于印发《非公有制经济参与国防科技工业建设 指南》的通知], Commission for Science, Technology and Industry for National Defense, People's Republic of China, August 8, 2007, available at <www.gov.cn/zwgk/2007-08/07/content_708284.htm>.

[2] "Guiding Opinions Regarding the Development of Defense S&T Industry for Civilian Industry" [《大力发展国防科技工业民用产业的指导意见》发布], Commission for Science, Technology and Industry for National Defense, People's Republic of China, March 2, 2007, available at <www.gov.cn/gzdt/200703/02/content_539623.htm>.

[3] "Certain Opinions Regarding Deepening Reform of Investment System for Defense S&T Industry" [《深化国防科技工业投资体制改革的若干意见》], Commission for Science,Technology and Industry for National Defense, People's Republic of China, March 5, 2007, available at <www.china.com.cn/policy/txt/200703/05/content_7905219.htm>.

[4] "Guiding Opinions Regarding Promoting Shareholding System Reform for Defense S&T Industry" [国防科工委 发展改革委 国资委关于推进军工企业股份制改造的指导意见], Commission for Science, Technology and Industry for National Defense, People's Republic of China, June 23, 2007, available at <www.gov.cn/gzdt/2007-06/23/content_658955.htm>.

[5] "Interim Measures for Implementation of Shareholding Reform for Defense Enterprises" [《军工企业股份制改造实施暂行办法》], Commission for Science, Technology and Industry for National Defense, People's Republic of China, November 21, 2007, available at <http://gov.finance.sina.com.cn/chanquan/2007-11-21/50173.html>.

[6] "Certain Opinions Regarding Establishment and Improvement of Civil-Military Integration of Weapons and Equipment Research and Production Systems" [国务院中央军委关于建立和完善军民结合寓军于民武器装备科研生产体系的若干意见], State Council and Central Military Commission, People's Republic of China, October 24, 2010, available at <www.jxgb.gov.cn/2011-1/20111111433114.htm>.

[7] "Guiding Opinions Regarding Categorically Promoting Reform of Public Institutions" [中共中央国务院关于分类推进事业单位改革指导意见], State Council, People's Republic of China, March 23, 2011, available at <www.gov.cn/jrzg/2012-04/16/content_2114526.htm>.

The initiative to allow firms to tap the domestic equity markets was curtailed by the 2008–2009 global financial crisis, and this hiatus continued into the early 2010s. As a consequence, many defense companies delayed undertaking management, financial, and other reforms, such as becoming shareholding entities that would allow them to issue shares to outside investors.

The situation changed in 2013 when SASTIND began to permit firms to issue share placements using military assets as securitization.[59] This opening up of the defense industry to investment from capital markets is part of a broader initiative by Chinese authorities to forge closer integration between the science and technology system and financial markets. Premier Li Keqiang stated in 2014 that:

> it is necessary to increase the efficiency of science and technology innovations with institutional innovation . . . and let the market decide allocation of innovative resources. We should intensify financial support, guide more enterprises and social capital to increase input in research and development. We should pay particular attention to activating stock assets and enhance capital usage efficiency.[60]

China Shipbuilding Industry Corporation (CSIC) became the first defense firm to undertake a private share placement in September 2013 and raised Rmb 8.5 billion ($1.4 billion) from 10 Chinese parties to acquire production facilities to manufacture warships. More than one-third of the funds (Rmb 3.275 billion) was earmarked for the acquisition of medium- and large-sized surface warships, conventional submarines, and large landing ships, while Rmb 2.66 billion was designated for arms trade–related undertakings and civil-military industrialization projects, and the remaining Rmb 2.54 billion was allocated as working capital.[61] CSIC explained that the funds would "satisfy the development and manufacture of a new generation of weapons and equipment," adding that "we need urgent large-scale technological improvements and need to expand our financing channels."[62] Dalian Shipyard is one of the CSIC facilities that are slated to receive proceeds from the share placement, and it is reportedly China's first domestically designed aircraft carrier.[63]

All 10 big defense conglomerates have begun actively issuing public and private equity offerings and bond issuances, although to varying degrees. Total funds raised in public and private equity offerings between 2010 and June 2016 totaled nearly Rmb 207.6 billion ($31.14 billion), with most of these funds going specifically to military development projects. Funds raised decreased from 2010 to 2012, but have significantly increased annually thereafter. Funds raised in 2016 were expected to register a significant jump from 2015, as total funds raised in the first half of the year had already exceeded total funds raised in 2015 by Rmb 4.3 billion ($645 million).[64]

The shipbuilding and aviation industries raised by far the largest amount of funds, significantly dwarfing the other defense industrial sectors. Between 2010 and June 2016, the shipbuilding industry raised Rmb 63 billon ($9.45 billion) while the aviation sector brought in Rmb 65 billion ($9.75 billion). The space industry raised Rmb 31.9 billion ($4.79 billion), ordnance industry Rmb 27.1 billion ($4.07 billion), electronics industry Rmb 17.3 billion ($2.6 billion), and nuclear industry came last with Rmb 3.4 billion ($510 million). See figure 3.

Bond issues by defense firms were also substantial and totaled Rmb 211.5 billion ($31.73 billion) between 2010 and June 2016. Shipbuilding came first in total bonds raised during this period with Rmb 101.8 billion ($15.27 billion). Surprisingly, the nuclear industry came second with Rmb 40.8 billion ($6.12 billion). Space came in third at Rmb 20 billion ($3 billion),

Figure 3. Chinese Defense Corporate Equity Deals, 2010–June 2016

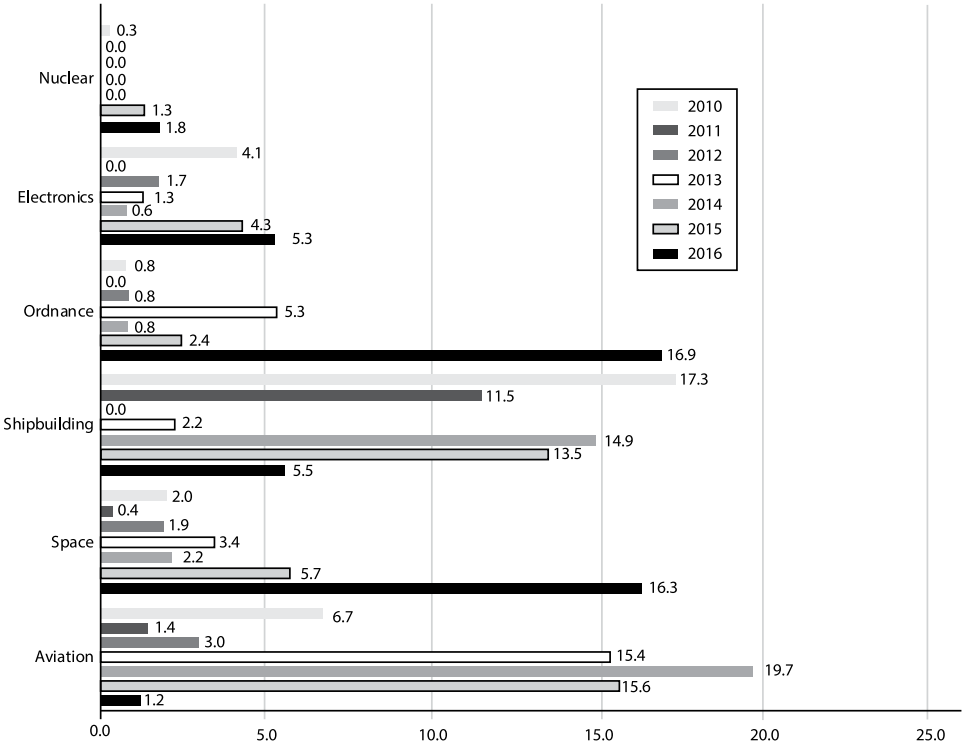
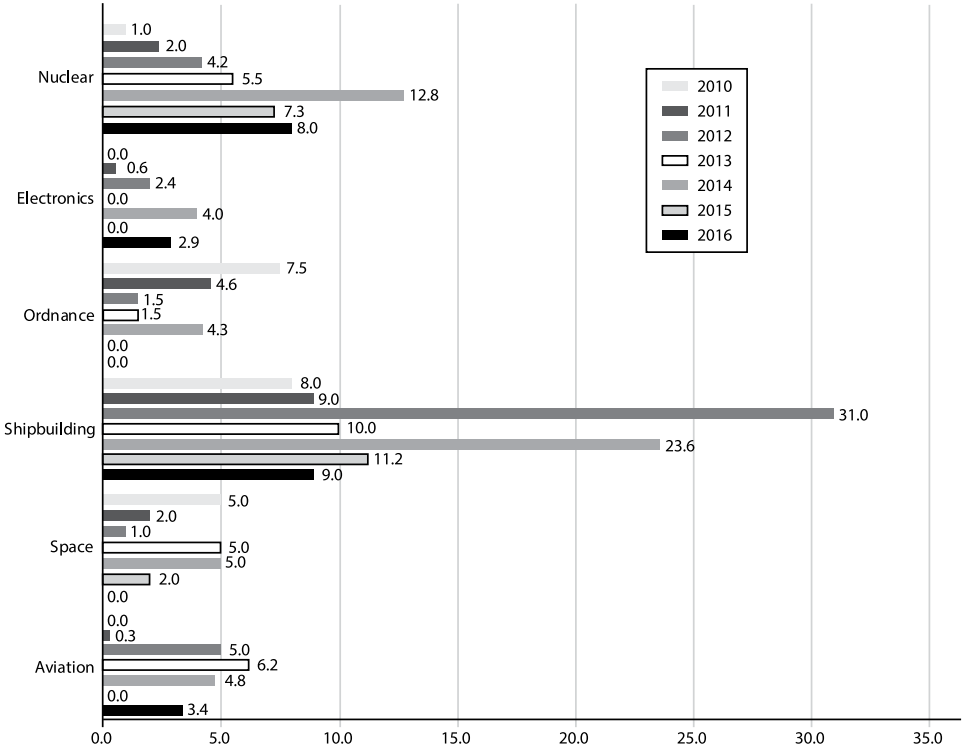


Figure 4. Chinese Defense Corporate Debt Issuances, 2010–June 2016

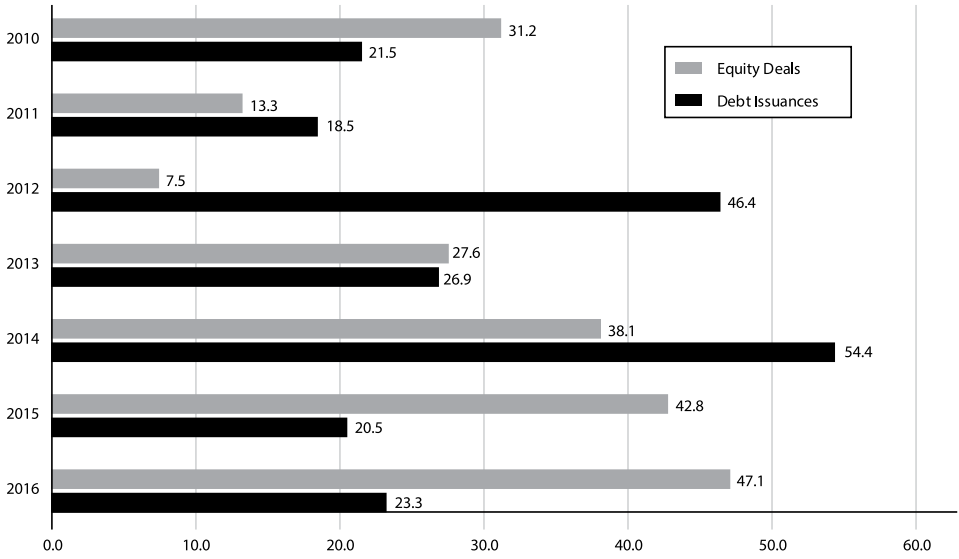


followed by aviation at Rmb 19.6 billion ($2.94 billion) and ordnance with Rmb 19.4 billion ($2.19 billion). Electronics came last with Rmb 9.9 billion ($1.49 billion). See figure 4.

Total equity and bond offerings between 2010 and June 2016 reached Rmb 419.16 billion ($62.87 billion), which is equivalent to 8.9 percent of the official Chinese defense budget total of Rmb 4.7 trillion ($704.39 billion) for the same period. See figure 5.

Defense corporations will be able to continue to raise large amounts from asset securitization deals and bond issues as well as from bank loans in the coming years. As of March 2016, the big 10 defense companies had 80 subsidiaries listed on China's stock exchanges, which accounted for around 25 percent of their total assets.[65]

Figure 5. Chinese Defense Corporate Equity Deals and Debt Issuances, 2010–June 2016



Analysts estimate that if China follows the United States, which has around 70 percent of defense industrial assets listed, this could allow Chinese firms to raise upward of another Rmb 1 trillion of funds. Aviation Industry Corporation of China's Deputy General Manager Wu Xiandong stated, "Not all military industrial enterprises are suitable to marketize and undergo shareholder reform, but the vast majority are suitable."[66] As an example of the magnitude and speed of growth at which the Chinese firms may grow, the China Aerospace Science and Technology Corporation plans to triple its asset securitization rate from its current 15 percent to 45 percent by the end of the 13th Five-Year Plan.[67] Other defense conglomerates can be expected to strive toward similar growth.

Weaknesses in the Chinese Defense Industry

The principal constraints and weaknesses that the Chinese defense industry faces at present stem from its historical foundations and uncertain efforts to overcome the corrosive legacy of its difficult past.[68] The institutional and normative foundations and workings of the Chinese defense

industry were copied from the former Soviet Union's command economy and continue to exert a powerful influence. The PLA and defense industrial regulatory authorities are seeking to replace this outdated top-down administrative management model with a more competitive and indirect regulatory regime, but there are strong vested interests opposed to any major changes.

Monopolies

One of the biggest hurdles that PLA and civilian defense acquisition specialists point out is the defense industry's monopoly structure. Little competition exists to win major weapons systems and defense equipment because each of China's six defense industrial sectors is closed to outside competition and is dominated by a select handful of state-owned defense corporations. Contracts are typically awarded through single-sourcing mechanisms to these corporations. Competitive bidding and tendering only takes place for noncombat support equipment, such as logistics supplies.

An effort in 1999 to inject more competition by splitting corporations that monopolized their sectors into two separate entities did little to curb monopolistic practices because these firms focused on different areas of business in their domains and there was little direct rivalry. These powerful defense firms have subsequently sought to reverse this effort at demonopolization by finding ways to remerge or collaborate. In 2008, the aviation industry made the first and so far only successful challenge by consolidating its two post-1999 entities back into a single monopoly structure. There have been occasional reports that the space and shipbuilding sectors might also seek to reestablish a single holding company arrangement.

Bureaucratic Fragmentation

A second serious weakness that has seriously handicapped the effectiveness of Chinese defense economy is bureaucratic fragmentation. This is a common characteristic of the Chinese organizational system,[69] but is especially virulent within the large and unwieldy defense sector. A key

feature of the Soviet approach to defense industrialization that China imported was a highly divided, segmented, and stratified structure and process. There was strict separation between the defense and civilian sectors as well as between defense contractors and military end-users, compartmentalization between the conventional defense and strategic weapons sectors as well as among the different conventional defense industrial subsectors, and division between R&D entities and production units. Key reasons for this excessive compartmentalization include an obsessive desire for secrecy and the powerful influence of the deeply ingrained Chinese model of "vertical functional systems" [*tiao tiao*, 条条] that encouraged large-scale industries like those in the defense and supporting heavy industrial sectors, such as iron, steel, and chemicals, to become independent fiefdoms.

This severe structural compartmentalization is a major obstacle to the development of innovative and advanced weapons capabilities because it requires consensus-based decisionmaking that is carried out through extensive negotiations, bargaining, and exchanges. This management by committee is cumbersome, risk-adverse, and results in a lack of strong ownership that is critical to ensure that projects are able to succeed the thicket of bureaucratic red tape and cut-throat competition for funding.

The research, development, and acquisition (RDA) system also suffers from compartmentalization along many segments of the RDA process. Responsibilities for research and development, testing, procurement, production, and maintenance are in the hands of different units, and under-institutionalization has meant that linkages among these entities tend to be ad hoc in nature with major gaps in oversight, reporting, and information-sharing.[70] The fragmented nature of the RDA process may help to explain why Hu Jintao was apparently caught by surprise by the first publicized test flight of the J-20 fighter aircraft that occurred during the visit of U.S. Defense Secretary Robert Gates in January 2011.[71]

Weak Management Mechanisms

A third major weakness is that the PLA continues to rely on outdated administrative tools to manage projects with defense contractors in the absence of the establishment of an effective system. The PLA did implement the use of contracts on a trial basis in the late 1980s with the introduction of a contract responsibility system.[72] These contracts are administrative in nature, though, and have little legal rights because of a lack of a developed legal framework within the defense industry. Consequently, contracts are vague and do not define obligations or critical performance issues, such as quality, pricing, or schedules. Contracts for complex weapons projects can be as short as 1 to 2 pages, according to analysts.[73]

Moreover, the PLA acquisition apparatus is woefully backward in many other management approaches and tools that it uses compared to its counterparts in the United States and other advanced military powers. It has yet to adopt total life-cycle management methods, for example, and many internal management information systems are on standalone networks that prevent effective communications and coordination. One analyst stated that this often meant that the only way for project teams to exchange information was through paper transactions.[74]

Outdated Pricing Regime

A fourth serious weakness is the lack of a transparent pricing system for weapons and other military equipment, representing a lack of trust between the PLA and defense industry. The existing armament pricing framework is based on a cost-plus model that dates back to the planned economy, in which contractors are allowed 5 percent profit margins on top of actual costs.[75] There are a number of drawbacks to this model that hold back efficiency and innovation. One is that contractors are incentivized to push up costs as this would also drive up profits. Another problem is that contractors are not rewarded with finding ways to lower costs such as through more streamlined management or more cost-effective designs or manufacturing techniques. Contracts rarely have performance incentives,

which discourage risk-taking and any willingness to adopt innovative approaches. Yet another issue is that contractors are dissuaded from making major investments in new technological capabilities or processes because of the low 5 percent profit margin that is available.

To address this longstanding problem, the PLA, Ministry of Finance, and National Development and Reform Commission held a high-level meeting on armament pricing reform in 2009 that concluded the outdated pricing system had seriously restricted weapons development and innovation.[76] A number of reform proposals were put forward that provide incentives to contain costs, switch from accounting procedures that focus on ex post pricing to ex ante controls, and expand from a single-pricing methodology to multiple pricing methods. Some of these ideas were incorporated in a document issued after the meeting titled "Opinions on Further Pushing Forward the Reform of Work Concerning the Prices of Military Products."

At the beginning of 2014, the GAD announced that it would conduct and expand on pilot projects on equipment pricing. These reforms include the strengthening of the pricing verification of purchased goods, improving cost controls, and shifting from singular to plural pricing models, from "after-purchase pricing" to "whole-process pricing," and from "individual-cost pricing" to "social average–cost pricing."[77] These represent modest steps in the pricing reform process, but the PLA will continue to face fierce opposition from the defense industry on this issue.

Corruption

A fifth impediment is corruption, which appears to have thrived with the defense industry's uncertain transition from centralized state planning to a more competitive and indirect management model.[78] PLA leaders have highlighted the RDA system as one of a number of high-risk areas in which corruption can flourish along with the selection and promotion of officials, enrollment of students in PLA-affiliated schools, funds management, and construction work.[79]

At the PLA's annual conference on military discipline inspection work in January 2014, CMC Vice Chairman General Xu Qiliang, who heads the PLA's anti-corruption efforts, pointed out that armament research, production, and procurement was one of two areas that required "better oversight."[80] The other area that Xu highlighted was construction projects, which have been plagued by a number of high-profile corruption scandals in recent years including the case of the General Logistics Department Deputy Director Lieutenant General Gu Junshan, who amassed a huge fortune from lucrative real estate kick-backs.[81]

The almost complete absence of public reporting on corruption in the defense industry and RDA system means that the extent of the problem is not known. Military authorities justify this lack of transparency, as many of the cases involve classified programs. In the latest anti-corruption crackdown that began with Xi Jinping's ascent to power at the 18th Party Congress in November 2012, there have only been a handful of cases of defense industry executives being arrested on corruption charges.[82] A rare instance of official reporting into defense industrial–related corruption was when the Central Discipline Inspection Commission sent a team to investigate SASTIND for 2 months in the spring of 2016. SASTIND was required to set up a "comprehensive rectification program" [*fankui zhuanxiang*, 反馈专项] covering 100 measures and the investigation led to 2 officials being subject to "party discipline" [*dangji zhengji chufen*, 党纪政纪处分], 14 officials were "verbally admonished" [*jiemian tanhua*, 诫勉谈话], 3 officials were moved from their positions, and 10 officials were given letters of criticism.[83]

Implications for U.S.-China Military Technological Competition

Chinese defense industry efforts to successfully transition from an innovation follower to an original innovator able to engage in higher end technological development appear likely to succeed because of the confluence of powerful factors discussed in this chapter. What are the implications for the intensifying military technological competition with the United States from a more capable and innovative Chinese defense industry?

First, as the Chinese defense industry becomes more self-reliant and less dependent on foreign sources, this will allow it greater ability to forge a more independent development path. This is an important policy consideration because Chinese analysts have pointed out that a key goal in the U.S. Third Offset Strategy is to lure potential adversaries to compete in areas that the United States chooses and in which it enjoys a decisive advantage. According to one analysis in the *PLA Daily*, China should avoid this temptation and "persevere in taking our own development road, continue to stress and strengthen the domains where we enjoy superiority, and not be influenced by the United States."[84]

Second, as the pace and intensity of the Chinese defense industry's restructuring efforts quicken, the United States will find it has a narrowing window of opportunity to pursue the Third Offset and other related initiatives and restore its strategic superiority before China is able to catch up in critical areas. The next 5 to 10 years could be a decisive period in shaping the nature of U.S.-China military technological competition. This is a viewpoint that is shared by Chinese decisionmakers, including Xi Jinping, who see China engaged in a zero-sum global race for technological leadership in both the civilian and defense S&T domains.[85]

Notes

[1] "China Announces 7.6 Percent Defense Budget Rise, Lowest in Six Years," Xinhua, March 5, 2016, available at <www.xinhuanet.com/english/2016-03/05/c_135158243.htm>.

[2] "China Civil-Military Integration Development Report 2015" [中国军民融合发展报告2015] (Beijing: National Defense University Press [国防大学出版社], 2016), 59.

[3] *The PLA Navy: New Missions and Capabilities for the 21st Century* (Suitland, MD: U.S. Office of Naval Intelligence, April 13, 2015), available at <https://fas.org/nuke/guide/china/plan-2015.pdf>. See also Tai Ming Cheung, "Innovation in China's Defense Technology Base: Foreign Technology and Military Capabilities," *Journal of Strategic Studies* 39, nos. 5–6 (2016), 728–761.

[4] *The PLA Navy*, 15.

[5] Ibid., 13.

[6] "Xi Stresses Military Talent," Xinhua, November 6, 2013, available at <www.china.org.cn/china/third_plenary_session/2013-11/06/content_30544430.htm>.

[7] "Xi Jinping Addresses CCP Central Committee Political Bureau 17th Collective Study Session, Emphasizes Need to Acurately Grasp New Trend in the World's Military Development, Advance with the Times to Vigorously Promote Military Innovation" [习近平在中共中央政治局第十七次集体学习时强调准确把握世界军事发展新趋势 与时俱进大力推进军事创新], Xinhua [新华], August 30, 2014, available at <www.xinhuanet.com/politics/2014-08/30/c_1112294869.htm>.

[8] "Xi Jinping Chaired the First Meeting of the CMC National Defense and Military Small Leading Group" [习近平主持中央军委深化国防和军队改革领导小组第一次全体会], State Council, People's Republic of China, March 15, 2014, available at <www.gov.cn/xinwen/2014-03/15/content_2639427.htm>.

[9] "Documentary of the Design Process of Deepening Defense and Military Reform by Xi Jinping and the CMC" [习主席和中央军委运筹设计深化国防和军队改革纪实], Sina News Center [Sina 新闻中心], December 30, 2015, available at <http://news.sina.com.cn/o/2015-12-30/doc-ifxncyar6047368.shtml>.

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[11] "Ministry of National Defense Holds News Conference on CMC Administrative Reform and Reorganization," *China Military Online*, January 11, 2016.

[12] "Former GAD S&T Committee Director Liu Guozhi Appointed Director of New CMC S&T Committee," *The Paper* [澎湃新闻], January 11, 2016.

[13] "Former GAD Director Zhang Youxia Becomes New Director of CMC Armament Development Department," *The Paper* [澎湃新闻], January 14, 2016.

[14] Zhao Lei, "PLA Says Chief of Its Arms Wing Replaced," *China Daily* (Beijing), September 19, 2017, available at <www.chinadaily.com.cn/china/2017-09/19/content_32187194.htm>.

[15] "2016 National Defense Science, Technology and Industry Working Conference Was Held in Beijing" [2016 年国防科技工业工作会议在京召开], State Council, People's Republic of China, January 9, 2016, available at <www.gov.cn/xinwen/2016-01/09/content_5031770.htm>.

[16] Laura Zhou, "China Almost Doubles Weapons Exports over Past Five Years, with Pakistan Biggest Buyer: Think Tank," *South China Morning Post* (Hong Kong),

February 22, 2016, available at <www.scmp.com/news/china/diplomacy-defence/article/1915140/china-almost-doubles-weapons-exports-over-past-five>.

[17] Ibid.

[18] Liu Zhongcai [刘重才], "'Defense 2025' Is Coming Soon: Aero-Engines May Become the Breakthrough" ["军工版2025"呼之欲出航空发动机将成突破], Xinhua [新华], June 19, 2015, available at <http://news.xinhuanet.com/fortune/2015-06/19/c_127931606.htm>.

[19] "Defense Science, Technology and Industry Development Strategy Committee Was Established" [国防科技工业发展战略委员会成立], Ministry of National Defense, People's Republic of China, June 6, 2015, available at <http://news.mod.gov.cn/headlines/2015-06/05/content_4588445.htm>. Xu Dazhe was the initial head of the committee when he was State Administration for Science, Technology, and Industry for National Defense (SASTIND) director, but he was transferred to become governor of Hunan Province in September 2016.

[20] *Selection of Xi Jinping's Comments on Science, Technology, and Innovation* [习近平关于科技创新论述摘编] (Beijing: Central Party Literature Press, 2016), 42–43. China continues, though, to undertake a comprehensive and sophisticated effort to acquire foreign technology and know-how through diverse means. See Tai Ming Cheung, "Innovation in China's Defense Technology Base."

[21] "Outline of the National Strategy of Innovation-Driven Development" [国家创新驱动发展战略纲要], Chinese Ministry of Science and Technology, May 23, 2016, available at <www.china.com.cn/zhibo/zhuanti/ch-xinwen/2016-05/23/content_38515829.htm>.

[22] *Selection of Xi Jinping's Comments on Science, Technology, and Innovation*, 41.

[23] Cao Kun [曹昆], ed., "Xi Jinping Pointed Out Three Directions for Technological Innovation" [习近平指出科技创新的三大方向], *People's Daily* [人民日报], June 2, 2016, available at <http://politics.people.com.cn/n1/2016/0602/c1001-28406379.html>.

[24] *Selection of Xi Jinping's Comments on Science, Technology, and Innovation*, 50–51.

[25] "The 13th Five-Year Plan" [十三五规划纲要(全文)], Xinhua [新华], March 18, 2016, available at <http://sh.xinhuanet.com/2016-03/18/c_135200400_2.htm>.

[26] "What Dragged National Laboratory: Still under Development after Ten Years" [谁拖了国家实验室的后腿：十多年仍难去"筹"], Sohu News [搜狐新闻], March 3, 2016, available at <http://news.sohu.com/20160303/n439195452.shtml>. These laboratories included Shenyang National Laboratory for Material Sciences,

Beijing National Laboratory for Condensed Matter Physics, Hefei National Laboratory for Physical Sciences at the Microscale, Tsinghua National Laboratory for Information Science and Technology, Wuhan National Laboratory for Optoelectronics, Beijing National Laboratory for Molecular Sciences, and Qingdao National Laboratory for Marine Science and Technology.

[27] "13th Five-Year Plan."

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