

# UC San Diego

## SITC Research Briefs

**Title**

China's Defense Innovation System: Making the Wheels Spin

**Permalink**

<https://escholarship.org/uc/item/3hx613nj>

**Journal**

SITC 2011, 2011(Policy Brief 23)

**Authors**

Walsh, Kathleen A  
Francis, Ed

**Publication Date**

2011-09-01



# Policy Brief No. 23

## September 2011

### *China's Defense Innovation System: Making the Wheels Spin*

Kathleen A. Walsh and Ed Francis

---

#### SUMMARY

China is developing a defense innovation system (DIS) as part of a broader effort to construct a national innovation system (NIS) that incorporates a system-of-systems approach. Modeled on China's commercial-sector economic development zones and investment strategies, the DIS is focused on enhancing integration and interaction among key defense industry actors, institutions, industry sectors, and regions, both domestic and international. Although serious obstacles remain to realizing an effective DIS, China is laying the foundation for a dual-use DIS that employs both top-down development strategies and fosters greater bottom-up, market-driven, innovation dynamics.

---

*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.*

## DEFENSE INNOVATION IN CHINA: A SYSTEM-OF-SYSTEMS APPROACH

China's conception and implementation of a defense innovation system remains a work in progress and is opaque, in part due to the lack of a clear or agreed-upon definition of what comprises systemic defense innovation in either the Western or Chinese literature. Yet it is clear that the notion of developing a defense innovation system (国防创新体系) is a Chinese aspiration. It is listed among the objectives in the 2006–2020 Medium- to Long-term S&T Development Plan. Chinese writings also indicate that its DIS is being pursued as a subset of a more broadly accepted concept, that of an NIS.

The NIS concept (国家创新体系) is more fully developed and widely recognized internationally. Generally speaking, an NIS relies on development of collaborative processes through which innovation is fostered, facilitated, and to varying degrees financially supported by the nation-state as a means of hastening economic growth, technological advances, and international competitiveness, particularly in high-tech, high value-added sectors.

The study of innovation has shifted over time from a linear concept of scientific discovery leading to technology development to this more holistic, complex, cluster-oriented approach meant to underpin a national system of innovation and sub-variants, of which the DIS is one. Pursuing an innovation-centric model of economic growth thus requires increased investments in education and other “knowledge-based” activities, services, and industries. This approach, followed by the United States and other leading defense innovators, paired with new opportunities afforded by the information technology and communications revolution, have encouraged many states to pursue their own NIS and “knowledge-based societies.”

China's efforts to develop an NIS date back to the 15th Party Congress and the 9th Five-Year Plan (1996–2000); the DIS now comprises part of this effort. China is working to build an NIS and “an innovation-based society” as the primary means by which to promote continued, advanced economic growth, defense industrial development, and military modernization, in order to realize what Chinese leaders describe as a “comprehensive national power” and a “well-off society in an all-around

way.” The development of a robust, dual-use DIS is a critical component in this endeavor.

## CHINA'S DIS: A KEY COMPONENT OF THE CHINESE NIS

Chinese scholars depict their country's NIS as consisting of linkages between and among the following key actors and systems (see chart on p. 22):

- *Enterprises as the innovative center and linchpin* (with the “defense innovation system combining military and civil use” listed as a subcomponent);
- *Government or state-sponsored research institutes* comprising a “knowledge innovation system” along with universities and colleges;
- *“S&T intermediate service system”* (investment zones, science parks, incubators, industry associations, technology transfer and product promotion centers, and so on);
- *“Regional innovation system* embodying individual features and advantages” (for example, the Yangtze River Delta region and other geographically oriented clusters); and
- *“Government system coordinating S&T policies and economic policies.”* [emphases added]

China's DIS shares connections with and among these same components and is nested within the broader NIS construct and its system of systems.

This framework notes that key actors and systems must be connected via six layers of vital linkages to make this a dynamic NIS. These include linkages among: 1) actors; 2) knowledge; 3) industrial clusters; 4) regions; 5) environments (described as “institutions and the legal system, education system, infrastructures, market mechanism, and innovation culture”); and 6) international linkages. The last is particularly notable. While some states' NIS might focus primarily, if not exclusively, on promoting domestic linkages, China's NIS and DIS both emphasize international linkages as a core component, seeking to leverage foreign investment, technology, and know-how in pursuit of China's own indigenous innovation capabilities. As is also clear from the above list of systems, China's approach to developing an NIS and DIS involves both a top-down, strategic approach to innovation

as well as an emphasis on fostering bottom-up, cross-cutting, dual-use, market-driven dynamics.

## **ELEMENTS OF CHINA'S DIS STRATEGY**

China is largely following in the footsteps of the United States and other developed states in establishing an NIS and DIS, but puts particular emphasis on the role of the state as the guiding force for instituting innovative strategies and policies, more so than in the United States but in some respects on par with the European Union's, Japan's or South Korea's top-down, state-led efforts. This and several other themes stand out in China's present efforts to develop its DIS.

### ***A Long-Term Strategic Approach to Defense Innovation***

The pursuit of national strategic objectives is traditionally an important driver in defense innovation. Moreover, given the advent of more globalized scientific collaborations and cross-border technological endeavors, a top-down strategic approach to leveraging such emerging international dynamics is increasingly viewed as an important competitive advantage. Yet China's state plans today also reflect more flexible guidance than the largely quantitative goal-oriented mandates of the past, although they continue to be expressed as near-, medium- and long-term milestones as outlined in regular five-year plans as well as longer-term plans and strategies, most aiming at completion by 2020, others 2050.

### ***"Civil-Military Fusion": Prioritizing S&T Development for Economic Growth and Military Modernization***

Under Hu Jintao's leadership, China's official doctrine has shifted to S&T as the foundation for continued economic growth and military modernization. This approach, known in official parlance as the "scientific concept of development," is evident in China's escalating scientific and research statistics as well as continued investment of huge sums into S&T development programs, infrastructures, education, and other activities expected to enhance S&T development overall and provide the foundation for a robust, dual-use

commercial and defense innovation system. It is notable that Chinese planners envision 'scientific development' as a means of achieving both economic growth and military modernization simultaneously, rather than one at the expense of the other. A recent slogan put forward for the defense industries, "civil-military fusion," builds on existing Chinese doctrine of "combining military and civilian and placing military into civilian," and reflects the persistent belief that the NIS and DIS are symbiotic.

### ***DIS Innovation Zones: A "Clustering" Approach***

Having reaped substantial rewards from opening its doors to foreign investment and from experiments with various forms of investment and development zones in what has become the basis of China's NIS, Beijing is adapting the same overall strategy to its defense industrial development and DIS. Much like past designs for industry-specific development zones, S&T parks, incubation centers, and other technology- and industry-specific promotion efforts in the commercial sector such as the aforementioned "S&T intermediate service system", China is designing defense innovation-specific investment zones, regulations, collaborative ventures, and services that it hopes will enable and enhance the development of innovative clusters in the defense sector as well as across the commercial-defense divide.

Beijing clearly believes that adopting a similar approach for the defense sector will: 1) promote and hasten interactions between and among key innovative actors—defense researchers, industry, academia, and government officials—creating critical, new defense clusters of innovation; 2) foster dual-use technology development efforts through sharing S&T resources, services, and infrastructure; 3) facilitate domestic and foreign technology transfers to and from the defense sector; and 4) maximize opportunities for serendipitous/improvisational innovation by co-locating key innovative actors and institutions where they already reside or will reside.

Accordingly, recent regulatory reforms to the Foreign Direct Investment (FDI) Catalogue permit greater foreign investment in select defense industrial sectors and areas of advanced S&T re-

search; promote more advanced forms of technology transfer by both domestic and foreign firms (for example, establishing R&D centers, research contracts, management consulting services, and so on); and incentivize investments in and around new or existing zones or parks where, it is expected, other defense, commercial, and S&T enterprises will also locate their ventures or institutes. In short, Beijing seeks to build on a proven development model in advancing its defense industrial and innovative capabilities, and one that the World Bank has cited (highlighting the “plug-and-play” nature of China’s investment zones) as being a key competitive advantage over other industrializing economies.

Moreover, if the same model is followed down to the enterprise level, one can expect to see Chinese defense enterprises following a similar development strategy to their commercial counterparts—attempting to form strategic partnerships and joint ventures with a range of foreign investors possessing up- and down-stream industrial and technological know-how. As presently envisioned, the ten defense conglomerates are expected to become the innovative centers of gravity, taking over much of the strategic industry development oversight role and technological development planning previously performed by ministry officials. To the extent that this new approach is effectively implemented, it could grant the defense industries a more autonomous role in directing China’s evolving defense innovation system.

At the same time, these and related S&T reforms are also aimed at promoting more efficient use and sharing of resources, employing various mechanisms such as nation-wide information technology (IT) networks, libraries and databases, shared industry and S&T roadmaps, and more.

### ***Interconnected Innovation Clusters: A “Grid” Approach***

One of the fundamental challenges to China’s long-time defense innovation efforts has been geographical distance and disparity among defense sectors, effectively limiting collaboration among these actors, institutions, and processes as well as with civilian counterparts. Those defense indus-

tries with access to the more vibrant commercial sectors—which tend to be located in coastal zones (for example, IT and shipbuilding)—have generally fared better than those without sufficient outlet to the commercial sectors and/or coastal zones, primarily those tied down in the interior, or third-line defense areas (for example, aviation). Beijing’s strategy is two-fold: 1) to enhance intra-regional interactions to develop the aforementioned “regional innovation system embodying individual features and advantages” of each particular region and the industry sector[s] in which it is most competitive by connecting scientists, researchers, industry executives, entrepreneurs, government officials, and others working in dispersed municipal or regional locations within clusters connected at the local, provincial, regional, and national levels as national defense innovation nodes; and 2) to expand inter-regional—particularly coastal-inland—connections among these nodes in order to promote defense innovation capacities across all areas and sectors. This cross-regional connection of innovation clusters and is referred to in Chinese writings as a “grid” approach.

### ***Leveraging Global S&T Expertise and Domestic Human Capital***

China’s current DIS plans recognize the importance of human resources and seek to exploit talent wherever it resides, whether in the commercial sector, academic institutions, or overseas. Defense universities, labs, and enterprises have received state funding for the express purpose of attracting domestic and foreign expertise through a variety of formats, such as lectures, fellowships, collaborative and joint projects, and co-authorship of scientific papers.

Although direct connections between defense sector personnel and foreign researchers might be limited due to security concerns on both sides, a growing number of university–university programs, foreign university satellite campuses in China, and other collaborative and incentive programs have emerged. Such efforts increase potential opportunities for interaction between Chinese defense researchers or industry experts and their foreign counterparts as well as enhance potential spillover effects from civilian to military applica-



tions, promote greater understanding of industry practices tied to academic integrity and quality assurance, advanced management skills, and other innovation-oriented capabilities.

### ***Promoting Cross-Disciplinary and Cross-Sector Research: A “Matrix” Approach***

The lack of effective cross-industry interactions is viewed as a serious hindrance to defense industry evolution. A new approach, termed a “matrix” management approach in Chinese analyses, reflects the State’s plan to make enterprises “the main players in the market” and expects the defense conglomerates to become in some respects similar to their Western equivalents, the defense-sector prime contractors. China’s conglomerates would coordinate development of cross-cutting, horizontally- and vertically-integrated industrial development efforts, rather than focusing exclusively on their respective industry sectors, as is presently the case. This would include interacting with China’s increasingly internationally competitive commercial enterprises, which are becoming key suppliers and partners to China’s military. Notably, however, this defense innovation effort could easily conflict with the structural reform cycles also being pursued.

### ***Instituting a Regular Cycle of Structural and Institutional Reforms***

While the defense conglomerates are expected to gain greater autonomy, the Chinese government will continue to oversee regular periodic defense industry restructuring. The Chinese state appears to use cyclical patterns of institutional consolidation and disaggregation to ensure its defense industries remain innovative and to prevent vested corporate interests to become systemic obstacles to innovation. This “transformation” approach to innovation applies to both industry and research institutes and aims at “recombination learning” via market-oriented reforms, reorganization, technical and management training, and institutional restructuring. This creative-destructive institutional cycle is meant to promote greater efficiencies and effectiveness as well as to fill critical capability gaps that might otherwise go unaddressed by status quo-oriented defense conglomerates.

### ***Focusing on Incremental Innovation, but Also Seeking Breakthroughs***

Although China has long advocated “taking the road of leapfrog development” and “accelerating the revolution in military affairs with Chinese characteristics,” from a closer examination of China’s indigenous innovation strategy as well as recently unveiled weapons platforms and defense technologies, it appears that in practice China has generally taken an incremental approach to defense innovation. China prioritizes programs and platforms that fill critical gaps in its existing force structure (for example, developing late-generation fighters, undersea warfare capabilities, modern surface ships, and aircraft carriers) while simultaneously pursuing longer-term, fundamental research that might enable more radical innovation. While hard to confirm, such an approach is considered the norm for developing countries, and is in line with more recent interpretations in the West of the meaning of indigenous innovation. This near-term incremental, longer-term fundamental approach is suggested in the medium- and long-term S&T plan, which cites the goal for defense S&T as being “basically meeting the needs in developing modern arms and associated information technology, and providing S&T support for safeguarding national security” while also seeking to catch up to the world’s leading powers by 2020.

## **CONCLUSIONS: CHINA’S DIS STRATEGY MAKES DEFENSE INNOVATION MORE LIKELY**

Numerous challenges remain in China’s efforts to advance its DIS and capabilities. Primary among these are the persistent legacy issues affecting the defense industrial sector (for example, geographic and institutional distance from more innovation-oriented industry sectors, actors, and practices) as well as the obstacle of inherent sensitivities surrounding development of defense technologies and continued Tiananmen-era sanctions on select advanced technology and weapons sales.

Nevertheless, Beijing’s primary focus in developing its DIS today is on integrating the defense sector into a still-in-development innovation system of systems that comprises China’s

broader, mainly commercially oriented, national innovation system. Notably, the current approach pairs both a more flexible top-down strategy with efforts to foster more dynamic, bottom-up, and collaborative interactions within and across the defense sector (making the innovative wheels spin) in ways that have proven effective in the commercial sphere in China and elsewhere. To the extent that Beijing can thereby incentivize key actors, institutions, and regions in the defense sector to similarly collaborate and increasingly innovate, the more likely China is to realize the dual-use

defense industrial innovation system it seeks to advance both its economic and military modernization goals.

---

**Kathleen (Kate) WALSH** is an associate professor of national security affairs at the U.S. Naval War College.

**Ed FRANCIS** is a research associate with Defense Group Inc.'s Center for Intelligence Research and Analysis.

The views expressed here are those of the authors alone and in no way represent views of the U.S. government or any other institution.