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China's Efforts in Civil-Military Integration, Its Impact on the Development of China's Acquisition System, and Implications for the United States

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Abstract

China, under the leadership of Xi Jinping, is significantly stepping up its efforts to pursue civil-military integration—or what he calls military-civil fusion (MCF)—as an integral component of its grand development strategy of building a technologically advanced and militarily powerful state within the next one to two decades. This paper examines the making, nature, and implementation of Xi's grand MCF undertaking. This paper offers an analytical framework that seeks to provide a coherent and holistic view of the many moving parts and disparate elements of MCF through an innovation systems perspective. This framework identifies seven categories of factors that are important in shaping the structure and process of the MCF system: catalytic, input, institutional, organizational, networks, contextual, and output factors. Key dynamics that are examined in detail in the paper include the high-level leadership engagement, the influence of the external threat and technology environments, the application of new financial mechanisms such as hybrid state-private sector investment funds, the role of key state and military agencies, and the evolution of the Chinese defense acquisition system to embrace MCF.

Introduction

The defense and civilian economies in China co-exist side-by-side, but their relationship has been far from harmonious or close. They are separated by deep-seated structural, normative, and operational dynamics that have limited their mutual interactions and linkages. This division was originally by design as the Communist state's founding fathers wanted to maintain tight secrecy over defense activities and prioritize the forging of the defense industrial base over civilian economic development during the height of the Cold War between the 1950s and 1970s. This rigid civil-military compartmentalization became so deeply entrenched that succeeding regimes in the post-Mao reform era have struggled mightily to bridge this yawning gap—with mixed results.

From Deng Xiaoping in the 1980s to Xi Jinping today, Chinese leaders have pursued an assortment of strategies to straddle the civil-military divide for different reasons. Deng sought to divert large segments of the defense industrial base from military to civilian production to support broader economic development. Jiang Zemin and Hu Jintao pursued an incremental approach of reducing barriers between the civilian and defense economies to promote an expanding overlap of economic activities, such as allowing civilian firms to compete for military orders and permitting defense firms to tap into the capital markets.

Xi Jinping has made civil-military integration (*Junmin Yitihua*), or what he calls military-civil fusion (MCF -*Junmin Ronghe*), a key element of his grand development strategy of establishing a technologically advanced and militarily powerful Chinese state. He has replaced the gradualist approach of his immediate predecessors in favor of a far more ambitious, high-powered, and expansive strategy that aims to establish a tightly integrated dual-use economy during his reign in power. To ensure that his goals and vision are carried out, Xi put himself in direct charge of this fusion initiative.

To address the title question of whether Xi can build a truly effective and integrated civil-military economy, this paper examines the making, nature, and implementation of his grand MCF effort. This paper offers an analytical framework that seeks to provide a coherent and holistic view of the many moving parts and disparate elements of MCF through an innovation systems perspective. This framework identifies seven categories of factors that are important in shaping the structure and process of the MCF system. These factors will be examined in detail in the rest of the paper. This paper begins though by providing a brief overview of the development of MCF policy in China since the beginning of the 21st century through to its embrace by Xi Jinping during the first term of his rule in the mid-2010s.

Defining Chinese Approaches to MCF

The study of MCF in China is greatly complicated by the lack of clear definition. The integration of the military and civilian economies in its broadest definition is an effort to remove the longstanding institutional and regulatory barriers between the two systems and fuse them into a single entity able to produce for both civilian and military needs. In reality, however, the two separate spheres interact in highly disparate ways depending on the local political economy conditions in which they are embedded.

The way MCF is discussed in China can be summarized by grading its related activity on a scale of integration, a MCF value chain if you will, which reflects both the efficiency and innovation gains in the system through collaboration. At the bottom is a complete division between the defense and civilian economies, a condition that has no integration in the system, is inefficient and produces little collaborative innovation. Although simplified, this was largely the state of affairs in China during the 1960s and 1970s.

The next level is defense conversion (*junzhuanmin*), which dominated civil-military interaction from the beginning of the reform era (1978) to the late 1990s. With some exceptions, this period was marked by a diversion of excess capacity in the defense industrial base, precipitated by decreased defense budgets while maintaining the sector's productive force. Integration with the civilian sector was low as this was in the main a one-way conversion process. While it helped spare the defense industrial base, efficiency and technological collaboration were low as the sector competed with the civilian sector in low-tech, consumable goods.

Since the defense industry reforms of the late 1990s, a number of additional forms of MCF have come to characterize the Chinese economy, including spin off (or military to civilian transfer, *junzhuanmin*) and spin on (civilian to military transfer, *minzhuanjun*). *Spin off* is the commercial application of a product or technology originally conceived for military purposes, while *spin on* is the reverse: technologies developed entirely within the commercial sector and adapted for defense. Both are common in the Chinese economy, which can lead to efficiency gains (particularly with relevant commercial-off-the-shelf [COTS] products). However, while some interaction is inherent in such spillover economic activity, collaboration greatly varies and is often minimal in the Chinese system.

Dual-use activity (*junmin liangyong*), on the other hand, particularly the Chinese context, implies a closer relationship between the defense and civilian sectors. While some degree of dual-use potential is intrinsic to many technologies, this refers to science and technology (S&T) programs that intentionally serve both defense and non-defense outcomes. This type of program began in earnest with China's 863 Program in the late 1980s, but has since been a central component of many national innovation projects (Cheung et al., 2016). While the level of civil-military cooperation required for such programs is substantial, these dual-use programs are frequently focused on particular technologies

and limited in their effect in breaking the barriers of separation between defense and civilian participants within these programs, much less the broader economy.

The next level that has become a leading mantra of defense innovation scholars is the so-called *mincanjun*, or the participation of civilian or commercial entities in defense projects. As this domain increases its investment in research and development (R&D) and its capacity to lead the defense industry in many emerging technologies, the military is looking to encourage their participation in defense projects. *Mincanjun* clearly has the potential to produce a higher form of civil-military interaction and incorporate a much larger swath of economic and technological activity for defense purposes.

And under a final phase, there is a complete fusing of defense and civilian productive forces (*yitihua, or junmin ronghe*), where there are not two separate sectors, but a single industrial and technological ecology able to produce for both military and the national economy as needed. Such full integration would enable China to achieve maximum efficiency and technological innovation gains. While this unified system is more of a long-term aspiration than an immediate goal, Xi Jinping has emphasized that a fully integrated or fused "national strategic system" is his primary policy focus (Jingjing, 2016, pp. 19–20).

Overview of Chinese Efforts to Pursue MCF in the 21st Century

MCF 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 have viewed MCF as essential in the drive for original innovation and defense modernization.

Hu Jintao attempted to broaden MCF's scope and pushed for deeper implementation during his tenure from 2002 to 2012, although with limited success. Ultimately, Hu's aim to implement "overall coordination" stalled due to persistent obstacles such as poor coordination among top level decision-making 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 MCF implementation, it proved insufficient to mobilize all the needed actors and agencies.

Two modest successes of Hu's push were (1) broadening the thinking on MCF away from its former limited understanding of "combining the military and civilian sectors" [*Junmin Jiehe*] to an understanding more reflective of the deep implementation required through "integration" or "fusion" of civilian and defense sectors; and (2) broadening the scope of MCF to include all available economic resources in the promotion of the defense industry, including capital, technology, human capital, facilities, and information (Alderman, Crawford, Lafferty, & Shraberg, 2014).

When Xi became China's supreme leader at the 18th Party Congress in November 2012, MCF was included in major leadership speeches and policy documents to show that the incoming regime would continue to pay attention to this issue. There was though little indication of a new direction in MCF policy. The 18th Communist Party Congress work report issued in November 2012 detailing Xi Jinping's policy agenda for his first term pointed out that the country would

> continue to follow a Chinese-style path that integrates the development of the military and civilian sectors, combine efforts to make the country prosperous and the armed forces strong, and strengthen strategic

> planning, system building as well as related laws and regulations to boost the development of military and civilian sectors in an integrated way. (Jintao, 2012)

A year later at the Third Plenum of the 18th Party Congress in November 2013 that laid out an ambitious roadmap of economic reforms, Xi and his lieutenants offered intriguing but vague hints that they were looking to inject new thinking and initiatives on MCF as part of the broader goal of undertaking comprehensive reforms of the economy and military establishment. The Third Plenum decision noted the importance of

> promoting the extensive development of military civilian fusion. Establish mechanisms for unified leadership, coordination between the military and localities, linking needs and demands and resource sharing at the national level so as to promote the joint development of the army and the people … and guiding superior private enterprises to enter into areas of military material research, development, production and maintenance. ("Decision of the CPC Central Committee," 2013)

What stood out were the references to the promotion of "extensive" MCF development, creating "mechanisms for unified leadership," and "guiding superior private enterprises" into military activities.

Xi's commitment to MCF became evident by 2015, when it was designated as a national priority and was consciously incorporated into the innovation driven development strategy (IDDS), the country's new national development strategy, which aimed to develop a strategic system and capabilities that will allow China to "implement key science and technology projects and race to occupy the strategic high ground for science and technology innovation" ("Xi Calls for Deepened Military, 2018). 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 development strategy. This includes the 13th 5-Year Special Plan for Science and Technology MCF Development issued jointly in 2017 by the Central Military Commission Science and Technology Commission (CSTC) and the Ministry of Science and Technology (MoST) that detailed the establishment of an integrated system to conduct basic cutting-edge R&D in artificial intelligence, bio-technology, advanced electronics, quantum, advanced energy, advanced manufacturing, future networks, and new materials "to capture commanding heights of international competition" (CMC Science and Technology Commission and Ministry of Science and Technology, 2017). This plan also noted the pursuit of MCF special projects in areas such as remote sensing, marine-related technology, advanced manufacturing, biology, and transportation.

Analytical Framework: The MCF Innovation System

As a starting point, it is crucial to understand that MCF is arguably one of the most ambitious industrial policy programs China has ever embarked on. MCF not only incorporates numerous traditional industry sectors (from shipping to aviation), but the industry chain of each sector including upstream R&D to downstream manufacturing. In so doing, it requires the coordination of an enormous range of bureaucratic stakeholders governing the economy. Additionally, there is the divide between the private and state-owned firms in the economy that must be managed in order for MCF to be effective. As much of China's economy is operated at the local level, a center-local dynamic also plays an important role given the national level goals and actors that MCF embodies. This decentralized system accentuates the diversity of China's economy geographically, a phenomenon that profoundly impacts a coherent national MCF strategy. If all of this was not sufficiently challenging, underlying all of the above is the separation between the military

and civilian systems within China that first and foremost must be tackled in order for MCF to be conceivable.

One analytical approach to address this complexity and confusion is to view MCF as a hybrid eco-system comprised of institutional arrangements, organizations, networks, inputs, outputs, and various other factors. This paper applies the notion of an innovation system derived from the systems of innovation and public policy process literature to examine the Chinese approach to MCF. Innovation systems are complex, constantly evolving eco-systems that include "all important economic, social, political, organizational, institutional and other factors that influence the development, diffusion and use of innovations" (Edquist & Johnson, 2005). Innovation is of central importance to MCF because its mantra is about finding new or improved ways of meeting defense and dual-use needs faster, better, and cheaper.

A diverse array of factors are involved in the MCF innovation process, and the framework distinguishes seven categories:

- **Catalytic Factors:** Catalysts are the principal motivators of this colossal undertaking and are the sparks that ignite innovation of a more disruptive nature. These powerful factors are normally external to the MCF innovation system and their intervention occurs at the highest and most influential levels of the eco-system and can produce the conditions for enabling considerable change and disruption.
- **Input Factors:** These are material, financial, technological, human and other forms of contributions that flow into the MCF innovation system. Most of these inputs are externally sourced but can also come internally.
- **Institutional Factors:** Institutions are rules, norms, routines, established practices, laws, and strategies that regulate the relations and interactions between actors (individuals and groups) within and outside of the MCF innovation system (Edquist & Johnson, 2005, p. 46; Ostrom, 2007, p. 26). Rules can be formal (laws, regulations, and standards) or informal (routines, established practices, and common habits). Norms are shared prescriptions guiding conduct between participants within the system.
- **Organizations and Other Actors:** The principal actors within the MCF innovation system and main units of analysis of the framework are organizations, which are formal structures with an explicit purpose and they are consciously created. They include firms, state agencies, universities, research institutes, and a diverse array of organized units.
- **Networks and Subsystems:** Social, professional, and other types of personalistic networks are invaluable means for connecting actors within and beyond the MCF innovation system. Networks provide invaluable means of sharing information, often more quickly and effectively than traditional channels and they help to overcome barriers to innovation such as rigid compartmentalization that is a prominent feature of innovation systems (Taylor, 2016, pp. 157–168). Subsystems are issue or process-specific networks that link organizations and other actors with each other to produce outputs and outcomes (Weible et al., 2012; Jenkins-Smith et al., 2018). Numerous subsystems exist within the overall MCF innovation system and they can overlap or be nested with each other. The procurement and research and development subsystems are two of the most prominent subsystems.

- **Contextual Factors:** This category covers the diverse set of factors that influence and shape the overall MCF innovation environment. Contextual determinants that exert strong influence include historical legacy, domestic political environment, development levels, geographical diversity and a country's size and its markets.
- **Output Factors** are responsible for determining the nature of the products and processes that come out of the innovation system. They include the production process, commercialization, the role of market forces such as marketing and sales considerations, and the influence of end-user demand.

1. Catalytic Factors: High-Level Leadership Engagement and the RMA

Although MCF has attracted attention and support from Jiang Zemin and Hu Jintao between the early 2000s and early 2010s, much of this interest and engagement was sporadic and superficial and lacked sufficient political clout and credible commitment to overcome the difficult structural obstacles that blocked the path of meaningful progress in integrating the civil and defense economies. Xi Jinping's active and sustained interventionalist engagement in MCF affairs since 2015 is having a profound impact in reshaping the dynamics and momentum of MCF policy making and implementation.

Xi's decisive involvement in MCF can be highlighted by two events. The first was his announcement in March 2015 to elevate MCF into a national-level development strategy. Prior to this move, MCF was a sector-level industrial policy being managed by mid-level government and military officials. Xi's intervention quickly catalyzed high-level political and bureaucratic engagement. In March 2016, the Politburo approved a document titled "Opinions on Integrated Development of Economic and National Defense Building" and approved MCF as a national strategy ("Consideration of 'Opinions,'" 2016). These opinions formed the basis of the 13th 5-Year Special Plan for Science and Technology Military Civil Fusion Development that was issued in 2017 by the CSTC and MOST.

Another imprimatur of Xi's high-powered MCF involvement was his willingness to become the head of the Central Commission for Integrated Military and Civilian Development (CCIMCD) that was created in January 2017 to oversee MCF matters. Establishment of the CCIMCD was an unprecedented breakthrough with powerful Party, state, and military leaders as members.

A second important catalytic factor in promoting major development in the MCF innovation system is the global threat environment, especially technological threats and opportunities. Xi and the Chinese leadership perceive that the world is currently in the midst of a profound science and technology revolution in both the military and civilian realms and that China needs to be at the forefront of riding this change.

A focal point of this technological transformation lies in the intersection between civilian and military affairs, especially in the information and autonomy domains. These technological revolutions occur infrequently and in order to take full advantage of this opportunity and leapfrog to the global frontier, the Chinese authorities see the need to have a carefully coordinated undertaking between the civilian and military communities in areas such as artificial intelligence, big data processing, high-performance computing, advanced manufacturing, and robotics. This is being carried out in large-scale industrial and innovation initiatives such as the Made in China 2025 Plan and the Science, Technology, and Innovation 2030 Major Projects Plan.

2. Input Factors: Financial Integration

Input factors are the basic building blocks in the defense and civilian economies needed to advance the goals of MCF. They are tangible "hard innovation capabilities" and include advanced research and development facilities, firm-level capabilities in R&D and manufacturing, a cadre of experienced scientists and engineers and supporting programs to cultivate human talent, technology transfers, sourced domestically or through international knowledge markets, as well as the availability of funding and investment sources from state and non-state sources (Cheung, 2011). In the case of MCF, it also includes infrastructure projects and markets that create civil-military hybrid industrial and technological clusters. China has made large investments into building up these tangible inputs and infrastructure factors since the turn of the 21st century and this subject has received much analytical attention.

One of the most significant initiatives of the past few years has been the vast new sources of funding for the defense industry and MCF projects both through the capital markets and government venture funds. Over the past decade or more, the political and military leadership has come to grips with financial demands of achieving the goals of its expansive military modernization drive (Chaofeng, 2014). In addition, traditional forms of state funding—whether from the defense budget, subsidies and loans, or the sector's own profits—perpetuate a high degree of insulation from market forces. Greater opening to the capital markets offers the potential both for a large, new source of financing while stimulate greater accountability and competitiveness into a closed defense enterprise system. This section will focus on this subject area.

A cursory glance at the state of China's defense technological and industrial base (DTIB) serves as a useful reference point from which to assess the role of financial MCF. Measured by revenue and asset-base ($367 billion and $640 billion), the defense industry in China in gross terms is a thriving sector.[1] Importantly, however, is the rate at which the DTIB has grown in the recent past. In the past 10 years, while employee numbers have edged up only modestly, its revenue and asset base have ballooned, in several cases well over 150%, much more than its western counterparts, and an amount that could more than double again in the next five years ("The Frequent Claim," 2016).

The size and growth of the Chinese DTIB is in marked contrast to its meager performance as measured by profit growth and return on assets. Over the past five years, while all major defense enterprises have shown profits, they have been modest (averaging RMB 68 billion in the past five years), with some exceptions. More importantly, their average year-on-year growth in profits and return on investment (ROA) have been flat (<1% per annum since 2015), again with a few exceptions in the aerospace and ordnance sectors, while the overall average ROA is a mere 1.7%.[2] All in all, the Chinese defense industry, while pronounced in size and output, continues to underperform financially and contributes

[1] Data for defense industry was collected from various sources (including http://www.csindex.com.cn; http://www.fortunechina.com, http://stock.jrj.com.cn) as well as defense industry year end reports and websites.

[2] Boeing's and Airbus' average rate of profit increase for this timeframe is 19% and 47%, respectively, while their average ROAs over the same period have been 5.5% and 2.1%, respectively. See http://www.fortunechina.com/fortune500/node_65.htm and Boeing and Airbus websites.

modest profits to its own operations, raising the question of how its large and rapid expansion is being funded.

Naturally, the defense budget, and in particular the procurement budget, is a substantial source of income for the defense sector ("China's Defence Industry," 2018). However, the growth in the defense budget is slowing, reflecting a slowing in the broader economy. Financial transfers, subsidies tax breaks and especially low-interest loans have been the other sources of support and are certainly significant for state-owned enterprises—including the defense industry[3] (Haley & Haley, 2013, p. 2). While these conventional sources of funding are substantial, they do not account for the doubling in size of the defense industry during the last 10 years.[4]

Instead, the Chinese government has increasingly turned to new forms of financing to recapitalize the defense industry. These are closely linked to MCF efforts, because these defense monies are being tapped in the commercial and private capital markets. This trend was slow to develop until the passage of the mixed ownership reform initiative (MOR) in 2015 ("Opinions on Promoting Development," 2015). MOR encouraged the joint equity stakes by government and private shareholders in state enterprises, with the dual goal of expanding the defense industry's capital access and exposing the defense enterprises to greater market forces and thereby accelerating their reform. Moreover, the latest initiatives in defense sector reform have been the restructuring of research institutes, where some of the most productive assets lie. In early 2017, a pilot plan to reform 41 research institutes was confirmed ("Reform to Classification," 2017).

Mixed ownership has manifested in the markets in several important ways. First, defense securitization includes over 100 listed companies on China's primary stock market, most of which are majority controlled by the defense industry groups or other state-owned entities ("Structure and Design," 2018). These companies raised an estimated US$63 billion between 2010 and 2016 through various market operations (Cheung, 2016). Another form of defense industry participation in the market has been the rise in asset-backed securities, whereby state-owned non-liquid assets are converted into investment vehicles that can then be sold to intermediary financial institutions to be indirectly traded in primary and secondary capital markets (Yuwa, 2007).

The overall asset securitization rate of China's defense industry currently stands at an average of 33%. With a current total defense industry asset base of RMB 4.15 trillion ($638 billion), there is the potential to tap an additional several trillion RMB in the market as the defense industry opens up ("At a Rate of Only 30%," 2017). If the higher predictions of 20% annual growth in the defense industry overall for the next 5–10 years is realized, these astronomical figures may not be unwarranted, though many barriers remain to its implementation.

Another financial phenomenon that will profoundly impact the future of MCF implementation in China is the tidal wave of government guidance funds (GGFs) that has emerged on the scene in the last three to four years (Liang, 2018). GGFs are part of a

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[3] One estimate put the amount of subsidies to SOEs at US$310 billion (~2 trillion RMB) from 1985–2005 (nominal terms).

[4] Between 2009 and 2018, asset value has gone from roughly RMB2 trillion to over RMB4 trillion, and revenue has gone from RMB1.4 trillion to RMB2.4 trillion.

broader state-directed industrial policy to channel national resources into its goals under its 2016 “Innovation-Driven Development Strategy” (Ministry of Science and Technology, 2016). These efforts consciously link defense and civilian production and R&D capabilities to achieve its goals. Moreover, among the now thousands of GGFs that exist, explicit MCF projects have risen as an important portfolio of many local government sponsored GGFs.

To summarize the financial landscape of MCF, these new channels of funding in the form of securitization and government guidance funds are significant both in their scale, and in their nature. They represent in aggregate the opportunity for massive financial recapitalization of China’s DTIB, but they are being tapped with limited effect on the restructuring and opening up of the defense enterprises to the civilian participation. In fact, the evidence suggests their monopoly position and political status have risen in the past few years. The nature of a state-led investment approach poses inherent contradictions for an MCF economic model that seeks a genuine participation of the civilian private and commercial sectors with the defense sector.

3. Institutional Factors: Formal and Informal

The role of institutions is of central importance to innovation systems. Broadly defined, institutions are the norms, routines, habits, established practices, and other rules of the game that exist to guide the workings of the system and the interactions between organizations (North, 1990, pp. 4–5). These come in formal (such as development strategies, laws, and standards) and informal (conventional routines, market incentives, governance norms) variants. The notion of institutions is particularly salient for China’s MCF program because of the interplay of so many actors across industrial sectors, state and market entities, central and local governments, and civilian and military agencies. Understanding the nature of interactions amongst this panoply of organizations is critical because creating an effective institutional arrangement to achieve this has been one of the most intractable challenges for the Chinese leadership in its pursuit of MCF goal of fostering an innovative and collaborative ecosystem.

Under the Hu administration, efforts to promote MCF focused primarily on reforms to defense corporations and on establishing a body of regulations, policies, standards, and other mechanisms by which to encourage the flow of private-sector technology, talent, and investment into defense projects. The work done in building up these institutions is voluminous (Wenxian et al., 2015).[5] In essence, this pre-Xi period laid the *formal* institutional foundations for MCF. What this phase failed to accomplish however, as pointed out earlier, was to fundamentally alter established social, organizational, and cultural patterns of interaction and norms of behavior (Xie & Lu, 2014). In other words, the *informal* institutions relevant to MCF have proven far more difficult to change. A lack of leadership engagement and an overarching strategy led to ad hoc, structurally misaligned initiatives (Lafferty, 2019).

From an institutional perspective, Xi altered the MCF landscape in several important ways. First of all, a raft of new high-level strategies, plans and other administrative arrangements have been developed following 2015 Xi’s decision to elevate MCF to a

[5] One compendium of these efforts details over 300 major regulations, standards, and planning documents, covering a wide range of procurement, intellectual property rights protection, and other provisions issued by a host of agencies including GAD, the CMC, the State Council, the NDRC, SASTIND.

national strategy that collectively represent a committed effort to reform the defense S&T industrial base and shift behavioral norms and practices. They build on previous ideas but are much more specific in the sectors and actors involved, and call for closer collaboration between civilian and defense sectors working in these fields ("Xi Jinping Presided," 2017). Unlike previous institutionalization of MCF, these documents are issued by a superior authority ("Bluebook on Prospects," 2019).

A second way in which Xi is altering the institutional environment is by integrating MCF initiatives with the larger innovation-driven development strategy and many of the major national S&T programs associated with it. By linking strategic plans and initiatives together, and funding resources along with it, the interaction between organizations involved in these pockets of innovation is moving toward a freer, more fluid collaboration and exchange of ideas. This is most apparent in cutting-edge technology fields with strong government support, but it is occurring spontaneously in technology centers around the country, indicating a shift in normative behavior or informal institution building (Hagt, 2019).

Similarly, through his high-tempo and wide-ranging production of laws and opinions, Xi Jinping is not just ramping up a set of formal institutions but he is also sending a strong political signal of commitment to a MCF agenda. This catalytic factor in China's MCF ecosystem is impacting the relationship of other factors, as the innovation literature predicts (Kline & Rosenberg, 1986). Xi's support for MCF is coordinated with resource allocations, which is altering the interaction of organizations and changing mindsets and conventional practices.[6] The gradual rise in enthusiasm for experimenting with MCF projects at the local level is an example of this phenomenon. Also, the publication of product catalogues and technology patents also show changes in conventional practices.

4. Organizational Factors

Organizations and other actors in the civilian and defense economies are central factors in the MCF innovation system. They are the vehicles for technological change in that they carry through and facilitate innovations (Edquist & Johnson, 2005). Collectively, organizations refer to entities that are directly or indirectly involved in supporting a MCF economy, ranging from private and defense corporations, to government agencies, military entities, and the research and development system, but can also be key individuals in the policy decision-making process. Creating a MCF ecosystem, which calls for an additional set of actors and institutions, has been difficult given the complexity of managing a much broader group of players and interests in China's political economy (Cheung, Mahnken, & Ross, 2018).[7] This section will focus on one of the critical elements catalyzing China's current MCF innovation eco-system: the CCIMCD.

The creation of the CCIMCD in 2017 under Xi's leadership was an unprecedented move and is the highest such organization in Chinese history to oversee MCF related work (General Staff Department Compilation Group, 1991, p. 567). This Party institution was necessary not only to bring together the various civilian stakeholders within the economy, but also to bridge the two major parts of the Chinese system: the State Council, China's

[6] For instance, officers from CEDD, AMS, and NDU emphasize that past MCF-related efforts were frequently resisted by local if not aligned with its interests, but sustained political attention mitigates that over time. Interviews in Beijing, 2017.

[7] These authors distinguish between defense and military innovation.

supreme executive body overseeing the civilian national economy, and the Central Military Commission, China's leading military institution. Policy practitioners of the civil-military economy in China have long bemoaned the lack of such a supra-organization (Chuanxin, 2014). Without it, coordination of these two systems of equal rank in China's body politic in the pursuit of a complex undertaking like MCF is doomed to bureaucratic inertia, as previous efforts had demonstrated.[8]

The CCIMCD is populated with around two dozen senior Party, state, and military leaders. Its importance is best represented by the fact that the body has already convened four meetings, issuing important policy guidance on MCF initiatives with increasingly more specific measures to implement MCF across the country (Guangrong, n.d.). The CCIMCD is also distinctive in that the military has substantial representation in this body with five members (members and vice-chairman of the CMC)[9] ("Han Zheng Chairs National Symposium," 2018). This is a significant point given that MCF is an initiative that involves the civilian economy, a domain traditionally (and constitutionally) off limits to the military.[10]

Civilian Actors

The State Council, a supra-agency with chief administrative authority in China, holds a number of departments and ministries responsible for MCF. Two agencies are most relevant in this respect: the National Development and Reform Commission (NDRC) and State Administration for Science, Technology, and Industry for National Defense (SASTIND). The NDRC is a core department of the State Council with wide-ranging powers over major national development projects and their funding. Within this commission is the Department of Economic and Defense Coordination, which is the body most focused on macro-level economic planning involving the defense and non-defense sectors, with particular purview over national economic mobilization. With the NDRC's prominent role over economic planning, it also takes a lead role in MCF activity and is a principal in convening meetings.

SASTIND is a relatively lower ranked body, but it is the only agency charged with directly regulating the defense enterprises.[11] It is an agency under the Ministry of Industry and Information Technology (MIIT), the large bureaucracy with a purview over industrial planning and regulation. On the surface, this makes for a rational organizational framework, bringing defense and non-defense sectors under one administrative roof.

A number of other bureaucracies have a degree of input with respect to MCF implementation, including MoST, which plays a central role in the country's vast national S&T program—including the planning of S&T parks—much of which has dual-use applications. The State-owned Asset Supervision and Administration Commission (SASAC) and its local branches manage and own state enterprises, including the defense sector. In

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[8] In general, previous MCF efforts were ad hoc, structurally misaligned, of low policy priority. See Chao (2016).

[9] Previously Zhang Gaoli and currently Han Zheng.

[10] This point was made by NDRC officials. Interview BJ27-8.

[11] SASTIND has control over a substantial pot of money (estimated at RMB 100 billion over 10 year period, granted sometime in the mid-2000s), but interviewed sources generally admit that SASTIND is relatively weak and without this funding, would have little influence over the defense enterprises. Interviews in Beijing, 2015.

general, their responsibility is to ensure returns on investment of SOEs, but they also have some input in performance evaluation of state-owned sector leaders. The Ministry of Finance (MoF) is also involved with evaluating and funding development projects and supporting industry parks across the country. The State Intellectual Property Office (SIPO) is in charge of patents, intellectual property, and technology transfer in China and works with the CMC to declassify defense patents.[12]

Military Actors

The structure of leadership over MCF activity on the military side also involves a number of high-level bodies. The agency formally charged with leading this effort is the CMC Office of Strategic Planning (COSP). Originally a third-level organization subordinate to the General Staff Department, the COSP was elevated to one of the 15 departments directly under the CMC under the 2015 reforms, and is responsible for the overall configuration of defense resources and the PLA's modernization goals, particularly in science and technological innovation. An important task under this bailiwick is civil-military integration, and the department houses the MCF Bureau to manage the military's efforts and is the principal contact with State Council departments working on MCF.

Two other sources of expertise with regard to MCF reside in the PLA. One of these is the CMC Equipment Development Department (CEDD), responsible for procurement, acquisition, and defense R&D. CEDD was formerly a powerful general department, housing substantial expertise in managing defense projects, and had the closest relationship with the defense industry sector (Hagt, 2014). It has traditionally been the principal advocate for MCF in the military and supports the MCF Bureau. Another important player in MCF on the military side is the CSTC, a body also promoted in status under the 2015 reforms, reflecting the importance placed on S&T for military innovation. This institution also holds substantial expertise through its traditional relationship with military research institutes in the defense industrial base. The CSTC works with MoST to identify dual-use and MCF collaboration in key national S&T projects, the product of which was a recently published S&T MCF development plan (Tao, 2017).

Other departments involved more peripherally in MCF include the CMC Joint Staff Department (CJSD), which is in charge of operations and overall command and control of the armed forces ("The Battlefield Environmental," 2016; "The First Geology MCF," 2016). Also the Strategic Support Force, responsible for space, cyber, and electronic warfare, has built ties outside the military, signing cooperation agreements with research universities and software development companies (Laskai, 2018). The National Defense Mobilization Department—another body carved out of the former GSD and placed directly under the CMC—is significant in that defense mobilization planning dovetails with MCF efforts in a number of ways, such as the collaboration of transportation and communication infrastructure development projects to meet both civilian and military needs. In this respect, this organization works with its State Council counterpart to coordinate defense mobilization requirements. But it is also significant for its charge over the Provincial Military Commands (PMC) ("16 Provincial-Level," 2018). In short, this branch is the PLA's most direct interface with local (provincial governor) leaders on matters relevant to MCF (Li, 2014). The most

[12] SIPO works with the CMC National Defense Intellectual Property Office, and in early 2017, over 3,000 declassified defense patents were released at www.weain.mil.cn. Also, see Nouwens and Legarda (2018).

recent organizational addition to MCF relevant efforts under the CMC is the founding of the Military Science Research Steering Committee (MSRSC), an agency launched in early 2017 that is modeled on U.S. DARPA (Ni, 2017). Its specific mission is as yet unclear but will likely be to identify priority areas for investing R&D resources in both defense and civilian sectors and thereby help guide national security development plans.

There are several distinctive features of China's organizational approach to guiding its MCF strategy that point up both strengths and weaknesses in its design. With this new institution, the Party leadership has finally resolved a longstanding barrier to joint planning of the defense and civilian components of national economy and S&T innovation system. Second, the formation of a permanent commission, rather than an ad hoc leading group, sends a strong political signal about the top leadership's vision to pursue a long-term strategy of MCF.

It has led to a proliferation of institutions and planning initiatives at many levels of government.[13] The administrative and functional lines, and their status and authority in decision-making are unclear. In the State Council, for instance, the relationship between SASTIND and the MCF Promotion Bureau—both formally under MIIT—is ambiguous. The effectiveness of the NDRC and its subordinate National Mobilization office to coordinate with other offices is also problematic. On the military side, the MCF Bureau has little specific expertise and must rely on assistance from the CEDD and the CSTC, where relevant competence traditionally was housed. The addition of yet another body to guide R&D efforts in the military sphere, the MSRSC raises questions about its distinctive role in MCF, in relation to the MCF Bureau or the CSTC, both of which also have responsibilities over military R&D efforts (Grevatt, 2017). In short, the uptick in political commitment to MCF and the rise in organizations dedicated to this effort will help empower its implementation, but it will also increase bureaucratic bargaining, as China's system has frequently proven in the past (Lieberthal & Lampton, 1992; Mertha, 2008; Dougan, 2002).

A second feature evident in the organizational architecture is the limited role of the MCF strategy's foremost proponent, the military. While the PLA is substantially represented in the CCIMCD, it has virtually no footprint at the local level. This was not always the case. The PMC (*sheng jun qu*), through its role in national defense mobilization and procurement responsibilities for military region forces, had the potential to serve in some capacity as a useful local platform for certain types of MCF activity ("Following Reform," 2016; Li, 2014). However, the PMC's purview over local mobilization and army building was curtailed under the 2015 reforms, effectively constraining the potential of this regional civil-military entity as a platform for MCF. At local level, the military essentially has no direct formal representation to interact with government departments in charge of economic and industrial affairs and therefore has little authority or means to promote a MCF agenda with local development planning.

A third distinguishing feature here is the central role of the state-owned enterprises in China's defense industrial system. The 11 major defense firms control and operate the majority of China's defense sector research, development, and production. Despite ongoing reforms to transform their historically closed-off nature—through MOR reforms—the defense

[13] This discussion of continued bureaucratic chaos comes mainly from interviews with officials in 2017 and 2018 (Hagt, 2019).

industries have so far remained resistant to fundamental change ("90% of Defense Enterprises," 2018). Moreover, their dominant position in the defense political economy arena of China's system means that they will be instrumental in the outcome of an integrated national development plan that the MCF strategy envisions (Lafferty et al., 2013). However, there is effectively no direct authority or control over defense industry enterprise operations, and real power over them lies within the Communist Party. Since the CCIMCD has not yet been replicated at lower levels of the political system, there is a large power differential between the defense enterprises and the much lower ranking local governments in which they reside, making comprehensive planning needed for MCF difficult to achieve.

5. Networks and Subsystems

Traditional and formal organizations and institutions, many of which are described in this paper, heavily dominate China's MCF infrastructure. In fact, the formation of government bodies and the crafting of laws, regulations and planning guidelines are a particular strength of China's state-centric model of industrial policy making. However, as the literature makes clear, networks and subsystems are the "interstitial connectors" that link actors and processes in the innovation ecosystem and are crucial to mitigating compartmentalization and enhancing information sharing and technology diffusion (Taylor, 2016, pp. 157–168). Until recently, there has been an absence of such platforms in China's MCF system, a product of its statist approach, and exacerbated by issues such as secrecy, historical legacy, and unclear IPRs and the monopolistic behavior of its defense firms. However, that is changing, and an exciting new development in China's MCF efforts is the emergence of a range of novel mechanisms that are enabling these crucial linkages in the system.

Subsystem: CMI Acquisition System

One of the most prominent of these is the formation of what amounts to a new CMI-specific acquisition regime that is in part a reform of, but is also separate from, the existing monopoly-oriented system. The PLA and the State Council have instituted many components to this new acquisition platform that allow for private sector firms to be vetted and approved for defense work, that facilitate a more open bidding process and generally enhance transparency of the acquisition governance regime.

Some of the elements of this new system include web-based portals that are appearing both at the national and local levels. The much-heralded PLA's Weapons Acquisition Information Network (WEAIN), launched in 2015, provides information on the country's weapons and armament needs, relevant policies, procurement notices. Moreover, the PLA has vetted 13 intermediary tendering agencies to screen applicants and manage the bidding process ("The Military's Weapons," 2018). As of early 2018, it had attracted over 16,000 registered entities and listed more than 4,500 technology procurement notices (Yang, 2018). Moreover, the site also holds over 3,000 defense patents that were declassified in 2017 as part of an effort to increase transparency and encourage the private sector to engage defense research and production (Nouwens & Legarda, 2018). Many local governments and S&T parks have founded similar online platforms.

As of October 2017, the PLA, in conjunction with SASTIND, officially announced the streamlining of the arcane defense contractor approval process, making it substantially easier for smaller commercial firms to obtain the necessary licenses and approvals ("*Mincanjun*," 2017). Extensive catalogues of products, technologies, and firms for researching, developing, and manufacturing military weapons and equipment were released by SASTIND.

Within the last year, a number of reforms to the tax system, the pricing of military products and technologies and standards have made substantive progress, all of which are paving the way for greater private participation in the defense acquisition system. Commercial enterprises can now enjoy many of the tax incentives previously restricted to defense firms (lower VAT and "return first policy").[14] The fixed pricing system (cost-plus) that dominated earlier eras has given way to more flexibility and includes a range of negotiable pricing schemes for a much larger portion of defense products and technologies (Xi & Bingwei, 2018).

The PLA has also increased its efforts to sidestep the traditional acquisition system, particularly with regard to accessing the private and commercial domains for high-end and emerging technologies. The newly empowered CSTC now has greater control over the early phases of the R&D process—for example, experimental and exploratory research—whereas this was overseen by the General Armaments Department prior to 2015 reforms. The previously mentioned Military Science Research Steering Committee also serves to better identify emerging technologies for military application in the private domain. The creation of the National Defense S&T Innovation Rapid Response Team under the CSTC, located in Shenzhen, is the most recent move. This is very similar to the DIUx offices in the United States and forms another part of this new system to enhance technology acquisition in the commercial sphere.

Networks: Non-Traditional Platforms

There are also novel ways in which China is generating cross-linkages in the system. First, exhibitions where civilian and military enterprises gather to show off technologies and exchange information have proliferated. The Zhuhai Airshow is the most visible of these, but virtually every major S&T center convenes these events to demonstrate new dual-use projects and burgeoning MCF areas as well as facilitate a two-way channel of communication between private and defense enterprises. SASTIND has been the leading agency in holding exhibitions, but the PLA has also shown increasing interest in directly participating ("Private Enterprise," 2014).

The designation of national MCF demonstration bases has also been a prominent strategy to foster interaction between defense and civilian activities. As of mid-2018, there were 36 such bases in 22 provinces and cities around the country (Ministry of Industry and Information Technology, 2018). These are important because underlying this strategy is the notion that spatial proximity is key to technology diffusion. Industry clustering fosters a higher degree of interconnectedness that encourages spillover in technology and knowledge—between defense and commercial firms—thus stimulating productivity and innovation (Jolly & Zhu, 2012).

One of the most novel developments in China's MCF economy is the intermediary entities that are on the rise in many local governments. These range from government to quasi- and even non-government institutions, which provide an array of liaison, research, and consulting services to facilitate information exchange and interactions between civilian and defense actors in the local economy. Such organizations are especially active in thriving economic centers where industrial and technological complementarity with the resident

[14] Interviews in Chongqing, May 2016. For discussion on tax reform, see http://pg.jrj.com.cn/acc/Res/CN_RES/INDUS/2019/3/6/4e258c51-a0d9-4eff-9517-7455fc98a073.pdf

defense industry is higher. These intermediaries are unique in that they either have experts in-house that have defense industry backgrounds, or their staff includes retired military officers familiar with defense procurement and acquisition practices.[15]

In sum, these various platforms that are making their debut in the past few years largely fall outside the conventional actors and institutions of the MCF system. Yet, they constitute a vital enabler for MCF implementation in local economies where the threshold for the majority of commercial and private enterprises is too high to engage in defense work (Huixian, 2017). They provide the connections between the notoriously separate defense and civilian parts of the economy. These emerging entities are helping generate the bottom up collaboration that will be essential if MCF is to succeed.

6. Contextual Factors: MCF Implementation

This category comprises a set of conditions that shape the environment in which MCF happens. In this sense, they are usually broader in scope than other factors (such as inputs and formal organizations) and cover political, institutional, and even ideational aspects of an innovation system (Abramovitz, 1986). Using the framework of contextual factors is especially useful when examining China's MCF efforts at local levels, where much of the implementation occurs. The complexity of China in terms of geographical diversity, levels of development, governance structures and historical legacies dictate that MCF will be carried out with a high degree of variance in form and substance. And the aggregate of these contextual factors help understand the specific operating environment of MCF and the different outcomes that it leads to.

The set of conditions that impact MCF implementation can be summarized under several overarching variables, which, while not comprehensive, aid in deriving general models and are important indicators of their relative success (Hagt, 2019). The first is what may be called complementarity between the local economic and political context and the resident defense entity. In order for collaboration between the defense and commercial sectors to occur, a local economy must be sufficiently competent (in either industrial or technological aspects) in providing what the defense sector requires; or vice versa, for the defense sector to integrate with the local economy, it must be able to produce goods and technologies the commercial sector demands.

A second variable that is unique to China's system is the role of center-local relations. The objectives of a national MCF strategy are not always aligned with local development priorities and properly structuring incentives for civil-military collaboration is almost without exception a difficult center-local exercise. The center-local dynamic is also manifested in other ways. China's political system is sensitive to rank and status within the party and government structures. This hierarchy of power and position comes to be an important factor for MCF implementation because the defense industrial enterprises, as central, monopolistic institutions with immense influence at the political Center, are difficult to manage by local officials who are much lower in status.

A final variable affecting MCF implementation is the notion of governance. In general terms, this is the local government's ability to mobilize and effectively utilize its natural, financial, economic and political resources to pursue a policy agenda—in this case, MCF. In other words, how well a local government can parlay its particular economic and industrial

[15] Interviews in Shenzhen and Beijing, 2016–2017.

strengths into effective implementation of MCF has an important governance dimension. These variables interact dynamically across the national landscape and shape the implementation of MCF in myriad ways. This complexity at the national level does not lend itself easily to gross assessments; however, there are three relatively coherent models of a MCF economy that can be identified.

7. Output Factors: Measuring Implementation

Output in the context of defense innovation and the systems innovation literature is broken down into a number of archetypes, ranging from simple copying at the one end to sophisticated disruptive innovation at the other (Cheung et al., 2018). The notion of output for a MCF economy must differ to an extent because one is not just looking at technological innovations, but the level of collaboration and integration between the civilian and defense sectors that generated the output. In other words, the relational dimension of the civil-military axis is decisive.

There are many forms of civil-military activity conducted around the country that fall under the larger rubric of MCF. If conceptualized along a continuum, higher value types of MCF reflect closer collaboration and lead to greater efficiency and innovation gains in the system but they also become more challenging politically as an increasing array of organizations and institutions become involved. These extend from simple defense conversion with little or no integration on the one extreme to organic fusion of defense and civilian economies on the other. The current state of MCF is the widening participation of the commercial and private sector in the defense economy (*mincanjun*), though primarily lower (3rd and 4th tier) component supply in addition to discrete, or stand-alone technologies.[16] Quantifying MCF along this value chain is a direct way to measure output of a MCF innovation system.

The problem in measuring MCF output based on this formulation is a paucity of data. A second difficulty is the lack of specificity in documenting the nature of MCF conducted. This is partly for a lack of commonly held standards when reporting MCF s, but many local governments and agencies that benefit from "MCF output" are also incentivized to exaggerate results. Many cities and provinces use crude methods of calculating "MCF degree," which are devoid of significance in both qualitative and quantitative terms ("Speech by Luo Qiang, Mianyang Party Secretary and Cao Zhiheng," 2014).

That is not to say that all data published by the government are meaningless. Many government and military agencies provide some quantification, but these are usually top-line figures. For instance, one report states that two-thirds of enterprises approved to do defense work are civilian and a third of those are private firms. The PLA reported recently that by the end of 2017, almost 10,000 firms and over 700 high-tech firms had "entered the ranks of national defense and military construction" (Maorong, 2019). These headline numbers are impressive on the one hand, but they represent a miniscule percentage of their respective totals. These figures quantify civilian participation in the defense sector (*mincanjun*) in the most macro sense, but there is no discussion of quality, such as information that would help

[16] To date, expos around the country have typically showcased discrete technologies—though increasingly impressive—to sell as stand-alone systems, such as robots, 3D printing, energy storage systems, electronics, navigation equipment and software, cyber security system, high-performance materials, and drones (UAVs). See Guoli (2018).

one gauge an enterprise's engagement with the defense sector—R&D, production, design, subsystems, or component off the shelf sales.

Other, indirect quantitative methods of measuring output are also possible (Jaffe et al., 1993). One proxy for civil-military integration is technology diffusion. Joint patent activity and joint science and technology paper publications between these actors are frequently utilized to study collaboration in Beijing's innovation economy. Other ways of examining knowledge flow and technology diffusion include the use of patent citation analysis. Although much of the registered patented technology falls into the dual-use realm, all of these methods are imperfect yardsticks, as much of the data is not specifically defense oriented, or subject to selection bias (Nouwens & Legarda, 2018).

A more fruitful approach to measuring MCF progress and impact is qualitative in nature and borrows from the U.S. defense industry concept of the lead system integrator (LSI) (Gansler et al., 2009). Viewing MCF's success through this lens highlights the importance of many of the factors discussed in the systems innovation framework. A Chinese LSI from the private, corporate sector would represent a disruptive innovation at the institutional, political, bureaucratic, and economic level. Given the powerful position of the defense conglomerates, discussed earlier, the presence of an outside system integrator would clearly indicate a high level of political support by the leadership. Moreover, LSI would demonstrate genuine change in the monopolistic position of the defense enterprises and a more effective institutional and governance regime to implement collaboration.

A range of fields in high-tech, disruptive technologies where China is seeking to become globally competitive is receiving increasing analytical attention (Ray et al., 2016; Kania, 2017; Katwala, 2018; Fisher, 2010; Sinko, 2017; Krekel, Adams, & Bakos, 2012). These range from robotics, to artificial intelligence, quantum computing, aerospace, nanotechnology, new materials, drones, high performance computing, and others. In many of these, the private corporate sector is beginning to engage seriously in MCF through technology contribution, co-licensing, and partnerships in R&D ("Baidu Establishes," 2017). It is clear the military and defense sectors are able to leverage significant amount of technology and know-how from these projects. What is less understood is the degree to which firms are actively participating in these MCF projects or acting as system integrators. Government R&D institutions such as the Chinese Academy of Sciences, and defense enterprises, such as China Electronics Technology Group, continue to play central roles. Beyond these specialized technology programs, with their high-level government attention and funding, private enterprises' role in defense programs is limited to lower tier component supply. Measuring the level of participation would require deeper corporate profiling.

Implications for the United States

A central goal of China's MCF strategy is to develop and acquire weapons "better, cheaper, faster." The trajectory of that effort will have far-reaching consequences for the United States' ability to manage the military balance with China. The defense industrial complex itself has since the turn of the century greatly improved in its own ability to produce more advanced weaponry. Moreover, state-directed and funded institutions, especially Academies of Science and Engineering, national labs, and defense universities, and to a lesser extent civilian universities, represent an important *civilian* body of capabilities that have certainly helped transform China's research, development, and acquisition system. But all the available evidence strongly suggests this has come at a high cost. In aggregate, this state-led defense and civilian sectors capture enormous amounts of national resources, but these are highly inefficient (Liu, Simon, Sun, & Cao, 2011; "Interpret 'Made in China 2025,'" 2015). In short, the system has become better and faster, but not necessarily cheaper. The

fact that MCF has been elevated to a national strategy with a sense of urgency precisely at a period when China is making huge strides in its military modernization suggests the leadership views a fix to the inefficiency of the system as essential to sustain this trajectory. However, the goal to fix this—facilitate the participation of China's robust private or commercial economy in defense building—has only begun to achieve results, and its prospects for successful implementation remain highly uncertain despite its high level attention at the Center. Private and commercial sector engagement in defense acquisition and procurement programs remains limited largely to 3rd and 4th tier component production. The emergence of a genuinely private or commercial entity that acts as lead system integrator for a major defense program would demonstrate deeper reform of the system. That has not yet happened, as the defense enterprises remain largely resistant to fundamental change.

Another important goal of MCF is financial integration. Asset securitization and the ability to tap financial markets represent an important turning point for the defense industrial base. Access to the market is allowing for a massive recapitalization of the defense industry. A much larger windfall of capital in the years ahead could well materialize as SOE reform moves forward. The expansion of the defense sector in the last decade attests to this increased capture of national resources through the market. This financial aspect of MCF is significant because it falls outside conventional understanding of the resources devoted to China's defense industrial base. It is not a well-understood phenomenon, in large part due to the opaque nature of China's statist market and the complexity of SOE reform. But it is certain to be an important factor in China's military modernization drive. Military procurement budgets, preferential tax treatment, subsidies and loans—all of which are slowing in growth—may not be the biggest determinants of the defense industry. Assessments of China's military modernization trajectory based principally on budgetary and extra-budgetary state largesse misses this new source of funding that will grow in size and importance over time.

Ironically, this aspect of financial integration stands in contrast to the previously discussed MCF goal of increasing innovation and efficiency of defense work through private and commercial sector participation. Ideally, SOE reform and asset securitization is meant to diversify ownership in order to infuse better corporate management and governance, not just increase resources. However, despite the substantial securitization of defense assets, the group corporations remain completely state-controlled, and even its listed subsidiaries are in the main still government owned. In other words, the financial markets are being leveraged to recapitalize the defense sector with little impact on their political or monopoly position in the economy—and in fact may be helping to further consolidate it (Milhaupt & Zheng, 2016). The implications here are that military modernization may continue apace despite the lack of progress in MCF in terms of commercial participation. The rise of government industry guidance funds, an equal and possibly larger source of capital, may only accentuate this trend.

While the narrower definition of MCF has direct implications for the state of China's defense industrial base, there is also a broader conceptual goal for the national MCF plan that has profound implications for U.S. national security and its economic relations with China. IDDS explicitly formulates an agenda that closely links defense building with nation building, blurring the lines between defense and civilian domains (Levesque & Stokes, 2016). Strategic industries and dual-use technologies are targeted for development with the aim of transforming China into a world-class power in economic, technological, and military terms. This mobilization of national resources to achieve economic-hard power makes China a techno-security state. This has obvious and direct implications for America's own defense

industrial base, but even more troubling are the indirect, less discernible risks to U.S. defense and economic superiority.

The broader challenge for the United States regarding China's MCF strategy is two-fold. The first is the nature of many emerging technologies and industries from a dual-use standpoint, some of which have direct and clear defense applications—such as robotics and semiconductors—but many others that have potential for or are foundational to defense purposes that are frequently more remote from or are embedded in a long component defense industrial supply chain—specialized machine tools, artificial intelligence, and biotech are examples here. Moreover, most of these technologies have vast commercial potential, which means they are available to anyone and their development is widespread, making their monitoring for national security purposes a highly complex undertaking. The second and interrelated challenge stems from China's own well-defined industrial strategy linking defense and civilian economic goals, and which directly influences both outbound and inbound FDI. This intrinsically dual-use development plan entails the targeting of technologies and industries much farther upstream and downstream in the supply chain—both defense and commercial—than would normally be the case (Humphries, 2015, pp. 4–6; Bureau of Industry and Security, 2016, p. 3; Interagency Task Force, 2018). Similarly, the risks to technologies and components in the defense industrial supply chain become more widely spread and so much harder to map (Brown & Singh, 2018). Taken together with the variety of financing vehicles (acquisitions, mergers, but also minority stake ownership) that are employed by Chinese investors, monitoring is extremely difficult.

To date, the tools used by the U.S. government and Department of Defense are limited, though they have improved recently with the increased attention to Chinese investment behavior in the United States. The Committee on Foreign Investment in the U.S. (CFIUS) is one of the few mechanisms in place today with real power to govern inbound investments with potential national security threat (Jackson, 2018). While originally a blunt tool that only reviewed relevant transactions that resulted in a foreign controlling interest, CFIUS' jurisdiction has recently been expanded under the Foreign Investment Risk Review Modernization Act (FIRRMA) to cover non-controlling foreign interests in critical infrastructure, critical technologies, or sensitive personal data, including via indirect investment and if a foreign government is involved.[17] Importantly, however, a radical move to include U.S. outbound investments to China with potential national security implications was removed from the final FIRRMA reforms (Donnan, 2018).

Perhaps the most important lesson for the challenge that China's MCF strategy poses for the United States has to do with political will. China's strong, centralized, state-led system allows for a substantial degree of engineering of industrial and economic goals. Such a state-centric design in industrial policy is unfamiliar to the U.S. free-market system. Even control over broad technology in the United States is highly controversial within the commercial technology community, where the largest markets for many foundational and emerging technologies are non-defense in nature. Despite the reforms to CFIUS or other tech transfer measures, several major recent studies argue that the United States remains

[17] FIRRMA takes the "direct" out of foreign investment review. Therefore other investment types (assets purchased from bankruptcies, or the presence of Limited Partners in a VC fund) can now trigger CFIUS action. Also, filings involving foreign governments are mandatory. See Croley et al. (2018) and Oleynik et al. (2018).

vulnerable to loss of critical technologies. It is unclear how the U.S. polity could muster the political will to take a whole of government approach and institute a comprehensive policy tool set necessary to protect against the depth and breadth of the challenge: from supply chain vulnerabilities, to targeted investments for tech transfer and industrial espionage. Yet, bold action may be the only means to meet the challenge of protecting U.S. military technological advantage.

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