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The Chinese Defense Economy's Long March from Imitation to Innovation

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Summary

Since the beginning of the twenty-first century, China's defense science, technology, and innovation (DSTI) system has been vigorously developing a comprehensive set of innovation capabilities that will eventually allow it to join the world's top tier of military technological powers. Ample access to financial, human, and research resources; strong political support; inflows of foreign technologies and know-how; and the introduction of advanced modes of governance, market competition, and management are producing significant progress, although from a low base. But long-term success is far from assured as daunting structural bottlenecks stand in the way, not the least of which is the struggle to overcome a long history of debilitating Socialist central planning.

China's target is to catch up by 2020. Although this may be possible in a few select areas, the defense economy as a whole will likely require another 5–10 years beyond this date to successfully master the ability to produce radical breakthrough innovations. This briefing paper analyzes the key areas in the Chinese defense economy's gradual but accelerating shift from imitation to indigenous innovation.

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BUILDING HARD AND SOFT INNOVATION CAPABILITIES

The Chinese defense economy's technological advancement depends on the acquisition and mastering of hard and soft innovation capabilities. Hard capabilities are aimed at technological innovation, especially but not exclusively focused on product innovation. The most important of these capabilities for the Chinese defense economy include the research and development apparatus; the talent pool of scientists and engineers; access to capital markets and investment funds; the defense manufacturing apparatus; the role of defense conglomerates; linkages with foreign flows of technology and global innovation networks; and benefits that come from civil–military integration activities. Four of these areas are especially noteworthy:

Forging an advanced research and development apparatus: The Chinese defense R&D apparatus has been undergoing a far-reaching overhaul and expansion since the late 1990s to overcome serious organizational, management, and operational problems that crippled its ability to conduct high-quality work. The key goals of these reforms have been to enhance basic research capabilities, to diversify management oversight and funding sources from the state to the corporate sector, to tear down the barriers that have kept the defense R&D system separate from the rest of the national innovation system, and to forge close linkages with universities and civilian research institutes.

Fostering defense conglomerates as key innovation hubs: China's ten defense conglomerates have emerged over the past decade to become the most important cogs in the defense innovation system for several reasons. First, they now own and manage a growing segment of the R&D apparatus. Second, their growing financial strength 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 key institutional mechanisms that will safeguard the results of their innovation activities, especially the strengthening of intellectual property rights protection.

Training new generations of defense scientists and engineers: The Chinese defense economy has strong and growing demand for new generations of well-trained scientists, engineers, managers, and skilled factory workers to replace the graying ranks of its workforce of some two million and to fill positions created by the rise of new high-technology sectors. The seven universities affiliated with the State Administration for Science, Technology and Industry for National Defense (SASTIND) 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 improved, with the number of post-graduate students accounting for a greater proportion of total numbers.

These SASTIND universities are the principal pipeline of human talent to the defense economy. Of the 284,000 students who graduated from these universities between 1999 and 2005, 18 percent went to work in the defense economy. More significantly, 35 percent of those going into the defense economy had advanced degrees, which indicates that the human talent being recruited by the defense S&T establishment is of a higher quality than the rest of the national innovation system. This influx of younger talent is transforming the demographic make-up of the defense economy.

Access to external technology flows: Much of the credit for the progress in China's defense technological development over the past 10–15 years can be attributed to the importation and absorption of technologies and knowledge from abroad, especially from Russia. This has been a fruitful marriage of convenience for both countries. China acquired upwards of $30 billion of weapons and defense technologies from Russia between 1992 and 2009, heavily concentrated in the aviation and naval sectors. The Chinese sales have also been a crucial lifeline in keeping the struggling Russian defense industry financially afloat. But the long-term prospects for this relationship look bleak

because of growing distrust, due in large part to concerted Chinese efforts to illicitly reverse engineer Russian weapons. This diminishing access to foreign technology and knowledge flows could be a serious brake on the defense economy's urgent push to improve upon its innovation capabilities.

The defense economy may benefit from the growing interdependence between the Chinese and global economies, especially in the high technology, electronics, and information technology arenas. Since the late 1990s, a growing trend has been the formation of global innovation networks that integrate dispersed engineering, product development, and R&D across national boundaries. The rapid rise of these global innovation networks will lead to far-reaching structural changes to the geography of innovation and production in the high-technology sector within the next decade.

THE ROLE OF SOFT INNOVATION CAPABILITIES

Soft capabilities cover political, institutional, relational, social, and other factors that shape non-technological and process-related innovative activity. These soft capabilities include organizational, marketing, and entrepreneurial skills as well as governance factors. The most important soft capabilities for the Chinese defense economy include high-level leadership support; forging of a new state regulatory oversight model; cultivating new institutional culture and governance norms; constructing a modern regulatory and standards-based regime; improving technology diffusion and promoting intellectual property rights protection; and enhancing the role and influence of the People's Liberation Army (PLA), through the General Armament Department (GAD), in guiding technological development within the defense economy. Three issues are of particular importance:

National leadership support: Active and credible support and guidance from the highest levels of the policy-making and political leaderships is a crucial factor in the Chinese defense economy's ability to carry out innovation activities. Leadership backing is essential in tackling key structural barriers that include entrenched bureaucratic inertia, risk-adverse decision making, institutional compartmentalization, and chronic project management problems that cause prolonged delays and cost overruns. Without outside leadership intervention and oversight, many of the key achievements of the defense economy over the past 60 years might not have happened. This would include the development of the nuclear and strategic missile programs in the 1960s, the turnaround in the fortunes of the defense economy since the end of the 1990s, and the manned space program.

Changing industrial culture and governance norms: One of the biggest challenges in nurturing the innovative spirit of the defense economy is to overturn an insular and conservative institutional mindset shaped by decades of central planning. This has meant a strong aversion to risk, a lack of competitive instincts, poor motivation, and weak disciplinary practices. A campaign known as the "Four Mechanisms" was launched in the late 1990s to address governance deficits in four key areas: 1) competition, which focused on overhauling outdated contract and project management systems; 2) evaluation, which involved the setting up of an independent and robust evaluation system; 3) supervision, which sought to tackle widespread malpractices and bolster greater disciplinary oversight; and 4) encouragement and incentivization, which aimed to improve motivation among employees through ideological campaigns, better human resource management, and the use of financial incentives.

Growing clout of the military end-user: The emergence of the PLA as the dominant actor in guiding defense S&T research and production activities since the late 1990s has been an important factor in improving the performance of the defense economy. Under the watchful eye of the GAD, the defense economy has had to shift from pursuing technology-push strategies to focus increasingly on demand-pull requirements from PLA end-users.

CONCLUSIONS

The Chinese defense economy is making visible strides in building up its hard innovation capabilities and addressing shortcomings in its soft capabilities. 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 the 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. Moreover, uncertainty clouds the defense economy's long-term access to external military and dual-use technologies and know-how, especially with rising tensions and mistrust in once-close ties with Russia and the continuing arms embargo with the West. This is partially compensated for by 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 2012–13, since they also subscribe to the view defined in the country's science and technology development plan that having a world-class indigenous innovation capacity is critical to China's long-term national security and economic competitiveness. This means that the defense economy will likely transition from its current status as a hybrid imitator-innovator and become a fully-fledged innovation power by the mid to late part of this decade. However, this indigenous innovation will likely occur at the lower rungs of the innovation ladder focusing primarily on incremental and architectural types of innovation.

The ability to successfully conduct modular innovation activities on a sustained basis will remain beyond the reach of the Chinese defense economy until towards the latter half of this decade, although there may be occasional breakthroughs in select pockets of excellence such as in the space, aviation, and nuclear sectors. Radical innovation leading to major technological breakthroughs remains an even more distant long-range challenge stretching well into the 2020s. However, China has shown with its success in developing nuclear weapons and strategic missiles in the 1960s and 1970s that it can pursue this type of innovation if the survival of the regime was considered at risk. It was able to overcome serious drawbacks to its defense innovation system through concentrated mobilization of resources, organizational flexibility, and top-level leadership support.

If China's leaders were to see the country's national security once again as seriously threatened as during the Maoist era, this could prompt another concerted drive to attain breakthroughs in critical defense technological capabilities. This seems to be happening with the development of long-range precision ballistic missile capabilities and perhaps 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 DSTI system pursues a more moderate pace of transformation. But as the country grows more prosperous and more technologically capable, and its security interests become more global and complex, this targeted strategy is likely to broaden.

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