Thomas G. Mahnken
Jerome E. Levy Chair of Economic Geography and National Security
U.S. Naval War College

Testimony Before the U.S.-China Economic and Security Review Commission

Hearing on Chinese Innovation: Implications for the United States

Thursday, May 10, 2012

Thank you for giving me the opportunity to testify before the Commission on this important topic.

At the outset, I would note that I am testifying here today in a private capacity, and that any views expressed are mine alone. That having been said, I would also like to acknowledge that outstanding work that is going on under the leadership of Tai Ming Cheung of the University of California's Institute for Global Conflict and Cooperation. Specifically, I would like to single out the center's Project on the Study of Innovation and Technology in China (SITC), which has been funded by a grant from the Department of Defense's Minerva Research Initiative. Participation in SITC and collaboration with Prof. Cheung, as well as Pete Suttmeier, who testified earlier today, and Andrew Ross from the University of New Mexico, has played an important role in shaping my thinking about Chinese military innovation, and it is playing an important role in shaping scholarship and the next generation of scholars and policymakers. In my view, the Minerva Initiative deserves the full support of Congress.

Military innovation has historically been a source of both operational advantage and strategic surprise. In the mid-nineteenth century, Prussia's mastery of the railroad, rifle, and telegraph allowed it to defeat Denmark, Austria, and France and unify Germany under its control. At the beginning of World War II, Nazi Germany's development of armored warfare and tactical aviation delivered a string of unexpected lightning victories against Poland, Norway, Denmark, Belgium, Luxembourg, the Netherlands, and – most dramatically – France. Imperial Japan's use of carrier aviation, naval surface warfare tactics, and amphibious landings allowed it not only to cripple the U.S. fleet at Pearl Harbor, but also to seize American, British, and Dutch possessions in Asia in the span of five months. During the 1973 Arab-Israeli War, Egypt's innovative use of surface-to-air missiles and anti-tank guided munitions inflicted on Israel its worst battlefield defeat. The use of stealth and precision-guided munitions by the United States in the 1991 Gulf War yielded a rapid victory that shocked both participant and observer alike.

It is important to understand the scope and pace of Chinese developments. There is, on the one hand, the danger of overestimating the extent of Chinese military modernization, of crediting China with capabilities that it does not possess. Overestimation would threaten to increase the pressure for competitive arms dynamics in the region. There is also, however, the danger of underestimating Chinese military modernization. Doing so would open up the United States and other regional actors to surprise in the event of a future crisis or conflict.

China's military modernization has received increasing attention in recent years. Its January 2007 test of a direct-ascent anti-satellite (ASAT) weapon, its fielding of an anti-ship ballistic missile (ASBM), and its development of the stealthy J-20 fighter aircraft have garnered international attention.

It is increasingly apparent that the United States has underestimated the scope and pace of Chinese military modernization. Then Secretary of Defense Robert Gates admitted as much in January 2011 after the appearance of the J-20.[1] Gates' remarks mirrored those of Vice Admiral Jack Dorsett, at the time the U.S. Navy's senior intelligence officer, who has stated that the Defense Department "certainly would not have expected [the Chinese] to be as far along as they are today" in technology and has argued that the Pentagon needs to refine its intelligence on military matters in China.[2] For his part, the then Commander of U.S. Pacific Command (USPACOM), Admiral Robert F. Willard, told reporters in October 2009, "In the past decade or so, China has exceeded most of our intelligence estimates of their military capability and capacity, every year…They've grown at an unprecedented rate in those capabilities. And, they've developed some asymmetric capabilities that are concerning to the region, some anti-access capabilities and so on."[3]

Innovation is a diverse phenomenon (see Figure 1). It ranges from imitating existing systems as well as the invention of new capabilities. It includes the development of new technology, but also new processes and organizations. And the innovations themselves can be relatively simple, or they can be complex.

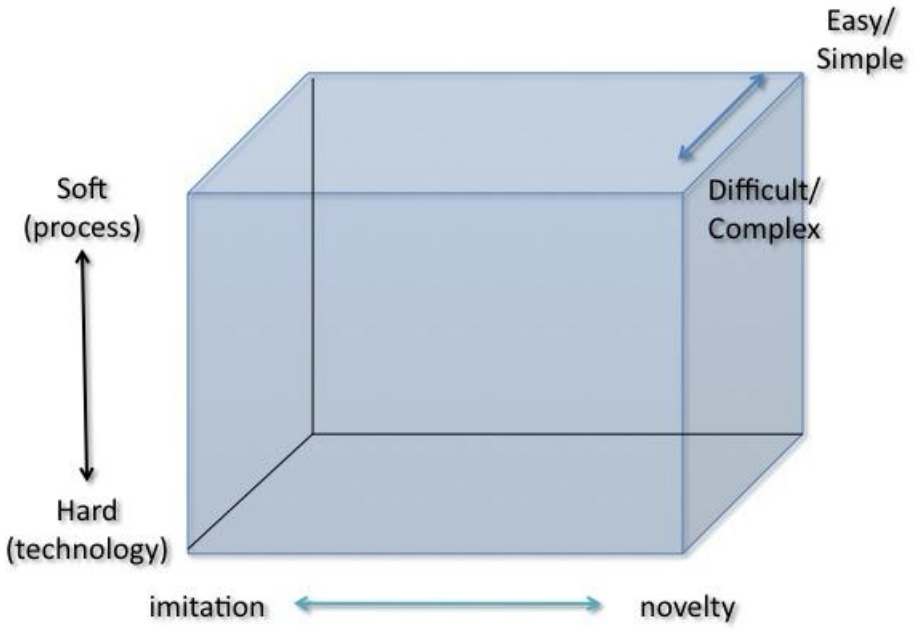

Figure 1. Classifying Innovations

[1] John Pomfret, 'Defense Secretary Gates: U.S. Underestimated Parts of China's Military Buildup," *Washington Post*, January 9, 2011, at http://www.washingtonpost.com/wp-dyn/content/article/2011/01/09/AR2011010901068.html.
[2] Anna Mulrine, "We Underestimated China, U.S. Official says after reports of J-20 Stealth Fighter," *Christian Science Monitor*, January 6, 2011.
[3] http://www.voanews.com/english/2009-10-21-voa8.cfm.

To date, China's military innovation programs have been more technologically than doctrinally or organizationally focused. Doctrinal and organizational changes appear to lag behind technological advances. This is hardly surprising, however; the development of new capabilities frequently precedes the emergence of new ways of war. It is not clear that the quality of soft capability inputs match the quality and quantity of hard capability inputs.

Similarly, Tai Ming Cheung has provided a useful taxonomy for thinking about innovations:[4]

- Duplicative Imitation: Products, usually obtained from foreign sources, are closely copied with little or no technological improvements. This is the starting point of industrial and technological development for latecomers such as China.
- Creative Imitation: This represents a more sophisticated form of imitation that generates imitative products with new performance features.
- Creative Adaptation: Products are inspired by existing foreign-derived technologies but differ from them significantly.
- Incremental Innovation: This is the limited updating of existing indigenously developed systems and processes. This innovation is often the result of organizational and management inputs aimed at producing different versions of products tailored to different markets and users, rather than significant technological improvements through original research and development (R&D).
- Architectural Innovation: This refers to innovations that change the way in which the components of a product are linked together, while leaving the core design concepts untouched.
- Component Innovation: This involves the development of new component technology that can be installed into existing system architecture. It emphasizes hard innovation capabilities such as advanced R&D facilities, a cadre of experienced scientists and engineers, and large-scale investment outlays.
- Radical Innovation: This requires major breakthroughs in both new component technology and architecture and only countries with broad-based, world-class R&D capabilities and personnel along with deep financial resources and a willingness to take risk can engage in this activity.

Much of Chinese military modernization involves a mixture of incremental innovation, creative innovation, and creative adaptation. The PLA is, for example, fielding a new generation of armored fighting vehicles to replace those that are becoming obsolescent. It is also deploying more capable fixed-wing aircraft.

[4] Tai Ming Cheung, 'The Chinese Defense Economy's Long March from Imitation to Innovation', *The Journal of Strategic Studies* 34/3 (June 2011). See also Tai Ming Cheung, 'Dragon on the Horizon: China's Defense Industrial Renaissance,' *Journal of Strategic Studies* 32/1 (Feb. 2009), 29-66.

Of greater concern is Beijing's development of qualitatively new capabilities, particularly so-called anti-access and area denial capabilities. As the Defense Department's 2010 *Quadrennial Defense Review* put it, "Anti-access strategies seek to deny outside countries the ability to project power into a region, thereby allowing aggression or other destabilizing actions to be conducted by the anti-access power. Without dominant U.S. capabilities to project power, the integrity of U.S. alliances and security partnerships could be called into question, reducing U.S. security and influence and increasing the possibility of conflict."[5] China's progress on areas as diverse as anti-ship ballistic missiles, information warfare, and anti-satellite weaponry evidence concerted effort in areas that could yield disruptive innovation.

It is worth noting that new ways of war do not spring forth overnight. Most major military innovations came about due to the recognition of a pressing strategic or operational problem that cannot be handled through improvements to the existing force, but rather requires a new approach. Moreover, past cases of military innovation show that military services tend to develop new approaches to combat in three distinct but often overlapping phases (see Table 1): speculation, experimentation, and implementation. Each phase yields indicators that can give us an estimation of the pace and scope of innovation.

[5] *Quadrennial Defense Review Report* (Washington, D.C.: DOD, February 2010), 31.

Phase	Potential Indicators of Innovation
I. Speculation	• Publication of concept papers, books, journal articles, speeches, and studies regarding new combat methods. • Formation of groups to study the lessons of recent wars. • Establishment of intelligence collection requirements focused upon foreign innovation activities.
II. Experimentation	• Existence of an organization charged with innovation and experimentation. • Establishment of experimental organizations and testing grounds. • Field training exercises to explore new warfare concepts. • War gaming by war colleges, the defense industry, and think tanks regarding new warfare areas.
III. Implementation	• Establishment of new units to exploit, counter innovative mission areas. • Revision of doctrine to include new missions. • Establishment of new branches, career paths. • Changes in the curriculum of professional military education institutions. • Field training exercises to practice, refine concepts.

Table 1: Potential Indicators of Innovation

In the case of China, the need to coerce, or if necessary defeat, Taiwan to ensure its unification with the mainland serves as a powerful driver of Chinese military capabilities. Key to success in such a scenario would be ensuring that the United States was unwilling or unable to project its maritime and air power in support of Taiwan. One would thus expect China to seek innovative approaches to achieve that aim.

China has for some time been acquiring the means necessary to pursue unification with Taiwan. As part of its planning for a Taiwan contingency, China is emphasizing measures to deter or counter U.S. intervention in a future cross-Strait crisis. These include the ability to interdict or attack, at long ranges, air and maritime forces that might deploy or operate in the Western Pacific. It is seeking to build the capability to hold at risk regional bases and aircraft carriers. It has also developed a variety of weapons and jammers to degrade or deny an adversary's ability to use space-based platforms.[6]

[6] *Annual Report to Congress: Military Power of the People's Republic of China* (Washington, D.C.: Department of Defense, 2008), 21-23.

Some of these capabilities represent evolutionary improvements to existing capabilities. China is, for example, fielding growing numbers of fourth-generation fighters and is developing fifth-generation aircraft. It is also deploying more sophisticated surface-to-air missiles. At sea, China is modernizing its surface navy and submarine force.[7] It is also fielding innovative systems as part of its anti-access strategy, including precision-guided conventional ballistic missiles and ASBMs. These capabilities are likely to be the most consequential for U.S. national security.

Let me conclude with a few recommendations as to how the United States can improve its ability to detect and recognize Chinese innovation. One way to do so would be to make a systematic effort to analyze open sources such as military newspapers, professional journals, and books, as well as semi-open sources such as doctrinal publications, to improve our knowledge of foreign doctrinal debates. In many cases, they may offer the first indication that a foreign service is studying new warfare areas. The limited efforts cited in this paper demonstrate the value of the approach. It would be worthwhile, for example, to translate into English and publish key Chinese doctrinal handbooks, such as *Science of Campaigns* and *Science of Second Artillery Campaigns*. Such an effort would give the non-Mandarin-speaking expert community needed insight into Chinese thinking on defense matters.[8]

A complementary approach would be to establish multi-disciplinary research centers to examine Chinese military affairs. During the Cold War, for example, a number of think tanks studied Soviet military concepts and doctrine. As noted above, the SITC is doing outstanding work. But that program grew out of a single grant out of 24 that have been awarded to date as part of the Minerva Research Initiative, and last year Congress cut funding for the program. Much more needs to be done.

An effort to identify and track innovators may further illuminate the scope, pace, and emphasis of foreign efforts. During the 1930s, for example, U.S. attachés in Germany followed Guderian's writings, mining them for clues to German armored doctrine. A dedicated effort to identify and track foreign individuals and institutions associated with innovation efforts could prove similarly useful. How do they portray future conflicts? Who, if anyone, within their armed forces pays attention to their ideas? Are their ideas used in war games and exercises? Are they incorporated in doctrine?

Finally, some states considering innovative approaches to warfare may move beyond speculation to begin experimenting with new operational concepts and organizations. An examination of foreign exercises may offer important clues regarding new technology and doctrine. Attempts to explore innovative weapons

---

[7] *Ibid.,* 22-23.

[8] To date, the only such document to appear in English is Peng Guangqian and Yao Youzhi, eds., *The Science of Military Strategy* (Beijing: Military Science Publishing House 2005).

and concepts should, for example, lead to a change in the observable pattern of exercises. An in-depth study of foreign exercise activity may reveal attempts to develop new approaches to combat.

The growth of Chinese military power has ramifications that go beyond the Asia-Pacific region. Similarly, the topic of Chinese military studies is far greater than the Asia specialist community. Rather, what is needed is a truly multidisciplinary approach – one that draws on the unique strengths not only of regional specialists, but also students of strategy, history, geography, culture, economics and technology.