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### Title

Rejuvenating the Chinese Defense Economy: Present Developments and Future Trends

### Permalink

<https://escholarship.org/uc/item/60z7p0kp>

### Journal

SITC 2011, 2011(Policy Brief 19)

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### Publication Date

2011-09-01



# Policy Brief No. 19

September 2011

## *Rejuvenating the Chinese Defense Economy: Present Developments and Future Trends*

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### Summary

This policy brief examines the rejuvenation, current state, and future prospects of the Chinese defense economy. Fifteen years of reforms have turned this once lumbering holdout of autarkic central planning into an aspiring champion of technological innovation. Critical factors behind these improving fortunes include top-level leadership support, effective implementation of a well-defined development vision, a leading role played by defense corporations, the remaking of the research and development apparatus, the emergence of new generations of highly-trained scientists and engineers, efforts to integrate the civilian and defense economies, and access to Russian technologies. One of the main conclusions is that the development of the defense economy will continue on an upward trajectory and could even accelerate, as long as the Chinese leadership remains committed to the goal of building a world-class military industrial complex, funding remains plentiful, and end-user demand continues to be strong.

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*The Study of Innovation and Technology in China (SITC) is a project of the University of California Institute on Global Conflict and Cooperation. SITC Policy Briefs provide analysis and recommendations based on the work of project participants. This material is based upon work supported by, or in part by, the U.S. Army Research Laboratory and the U.S. Army Research Office through the Minerva Initiative under grant #W911NF-09-1-0081. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the U.S. Army Research Laboratory or the U.S. Army Research Office.*

## INTRODUCTION

The Chinese defense science, technology, and industrial base has been engaged in an intensive effort over the past 15 years to transform itself from a crumbling relic of Maoist central planning to becoming a modern powerhouse of technological innovation. This Herculean task is beginning to bear fruit with the defense industry posting record annual profits, the advent of new generations of weapons systems in advanced development and production, and the emergence of a more dynamic research and development apparatus manned by younger generations of better trained scientists and engineers.

A number of key factors have played instrumental roles behind the improving performance of the defense economy, from high-level leadership support to the leading role of defense corporations.

### *Strong Leadership Support*

Active and sustained support and guidance from the highest levels of the policymaking and political leaderships is a crucial enabling factor in the Chinese defense economy's ability to carry out innovation activities. Leadership backing has been essential in tackling key structural barriers that include entrenched bureaucratic inertia, risk-averse decision-making, institutional compartmentalization, and chronic project management problems that have caused prolonged delays and cost overruns. Without outside leadership intervention and oversight, there would have been a high chance that many achievements of the defense economy would not have happened, especially since its turnaround from the end of the 1990s.

Credible commitment from the political leadership to the defense economy comes in a number of ways. The most obvious is high-level speeches, visits to defense industrial facilities, and attendance of defense industry-related events by senior leaders. They include Party General Secretary and Central Military Commission (CMC) Chairman Hu Jintao, Premier Wen Jiabao, and Vice Premier Zhang Dejiang, who is the State Council vice premier in charge of the defense industry portfolio.

Another important sign of leadership engagement is strategic guidance through policy reviews and longer-term development plans and projects. The enactment of a long-term defense science and technology development plan in 2006 is an indicator of the leadership's interest in the long-term vision and development trajectory of the defense economy.

The central leadership's direct and continuing involvement and oversight in the operations of the defense economy and of critical projects is also essential. This is often done through the establishment of leadership small groups and special committees. In defense S&T matters, one of the key mechanisms is the Central Special Committee, a high-powered group under the CMC and State Council chaired by Wen Jiabao.

Another key measure of credible commitment by the leadership is the defense economy's access to funds and resources. This can come through regular budget allocations as well as through the leadership's willingness to mobilize state resources on special occasions for key strategic projects. The defense economy's improving economic performance since the early 2000s suggests that the leadership has been extremely generous with its fiscal largesse.

In the aftermath of the 2008–2009 global economic crisis, the Chinese leadership has made it clear that building a strong indigenous innovation capability is even more pressing because the downturn showed that the country's technological and economic competitiveness still lags well behind world standards. The only way to maintain and sustain robust economic growth rates and be resilient against external shocks is through indigenous innovation.

## THE DEFENSE ECONOMY'S LONG-TERM DEVELOPMENT STRATEGY

The Chinese defense economy in conjunction with the PLA has been drawing up major plans over the past few years to guide long-term weapons, technological, and industrial development. In the near to medium term is the 12th Five-Year defense science and technology program that be-

gan in 2011. This provides detailed programmatic and procurement guidelines for projects that are in advanced stages of development and are expected to be ready for service during the plan's duration. Some of the defense industry's top development priorities during the 12th Five-Year Plan include the development of the J-20 stealth fighter aircraft, which was unveiled in January 2011, and research, development, and production of large-sized aircraft carriers and the aircraft and naval assets required to support carrier-based operations.

The principal long-term plan is the 2006–2020 Medium- and Long-Term Defense Science and Technology Development Plan (MLDP) that focuses on guiding defense-related basic and applied R&D. There is also a national medium- and long-term science and technology development plan (MLP) that covers the same period and includes dual-use and military projects. The principal aspirational goal of these plans is to reach the technological level of first-tier global advanced military and technological powers such as Western Europe within the next 10–15 years.

Of the 16 top priority technology development contained in the MLP, three are unnamed classified military projects while several others are being led by the defense industry and have potential dual-use applications. Chinese blogs have suggested that the three classified defense projects are an inertial confinement fusion laser project known as the Shengguang program, the second-generation Beidou satellite navigation system, and a hypersonic vehicle technology project.

## **SHIFTING THE DEFENSE ECONOMY FROM TECHNOLOGY-PUSH TO DEMAND-PULL**

Major organizational reforms in the late 1990s allowed the PLA to gain primacy in guiding defense science and technology R&D. Previously, the institutional interests of the state-owned defense industry overwhelmingly drove armaments development and the PLA's requirements were secondary. The PLA General Armament Department (GAD), which is one of the principal command bodies of the PLA general headquarters, is responsible for ensuring that military end-user needs are

being served. Created in 1998, GAD has quickly established itself as a powerful player in managing the often-competing interests of the military and defense industry.

To ensure that defense companies are in compliance with its requirements, GAD has created incentive structures and monitoring mechanisms. First, it has imposed tougher competitive and evaluation procedures in the development and procurement of weapons systems. In theory, defense enterprises have been required to improve their performance to meet these more stringent demands or face losing work. In practice though, the still highly regulated nature of the Chinese weapons market has impeded the effective application of these procedures.

Second, one of the main ways that GAD has been able to implement demand-pull mechanisms has been through the procurement process by withholding or postponing orders for equipment that do not meet its requirements. The military had no option but to accept the output of the defense economy during the Maoist era, but it was able to become more selective in the reform period. As the quality of indigenous equipment steadily declined, the PLA became increasingly reticent to procure these arms and began to look overseas for weapons that met its needs in the 1990s, especially from Russia. This practice faded in the 2000s with the improvement in domestic weapons quality.

Third, considerable efforts have been made to link military strategy and doctrinal planning with weapons and technology development. The separation between the military and defense industrial bureaucracies during the central planning era had led to a gap in joint planning over their long-term development strategies. While consultation and coordination did regularly take place between the two establishments, this was primarily concentrated on annual, three-year, and five-year economic and administrative plans. Little attention was paid to long-range strategic planning efforts that often played a crucial role in shaping the evolution of force doctrines and weapons requirements. GAD now works closely with the State Administration of Science, Technology, and Industry for National Defense (SASTIND).

## THE GROWING CLOUT OF DEFENSE CONGLOMERATES

The rise of China's ten major defense corporations is marginalizing the operational role of SASTIND. Over the past decade, these state-owned conglomerates, each of which has 50–200 subsidiaries, have sought to transform themselves from bloated loss-making quasi-state bureaucracies to become full-fledged market-driven enterprises. They have been slimmed down, allowed to shed heavy debt burdens, and given access to new sources of capital. Combined with a strong pickup in defense and civilian orders over the past decade, these companies have become highly profitable.

The defense industry's ten principal conglomerates earned an estimated RMB 70 billion in 2010, which was the highest in its history. The aviation, space/missile, defense electronics, and naval sectors have been the chief beneficiaries from this rising tide of defense procurement, while the ordnance industry has enjoyed considerable success from sales of civilian products such as motor vehicles. These corporations are now engaged in an ambitious expansion strategy to become global arms and strategic technology champions.

The revamping of these defense corporations is pivotal to the defense industry's aspirations to be a leading innovator. First, they now own and manage a growing segment of the R&D apparatus. Second, their growing financial clout allows these firms to invest heavily in innovation activities. Third, their collaboration with foreign companies and engagement in foreign markets makes them important conduits of external knowledge and technology. Fourth, it is in the core interest of these firms to support the development of institutional mechanisms that will safeguard the results of their innovation activities, especially the strengthening of intellectual property protection rights. Modest progress is being made in building legal and patent systems to safeguard local firms. However, the authorities have not protected the intellectual property of foreign companies and have supported unauthorized copying and reverse engineering in cases involving critical foreign strategic technologies, as Russian defense firms have discovered in the past few years.

## OPENING UP TO CAPITAL MARKETS

One of the most significant initiatives in the modernization of the Chinese defense industry since the mid-2000s has been its opening up to capital markets and the non-state economy to allow defense industrial firms to raise new sources of financing. A key goal is to expand the sources of funding available for defense firms to reduce their heavy reliance on the state. Chinese officials have said that limited access to investment funds has been a major factor holding back the defense economy's growth and technological modernization.

The authorities are especially eager to attract domestic state-owned, private, and even foreign firms to acquire equity stakes in defense companies as well as allow them to list on stock markets in Shenzhen, Shanghai, and Hong Kong. SASTIND issued a series of policy guidelines and regulations in 2007 to define the framework of this market liberalization.

Defense industrial firms have been allowed to list on the stock markets since the early 1990s, but under tight restrictions that precluded entities involved in military-related work. The more permissive regulatory regime now would allow firms with military programs to make stock market or private listings to outside investors as long as they satisfied secrecy regulations and their defense projects were not deemed to be too sensitive.

This financial opening up of the defense economy was slowed down by the 2008–2009 global financial crisis as stock and capital markets in China and around the world sharply cut back on their willingness to provide funding to companies. With access to these markets temporarily curtailed, defense companies appeared to slow down their reforms, especially in restructuring themselves into entities that would allow them to issue shares to outside investors.

Defense industrial firms listed on the Chinese and Hong Kong stock markets in 2010 numbered in the mid-60s, and only a handful were able to conduct initial public offerings in 2008 and 2009. Many defense enterprises decided instead to borrow from state-owned banks to take advantage

of the government's generous stimulus program. This suggests that instead of looking to the stock markets as their principal fund-raising source, defense firms may rely far more on other modes of capital acquisition, especially the corporate bond market, bank lending, and non-stock market private placements.

## **OVERHAULING THE RESEARCH AND DEVELOPMENT BASE**

The defense R&D apparatus has been undergoing a far-reaching overhaul and expansion to overcome serious organizational, management, and operational problems that have crippled its ability to conduct high-quality work for much of its 60-year history. The development of a robust defense R&D system is a top priority in the MLDP, which emphasizes a number of key goals. One goal is the shifting of ownership and funding of key portions of the state-controlled defense R&D apparatus to the country's defense conglomerates. The primary aims of this reform include reducing the dependence of the R&D apparatus to state funding; increasing the amount of investment that firms devote to R&D, especially in applied and commercial development; and speeding up the exploitation and commercialization of proprietary R&D output.

A stipulation in the MLDP is that defense enterprises and research institutes should invest at least three percent of their annual revenues for R&D during the course of the plan. This is a highly ambitious, even unrealistic, target as Chinese large- and medium-sized enterprises now spend less than three-quarters of one percent of their annual revenues on R&D.

A second goal of the MLDP is the development of an extensive defense laboratory system that would pave the way for long-term technological breakthroughs. Around 90 laboratories belonging to both the defense industry and PLA have so far been established. It will take some time before these research outfits are able to conduct high quality R&D because they lack experienced and top-rated scientific personnel.

A third goal of the MLDP is the breaking down of barriers that have kept the defense R&D system

separate from the rest of the national R&D base and the forging of close linkages with universities and civilian research institutes. Considerable progress has been made in the past few years with many top research universities, such as Tsinghua University, establishing sponsored research facilities with the defense sector. Large sums have also been invested to upgrade the research standards of the 9–10 science and technology universities directly under the PLA and defense industry.

## **CULTIVATING SCIENTIFIC AND ENGINEERING TALENT**

The Chinese defense economy has a strong and growing demand for a new generation of well-trained scientists, engineers, managers, and skilled factory workers to replace the greying ranks of its 2 million-plus workforce and to fill positions created by the rise of new high-technology sectors. While the country's higher education establishment is able to produce large numbers of science and engineering graduates to satisfy demand from both the civilian and defense economies, the quality of this talent pool is far from adequate.

The number of natural science and engineering (NSE) graduates from Chinese higher education institutions has surged since the late 1990s. In 1998, there were around 250,000 NSE first degree graduates, but this more than tripled to 800,000 by 2006. By comparison, the United States produced 250,000 NSE graduates in 2006. Upwards of 70 percent of the Chinese graduates are engineering majors.

Perhaps a better gauge of advanced educational quality that contributes to innovative capacity is the number of awards for postgraduate degrees. Around 10–12 percent of all NSE degrees issued annually in China are at the masters or doctorate level, which in 2005 numbered around 120,000. For doctorate awards, China has made significant strides. The country issued 1,900 doctorates in 1993, but this climbed to 21,000 in 2006. Although these figures are impressive, they barely tap into the full potential of the Chinese human resources talent pool.

The Chinese defense S&T educational establishment has also undertaken a major expansion

in its training capabilities over the past decade, although on a more modest scale compared with the civilian sector. The country's seven major civilian defense S&T universities registered an 86 percent increase in their total student populations between 1999 and 2005. The total number of students in these universities numbered 230,000 in 2005. The quality of these students also increased, with the number of postgraduate students accounting for a greater proportion of total numbers.

This influx of younger talent is transforming the demographic make-up of the defense economy. The aging of the defense S&T workforce had been a deep concern during the 1980s and 1990s as many of the senior and rank-and-file pre-Cultural Revolution employees reached retirement age.

This passing of leadership from older to significantly younger generations does appear to have taken place at the senior levels of the defense economy over the past decade. Fourth- and fifth-generation post-Cultural Revolution educated scientists, engineers, and technocrats in their mid-40s to mid-50s are assuming top corporate, bureaucratic, and project management posts and replacing their second- and third-generation elders. Many of these new leaders have science and engineering degrees from defense industry-affiliated universities.

## **CIVIL-MILITARY INTEGRATION AND SPIN-ON**

Efforts have intensified since the early 2000s to forge close linkages between the civilian and defense economies to allow the defense industry access to more advanced and more globalized civilian sectors. This has led to the development of some modest functional and geographical pockets of civil-military activity have appeared since the early to mid-2000s. The electronics, information technology, high technology, and automotive sectors have been in the vanguard through the efforts of China Electronics Technology Group and non-state owned firms such as Huawei Technologies and Zhongxing Telecommunications Equipment.

Geographically, cities such as Mianyang in Sichuan Province have been designated as military-to-civilian science and technology zones

because of their concentration of industries with significant civil-military potential, including in areas such as optical technology, composite materials and space, and aviation-related technology. But civil-military integration (CMI) overall has barely scratched the surface of the Chinese economy. Less than 1 percent of the country's civilian high-technology enterprises are estimated to participate in defense-related activities. The ability of the Chinese defense economy to successfully adopt CMI practices will require major structural and operational reforms. It will need to be more transparent, adaptable, and market-oriented, but this clashes with its insular and secretive nature.

## **ACCESS TO RUSSIAN DEFENSE TECHNOLOGY AND KNOW-HOW**

The Chinese defense industry has been a semi-pariah in the global defense industry since the end of the 1980s when Western countries imposed sanctions because of China's military crackdown on civilian protestors. Beijing has been able to sidestep this embargo by forging a close relationship with Russia, which has been a principal source of military technology, equipment, and knowledge since the beginning of the 1990s. This has been a fruitful marriage of convenience for both countries. China acquired upwards of \$30 billion of weapons and defense technologies from Russia from 1992 to 2009, and this has played a vital role in enhancing the qualitative modernization of both the PLA and defense economy. These sales have also kept the struggling Russian defense industry financially afloat.

The Chinese defense industry has employed a number of approaches in the pursuit of Russian and other foreign technological products and processes since the 1990s, ranging from off-the-shelf purchases to licensed production that allowed the transfer of technological products and manufacturing processes that were at least a generational leap ahead of existing Chinese technological levels.

A highly controversial Chinese method has been illicit acquisition and unauthorized reverse engineering of Russian equipment and parts. Platforms such as the Su-27 fighter, Su-33 carrier-capable fighter, and advanced defense electronic systems such as the radar and data link systems

for the Sovremenny II 956E destroyer and the Fregat M2EM 3D and Mineral-ME radar systems have all been successfully copied by China. The Chinese defense industry appears to have made this reverse engineering strategy a central tenet of its near-term development approach and this has caused a major slow-down in Russian arms sales to China in the past few years. Besides reverse engineering, Chinese military, defense industrial, and civilian intelligence agencies have aggressively sought access to non-public and classified technologies and knowledge from foreign countries using an assortment of both legal and clandestine means.

## **BARRIERS TO IMPROVEMENT**

The Chinese defense economy continues to suffer from serious structural weaknesses that could yet frustrate the goal of closing the technological gap with the West. One overarching problem is the widespread duplication and Balkanization of industrial and research facilities. The defense industry has around 1,400 large and medium-sized factories employing more than 1.6 million workers scattered across the country, especially in its land-locked interior, and often possessing outdated manufacturing and research attributes. Intense rivalry, local protectionism, and huge geographical distances mean that there is little cooperation or coordination among these facilities, preventing the exploitation of economies of scale and hampering efforts at consolidation.

Weak links in critical technological sub-sectors hold back broader progress. One of the biggest Achilles heels is the aero-engine sector, which has struggled to develop and produce state-of-the-art high-performance power plants to equip new generations of military aircraft. This has forced the defense industry and the PLA Air Force to be dependent on engine imports from Russia for its J-10 and J-11 fighter aircraft.

GAD officials also complain that the defense industry continues to suffer from excessive monopolization. Reforms in the late 1990s to introduce controlled competition in key defense industrial sectors do not appear to have had much impact. This has hampered the PLA in its efforts

to counter the domineering authority of the ten powerful defense conglomerates.

## **CONCLUSIONS**

The Chinese defense economy is making robust progress in its quest to catch up and become a leading global player. The most impressive progress has occurred in the opening up of the defense economy to the capital markets, the promotion of civil-military integration, the strengthening of GAD's role in managing weapons development, and the reform of the big defense conglomerates.

Results have been mixed in the revamping of the research and development apparatus, nurturing of a new talent pool of skilled scientists and engineers, and the building of a new regulatory and standards-based regime. Access to external sources of military and dual-use technologies and knowledge appear to be improving, especially with the resumption of more cooperative engagement between China and Russia and the deepening integration of China's civilian technology sectors with global innovation networks.

This progress in the development of the defense economy's innovation capabilities will continue on an upward trajectory and could even accelerate, as long as China's central leadership is committed to the goal of building a world-class military industrial complex, funding remains plentiful, and end-user demand continues to be strong. This is likely to be the case even as a new generation of leaders takes over the reins of power in 2012-2013, since they also subscribe to the view defined in the country's MLP that having a world-class indigenous innovation capacity is critical to China's long-term national security and economic competitiveness.

If China's leaders were to see the country's national security once again as seriously threatened as during the Maoist Cold War era, there could be another concerted drive to attain breakthroughs in critical defense technological capabilities. This seems to be happening in the area of asymmetric capabilities with the development of long-range precision strike ballistic missiles and kinetic anti-satellite systems. China's present approach appears to be the selective targeting of a few critical



areas for accelerated development while the rest of the defense science, technology, and innovation system pursues a more moderate pace of transformation. But as the country grows more prosperous, more technologically capable, and its security interests become more global and complex, this targeted strategy is likely to be broadened.

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