The Remaking of the Chinese Defense Industry and the Rise of the Dual-Use Economy

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China's leaders are urging the country's ugly duckling of a defense industry to transform itself into a world-class military technological and industrial powerhouse by the end of the next decade.[1] While such an ambitious target is more aspirational rhetoric than an attainable objective given a wide gulf in technological levels between China and the US and other top tier military industrial states, the Chinese defense industry has been achieving noteworthy progress since the turn of this decade. New generations of fighter aircraft, missiles, spacecraft, submarines, warships and other sophisticated hardware are coming off production lines at an impressive pace and quality.

A two-pronged approach is being pursued in the modernization of the Chinese defense industry.[2] First is the internal re-engineering of the defense industry that focuses on breaking down bureaucratic barriers and paring back the role of the state in conjunction with the nurturing of a more competitively minded and entrepreneurial institutional culture that encourages the nurturing, diffusion and absorption of technology and knowledge.

The second plank of the strategy is to realign the defense industry and integrate it into the civilian economy to form a dual-use technological and industrial base that serves both military and civilian needs. The Chinese authorities view a strategy of embedding the defense industry within the broader civilian economy as playing a central role in supporting the long-term modernization of the country's military capabilities, especially in technological innovation, as well as in the development of the country's science and technology (S&T) establishment.

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[1] Zhang Zhaoyin, "Firmly Seize the Period of Important Strategic Opportunities to Promote Leap-Type Development", ***Jiefangjun Bao***, 25 February 2003, in ***Foreign Broadcast Information Service*** ("***FBIS")***, 7 April 2003.

[2] For a more detailed and extensive treatment of this topic, see Tai Ming Cheung, ***Remaking of the Chinese Defense Economy: Nurturing Innovation, Forging Civil-Military Integration*** (Forthcoming).

Defense Industrial Reforms Since the Late 1990s

In the late 1990s, the Chinese defense industry adopted a more forward-looking, dynamic and coordinated approach to reform to replace a highly conservative, hesitant and piecemeal attitude that had led to stagnation during the 1980s and 1990s. Defense industry mandarins were pressed to establish a more streamlined, competitive and open structure without the barriers that had led to the rigid compartmentalization of activities and restricted knowledge flows within the system. This required a substantial curtailing of the role and reach of the state within the defense S&T and production systems, the adoption of market-based mechanisms to promote competition, evaluation, and initiative, and numerous other corporate, financial and structural reforms that were being pursued in the civilian economy.

Reform measures included providing greater funding for research institutions, improving the management of research funds, introducing a competitive mechanism for defense research, adoption of a contract system for research projects, speeding up the application of research findings for production and improving the integration of military and civilian technologies. Far-reaching organizational changes were also undertaken that led to a restructuring of the management hierarchy, a revamping of the country's military-industrial conglomerates, and a more influential and direct role for the People's Liberation Army (PLA) in the management of the defense S&T process.

Reducing the Role of COSTIND and Separating its Relationship with the PLA

A key reform measure was the separation of the military and civilian components of Commission for Science, Technology and Industry for National Defense (COSTIND). Under the old state planning system, COSTIND's role was to represent and balance the interests of both the defense industry and the military. But this had led to constant bureaucratic infighting because these two groups had widely divergent interests. As the consumer, the military wanted weapons that could be produced on time, met its specifications and were cost-effective. But the defense industry had little incentive to meet the PLA's requirements because it faced little competition.

Under the new system that was introduced in 1998, the military portion of COSTIND was incorporated into the PLA General Armament Department and the civilian component was retained and kept its COSTIND title. A crucial change under this newly separated system was that the defense industry no longer enjoyed monopoly control in the production and supply of arms to the PLA.

COSTIND's role following the restructuring was the making and administration of government policies towards the defense industry. A dearth of planning guidelines and detailed regulations had contributed to the woes and lack of direction for the defense industry during the 1980s and 1990s.

The Reform of State-Owned Defense Industrial Enterprise Groups

A central cause of the plight of the defense industry during the 1990s was the faltering performance of its industrial conglomerates. With little competition to encourage efficiency or innovation and continuation of soft budget constraints, firms steadily accumulated losses. But the implementation of far-reaching cost-cutting measures, debt restructuring and access to new sources of capital combined with a strong pickup in defense orders led to an impressive turnaround in the business operations of the defense conglomerates from the end of the 1990s.

After nearly a decade of losses, the defense industry finally broke even in 2002 and has since posted rising profits, which in 2006 totaled a record-breaking US$2.6 billion.[3] Earnings were strong for both civilian and military products.

Comparatively, six of the 11 defense conglomerates were listed among the top 100 best performing enterprises in China for 2005. Moreover, other performance indicators suggest that defense conglomerates are emerging to become among the country's most technologically savvy firms. For example, the defense industry had the second largest number of patents issued by industrial sector in 2004, accounting for 20% of all central government enterprise applications.

But compared with reforms undertaken by their counterparts in civilian sectors, the defense industrial conglomerates have a long way to go to fundamentally improve their efficiency and corporate governance. For example, none of the 11 corporations have introduced supervisory committees or boards of directors that are essential to improving management practices. This lack of basic modern management and business structures indicates that economic performance of defense enterprises is still measured through metrics such as output and value of assets rather than through profitability or returns on invested capital.

The Building of a Robust Regulatory and Standards-based Regime

A glaring deficiency of the defense industry up until the late 1990s was the absence of a comprehensive and coherent institutional framework of regulations and technical standards that is essential in guiding technological development. In an environment of conflicting standards and competing rules and practices, the diffusion of technological know-how and sharing of information was seriously impeded.

One of the first priorities for defense industrial policy makers after the 1998 reorganization was to strengthen and expand the regulatory regime. A key focus was on the drafting of detailed administrative regulations and laws governing armaments research and development, production and management issues. [4] A steady flow of new

[3] "Defense Industry Reaps US$2.5b in Profits", ***Beijing Zhongguo Wang***, 9 January 2007.
[4] Jiao Qiuguang (Chief Ed), ***Junshi Zhuangbei Guanli Xue (The Study of Military Armaments Management)*** (Beijing: Junshi Kexue Chubanshe (Academy of Military Sciences Press), 2003, p178.

rules and regulations concerning defense technological and weapons-related matters have since been issued.

Implementation of these laws and regulations though has been problematic. Military units and defense enterprises had previously enjoyed wide-ranging freedom in their activities and were unencumbered with the need to adhere to laws and regulations. Despite this resistance, the gradual adoption of a rules-based institutional culture will eventually lead to the emergence of a more effective and regularized environment that will enhance competition, diffusion and other processes essential to the nurturing of innovation and absorption capabilities.

The establishment of a common and comprehensive technical standards and military specifications regime has been another important mission for the defense industry.[5] This task has taken on added urgency since the mid 1990s in the face of growing leadership calls to the military establishment to pursue technological leapfrogging. This is because the development of complex weapons systems is dependent on thousands of standardized parts and components that must be of high quality and reliability.

Beginning in 1983 when the first 15 national military standards were issued, an average of around 400 standards were passed annually over the next 15 years, totaling around 5,700 by the end of 1998. The Chinese military specifications and standards regime though has a long way to catch up with its more established counterparts in advanced industrial countries. The US Defense Department had an active list of more than 26,000 military specifications and standards in 2001[6].

Access to Foreign Technology Transfers

Expanding access to foreign technological knowledge, products and practices, both in the military and civilian sectors, have had a profound impact in promoting the technological development of the Chinese defense industry in the reform era and this trend has accelerated and deepened since the late 1990s. Although self-sufficiency remains a cornerstone of the country's defense technological and industrialization modernization goals, this is a long-term strategic aspiration and the focus over the next couple of decades is to pursue a parallel but complementary development strategy of acquiring and absorbing foreign technology that both complements and supports indigenous weapons R&D. With increasing priority attached to leapfrogging and catching up with advanced military powers, the importation of foreign technology is crucial in meeting this objective.

The Chinese defense industry has employed a number of approaches in the pursuit of foreign technological products and processes:

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[5] Kong Xianlun (Chief Ed), ***Jungong Biaozhunhua*** [Military Standardization] (Beijing; Guofang Gongye Chubanshe [National Defense Industry Press], 2003).

[6] US Department of Defense, Office of the Undersecretary of Defense (Acquisition, Technology & Logistics) Logistics Plans & Programs ***MilSpec Reform: A Final Report*** (Washington; Defense Standardization Program Office, April 2001), p11.

- **Technical and advisory consultation**: China invited large numbers of foreign defense scientists and engineers during the 1990s to provide technical and consulting advice for weapons development projects as well as for academic and professional exchanges and conferences. This provided the defense industry with a useful source of external information and analysis.

- **Off-the-shelf purchases of complete systems:** The predominant form of technology transfers during the 1990s was the acquisition of sizeable amounts of completed weapons systems for the PLA's operational use. Supplies from Russia accounted for more than 90 percent of the monetary value of contracts signed. This is estimated to have been around US$1.2 billion annually during the 1990s, and has doubled in size since 2001.[7]

- **Supply of sub-systems and components:** In technological areas in which the Chinese defense industry was weak, foreign assistance has been sought to provide specific sub-systems and components to be incorporated in domestic designs. Among the most urgently sought technology are aircraft and warship propulsion systems and aircraft electronics, radar and fire control systems.

- **Off-set license assembly and production of complete systems:** From the mid-1990s, China signed a small number of deals for the license production of fighter aircraft and missiles. This allowed the transfer of technological products and manufacturing processes that were at least a generational leap ahead of existing Chinese technological levels.

- **Joint design and development**: This approach offers the greatest opportunities for technology transfers to China. In the past decade, Beijing has asked Moscow to undertake the joint development of new generations of weapons. Moscow had previously been lukewarm to these proposals because it was concerned that this would allow the Chinese defense industry to catch up with Russian defense technological levels. But senior Russian defense industry officials have said in the past few years that the previous pattern of off-the-shelf purchases "is increasingly giving way to a relationship of partners who are developing aircraft jointly."[8] One possibility that has been raised is including China in a joint Russian-Indian effort to develop a 5th generation multi-role fighter aircraft

Repairing a Broken Diffusion System

A fundamental weakness of the defense industry has been its poor ability to diffuse technological achievements. At the end of the 1990s, it was estimated that less than 15%

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[7] US Defence Department, ***Annual Report to Congress: Military Power of the People's Republic of China 2007*** http://www.defenselink.mil/pubs/pdfs/070523-China-Military-Power-final.pdf p28.
[8] Mikhail Kukushkin, "China Does Not Want Ready Aircraft", ***Moscow Vremya Novostey***, 5 November 2004, in ***FBIS***, 5 November 2004. The comment came from Yuriy Koptev, the head of the Defence Industry Department of the Russian Ministry of Industry and Energy.

of the military inventions annually developed by defense R&D institutes was able to be popularized and less than 3% were eventually adopted for large-scale serial production.[9]

A principal reason behind the ineffectiveness of the diffusion process is the lack of incentives that research institutions have to pursue their activities to fruition in the marketplace or on the production line. Most importantly, the absence of an effective patents system and intellectual property rights culture has meant that researchers and their institutions have received little or no reward from the exploitation of their work.[10] Without any benefits to provide encouragement, scientists and engineers have had little motivation to carry on with the development of their research output for commercial dissemination.

Diffusion of defense technological R&D has also been obstructed by other factors. The backward state of the military technical standards regime has been one bottleneck. Another obstacle has been the dominance of technology push in R&D projects, in which government requirements have determined priorities and goals and the demands of end-users have been ignored.[11] Yet another deficiency has been the lack of a comprehensive regulatory framework to provide rules and laws to guide the development of the commercialization of defense S&T achievements.[12] Concerns over the potential leaking of defense secrets have also been a powerful barrier to preventing dissemination flows.

Steps have been taken to strengthen the organizational mechanisms to promote diffusion since the late 1990s. This includes the establishment of defense technological commercialization centers such as the Ordnance Industry's Productivity Promotion Center.

These efforts will likely see an incremental improvement in technology dissemination over the long-term, but the fundamental cultural and structural barriers that have impeded diffusion flows remain deeply ingrained in the defense industrial R&D apparatus. Any improvement in the mechanisms and processes to enhance diffusion over the next couple of decades will be limited and gradual, especially in the absence of high level political attention.

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[9] Zhu Qinglin and Meng Renzhong (Chief Eds), ***Zhongguo Caijun Yu Guofang Ziyuan Peizhi Yanjiu*** [China's Disarmament and Research into the Disposal of Defense Resources] (Beijing: Junshi Kexue Chubanshe [Military Sciences Press], 1999), p152-153; and Xin Guoping, "Research on the Industrialisation and Commercialisation of Science and Technology Achievements from Military Industry", ***Ranqi Wolun Shiyan Yu Yanjiu*** [Gas Turbine Experimentation and Research], No.2, Vol. 14, 2001, pp55-58. The commercialisation rate for the NDSTU was 3 percent. See Zeng Huafeng (Ed), ***Zhujian Weili*** (Casting Swords into Ploughshares), (Beijing: Beijing Youdian Daxue Chubanshe (Beijing Posts and Telecommunications University Press, 2000), p172.

[10] See Du Ying, "Guofang Jishu Zhishi Chanquan Baohu Yanjiu" [Research into the Protection of Defence Technological Intellectual Property Rights], ***Zhishi Chanquan*** [Intellectual Property], April 2002, pp21-24.

[11] Carl J. Dahlman and Jean-Eric Aubert, ***China and the Knowledge Economy*** (Washington: World Bank, 2001, p109.

[12] Chen Lin & Chen Kai, "Tuiguang Zhuanhua Gongzuo" [Working to Transform Popularisation], ***Guofang Keji Gongye***, March 2003, pp36-37.

The Rise of the Dual Use Economy

Chinese defense and economic policy-makers engaged in an intensive debate over the development of a dual-use civil-military strategy from the late 1990s to the early part of this decade as part of overall efforts to chart the long-term course of the country's economic and military industrial development. The policy outcome that emerged from these deliberations was a new set of guiding principles contained in the 10th Five Year Plan that replaced Deng Xiaoping's original 16 character policy that was laid down at the end of the 1970s that called for a far-reaching demilitarization of the defense-industrial complex.[13]

This new 16 character list of principles were: "*Junmin Jiehe* (Combining Civil and Military Needs), *Yujun Yumin* (Locating Military Potential in Civilian Capabilities), *Dali Xietong* (Vigorously Promoting Coordination and Cooperation), *Zizhu Chuangxin*" (Conducting Independent Innovation).[14] The most important of these concepts is *Yujun Yumin* that refers most directly to the forging of an integrated civil-military dual-use system, especially the establishment of a civilian apparatus that has the technological and industrial capabilities to meet the needs of the military and defense economy.

The third plenum of the 16th Party Congress in 2003 gave the go-ahead for the construction of a new civilian technological and industrial base with embedded military capabilities. "The Decision of the Chinese Communist Party Committee on Several Issues in Perfecting the Socialist Market Economy" called for the building of an innovative *"Junmin Jiehe, Yujun Yumin"*-based system that focuses on the "mutual promotion and coordinated development of the defense and civilian technological sectors."[15] This elevated the *Yujun Yumin* guiding principle into the strategic outline for the future dual-use economy.

This decision to press for an amalgamated civil-military technological and industrial base was described by MOST Minister Xu Guanhua as of far-reaching strategic significance for protecting the country's national security and strengthening its innovation system.[16] Another senior MOST official said that the decision would have important ramifications for the coordinated development of the technological capabilities of the civilian and defense sectors over the next couple of decades.[17]

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[13] Zhang Nanzheng & Zhang Shengwang (Eds), ***Dangdai Guofang Jingji Lilun Qianyan Wenti Yanjiu*** [Research into the Forward Problems of Contemporary Defence Economic Theory] (Beijing; Guofang Daxue Chubanshe [National Defence University Press], 2003), pp145-149.

[14] "Outline of the 10th People's Republic of China Economic and Social Development Five Year Plan", ***Guangming Ribao***, 18 March 2001, Chapter 24.

[15] "'Decision' on the Direction of the Science and Technology Industry", ***Zhongguo Gaoxin Jishu Changye Daobao*** [China High New Technology Industry Newspaper], 29 October 2003, http://www.cutech.edu.cn/zhonghe/000070.asp

[16] "Goujian Junmin Ronghe De Chuangxin Tixi" [The Construction of a Merged Civil-Military Innovation System],], ***Liaowang,*** 24 November 2003, p24.

[17] "Sanzhong Quanhui Shi Zhongguo Keji Tizhi Gaige De Desange Lichengbei" [The Third Plenum is the Third Milestone in the Reform of China's Science and Technology System], ***Zhongxinwang*** [China News Network], 22 October 2003.

The structural reform and downsizing of the defense industry since the late 1990s has created a strategic opportunity for the involvement of civilian enterprises with no prior participation in defense industrial operations. A central goal of the overhaul of the defense economy is to establish a small inner core of dedicated defense prime contractors that is complimented by a large supporting base of secondary sub-contractors.[18] The defense industrial bureaucracy is keen to attract not only existing military and former military entities into this outer pool but also mainstream civilian companies with advanced expertise and technology in areas of high military demand.[19]

To attract civilian participation in this scheme, COSTIND has organized exhibitions and conferences targeting the participation of non-governmental enterprises. One of the first events took place in the spring of 2004 and was an exhibition entitled "Civilian Industrial Enterprises and Technological Products Participating in Defense Construction" that was attended by nearly 150 firms, many of whom were non-state entities.[20]

Will the Building of a Dual-Use Economy Succeed?

The building of the Chinese dual-use economy is in its infancy and the task of the laying of the foundation stones of this ambitious new system will require the full attention and active support of the country's leadership over the course of at least the next couple of decades. A key task of the medium and long-term (2006-2020) plan for the development of the country's science and technology system is the forging of the *Yujun Yumin* system.[21]

The future dual-use economy will essentially consist of two distinct but connected parts. One is a new high-technology-focused base that is embedded within the civilian economy. The bulk of the entities that will be linked into this new apparatus will be non-governmental civilian companies engaged in industries such as information and communications technology, nano-technology and electronics. They will include R&D-intensive enterprises that are leaders in product innovation as well as component sub-contractors. The other half of the dual-use economy will be largely made up of legacy state-owned defense industrial entities that are seeking to transform themselves into more nimble, new technology outfits able to meet the information warfare needs of the military.

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[18] See Sun Guangyun, ***Zhongguo Guofang Keji Gongyede Gaigehe Fazhan Wenti*** (The Problems of the Reform and Development of the Chinese Defence Technology Industry (Beijing, Hangkong Gongye Chubanshe (Aviation Industry Press), 2003), pp82-106.

[19] See Wu Yuanping, Zhao Xinli & Zhao Junjie, ***Xin Zhongguo Guofang Keji Tixi De Xingcheng Yu Fazhan Yanjiu*** [Research into the Formation and Development of New China's Defence Science and Technology System] (Beijing: Guofang Chubanshe [Defence Industry Press], 2006), pp389-400.

[20] "Tuozhan 'Minpin Junyong' De Guofang Jianshe Xin Luzi" [Expand the New Road of the 'Military Use of Civilian Products' in Defence Construction] ***Guofang Keji Gongye***, May 2004, pp22-24.

[21] "Wen Zongli Shitiao Zhidao Fangzhen, Yunniang Zhongde Zhongchangqi Keji Jihua" [Premier Wen Holds Deliberations on the Ten Guiding Principles of the Medium and Long Term Science and Technology Plan], ***Liaowang***, 27 March 2004.

The future performance and shape of the dual-use economy will depend on how two critical tasks are implemented. The first is the type of rules, routines, established practices and laws that will be drawn up and applied, as this will define the operating framework and guide the activities of the actors involved in this system. Will the focus be, for example, on transparency, market-based rather than administrative regulations, rules that seek to promote interaction and openness, and the adoption of commercially accepted business practices and standards? Many of these concepts and practices are alien to the defense economy and its willingness to adapt and conform to a more open system will significantly determine how well the *Yujun Yumin* system will be able to initiate and diffuse innovation.

As major portions of the foundations of the dual-use economy will be built on the existing defense industrial apparatus, the second crucial issue is how far and how fast the restructuring of the current defense economy will take place. This includes the overhaul of key institutional arrangements such as the acquisition and standards systems as well as organizational reforms to the management and enterprise system.

The potential benefits from the establishment of an effective and capable dual-use economy are numerous and wide-ranging. Fundamentally, this will lead to the building of an environment that will be more encouraging and supportive of the kinds of innovation and leap-frogging activities that the Chinese authorities are actively seeking to promote. This includes the marrying of commercial entrepreneurship and risk-taking with the support of substantial state resources and R&D capabilities. If successful, the results should be the development of technology and equipment that is cheaper, better and available in shorter timescales.

China’s success in this grand endeavor is by no means guaranteed, especially as there are numerous structural, bureaucratic, technological and cultural barriers to overcome. The track record so far has also been less than stellar. The haphazard civil-military integration efforts that took place in the 1980s and 1990s under the country’s defense conversion program led to the creation of a poorly structured and uncoordinated apparatus in which civilian production was emphasized and military requirements were largely neglected. The formulation of a more sophisticated and integrated approach under the *Yujun Yumin* banner coupled with sustained high-level political backing will significantly improve the chances for success over the next one to two decades.

Conclusion

A strenuous reform effort has enabled the Chinese defense industry to make long-awaited generational advances in the development and production of weapons systems. While this progress is significant, the defense industry still lags between one to two generations behind the latest global standards in many areas. Can the defense industry maintain this reform momentum and continue to advance up the ladder of technological innovation?

Some military planners point out that the defence industry "must not follow the conventional path of development", but must instead "act with daring to skip certain stages" of the modernisation process[22] and focus on the adoption of transformational information technology-related capabilities in place of conventional mechanized systems. This alternative pathway to modernisation though entails considerable risks. It involves the development of unproven technologies, the diversion of substantial resources from other parts of the defense industry, and the unpredictable nature of the technological development process.

The risks are even higher if the focus is on the development of 'frontier' technologies rather than the adaptation and imitation of already existing designs and products. Moreover, much of the information technology-related knowledge and technology lies outside of the boundaries of the defense industry and within the civilian and dual use sectors. This means that the establishment of an effective dual-use technological and industrial base is critical.

The Chinese defense industry would also need to devote significantly more capital investment and other resources if it is to realistically pursue the goal of catching up the world's advanced military industrial powers. In the late 1990s, China's defence S&T budget was reported to be equivalent to just 5% of the amount that the US spent in the same area,[23] although R&D expenditures have surged over the past decade as part of an overall effort by the state authorities to boost S&T spending in general. This huge gap in funding strongly suggests that any Chinese broad-based leapfrogging efforts would fall far short of reaching the technological standards enjoyed by the US and its Western allies.

A more attainable strategy is the concentration of limited resources in a select number of areas where chances of success in narrowing technological gaps are greatest. These pockets of technological excellence include portions of the dual-use information and communications technology dual-use sectors and elements of the missile, aviation, space and shipbuilding industries.

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[22] Fan Xizhong, "Grasp the Core of Informization", ***Jiefangjun Bao***, 8 February 2004, p2, in ***FBIS***, 8 February 2004.

[23] Liu Jingshu, "New Military Changes in the World and Research on the Distribution of China's Defense Economic Resources", ***Junshi Jingji Yanjiu*** (Military Economic Research), March 2004, p6.