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"Modernizing China's Defense Industries: How Effective Have Been Recent Reforms?"

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Introduction: The Chinese Military-Industrial Complex in the Late 1990s

Thank you, Mr. Chairman and the other members of the U.S.-China Economic and Security Review Commission for the opportunity to take part in the hearings you are holding today on the overall issue of Chinese military modernization and export control regimes, and in this particular case, on the topic of the modernization of China's defense and defense-related high-technology industries.

China possesses one of the oldest, largest, and most diversified military-industrial complexes in the developing world, an agglomeration of several hundred state-owned enterprises (SOEs) employing some three million workers, including more than 300,000 engineers and technicians. China is one of the few countries in the developing world to produce a full range of military equipment, from small arms to armored vehicles to fighter aircraft to warships and submarines, in addition to nuclear weapons and intercontinental ballistic missiles.

At the same time, the Chinese military-industrial complex has suffered from a number of shortcomings that in turn inhibited translating breakthrough technologies and design into reliable weapon systems. As late as the late 1990s, China possessed one of the most technologically backwards defense industries in the world; most indigenously developed weapons systems were at least 15 to 20 years behind that of the West – basically comparable to 1970s- or (at best) early 1980s-era technology – and quality control was consistently poor. China's defense research and development (R&D) base was regarded to be deficient in several critical areas, including aeronautics, propulsion (such as jet engines), microelectronics, computers, avionics, sensors and seekers, electronic warfare, and advanced materials. Furthermore, the Chinese military-industrial complex has traditionally been weak in the area of systems integration – that is, the ability to design and develop a piece of military equipment that integrates hundreds or even thousands of disparate components and subsystems and have it to function effectively as a single unit.

Consequently, aside from a few "pockets of excellence" such as ballistic missiles, the Chinese military-industrial complex appeared to demonstrate few capacities for designing

and producing relatively advanced conventional weapon systems. Especially when it came to combat aircraft, surface combatants, and ground equipment, the Chinese generally confronted considerable difficulties when it comes to moving prototypes into production, resulting in long development phases, heavy program delays and low production runs. The J-10 fighter, for example, took more than a decade to move from program start to first flight, and it will take more than twenty years before it enters operational service with the People's Liberation Army (PLA) Air Force. Even after the Chinese begin building a weapon system, production runs were often small and fitful. According to Western estimates, during much of the 1990s the entire Chinese aircraft industry of around 600,000 workers manufactured only a few dozen fighter aircraft a year, mainly 1960s- and 1970s-vintage J-8IIs and J-7. According to the authoritative *Jane's Fighting Ships*, China launched only three destroyers and nine frigates between 1990 and 1999 – a little more than one major surface combatant per year. The first *Song*-class submarine was only commissioned in 1999, eight years after construction began.

Consequently, despite years of arduous efforts, the inability of China's domestic defense industry to generate the necessary technological breakthroughs for advanced arms production meant that Beijing continued to rely heavily – even increasingly – upon direct foreign technology inputs in critical areas. The J-10 fighter, for example, is believed to be heavily based on technology derived from Israel's cancelled *Lavi* fighter jet program. These foreign dependencies are especially acute when it comes to jet engines, marine diesel engines, and fire-control radar and other avionics. For example, endemic "technical difficulties" surrounding the JH-7 fighter-bomber's indigenous engine resulted in significant program delays, forcing the Chinese to approach the British in the late 1990s about acquiring additional Spey engines in order to keep the aircraft's production line going. The new *Song*-class submarine uses a German-supplied diesel engine, while both the *Ming*- and *Han*-class submarines were reportedly upgraded with a French sonar and combat system. Chinese surface combatants incorporate a number of foreign-supplied systems, including Ukrainian gas turbine engines, French surface-to-air missiles, Italian torpedoes, and Russian ship-based helicopters.

Finally, and perhaps most significant, over the past decade – and particularly since the turn of the century – the PLA has increasingly favored imported weapons platforms over locally built counterparts. From this, one may infer that the Chinese military remains dissatisfied with the quality and capabilities of weapon systems coming out of domestic arms factories, or those local arms manufacturers are unable to produce sufficient numbers of the kinds of weapons that the PLA wants in the near future. In the early 1990s, for example, despite the fact that China already had four fighter aircraft programs either in production or development – the J-7, J-8II, JH-7, and J-10 – the PLA nevertheless decided to buy several dozen Su-27 fighters; this purchase was later supplemented by an agreement to license-produce 200 Su-27s and then a subsequent purchase of approximately one hundred more advanced Su-30 fighter-bombers. The PLA Navy is currently acquiring 12 *Kilo*-class submarines and four *Sovremennyy*-class destroyers (armed with supersonic SS-N-22 antiship cruise missiles), even though Chinese shipyards are building the *Song* and several new types of destroyers. In addition, China has reportedly purchased precision-guided munitions, active-radar guided air-to-air

missiles, AWACS, and transport aircraft from Russia, as well as acquiring several hundred S-300 and SA-15 surface-to-air missiles. Consequently, China has become one of the world's largest arms importers, and between 2001 and 2004 Beijing has signed new arms import agreements worth $10.4 billion.

Compounding these technological deficiencies was a number of structural and organizational/cultural deficiencies that impeded the design, development, and manufacture of advanced conventional weapons. Overall, arms production in China has largely been an inefficient, wasteful, and unprofitable affair. One reason was overcapacity: Quite simply, China possessed far too many workers, too many factories, and too much productive capacity for what few weapons it produced, resulting in redundancy and a significant duplication of effort, inefficient production, and wasted resources. The Chinese aircraft industry, for example, was estimated in the late 1990s to possess a workforce nearly three as large as it required. Within the shipbuilding industry, output during the same time period was only 17 tons per person per year, compared to around 700 tons per person in shipyards in more advanced countries.

By the mid-1990s as well, least 70 percent of China's state-run factories were thought to be operating at a loss, and the arms industries were reportedly among biggest money-losers. As a result, most defense firms were burdened with considerable debt, much of owed to state-run banks (who were obliged to lend money to state-owned firms); at the same time, arms factories were owed money by other unprofitable state-owned companies, which was nearly uncollectible.

The creation of China's "Third Line" defense industries – that is, the establishment of redundant centers of armaments production in the remote interior of southern and western China – in the 1960s and 1970s only added to overcapacity, underutilization, and unprofitability of the Chinese military-industrial complex. Estimates are that from 1966 to 1975, Third Line construction consumed perhaps two-thirds of all industrial investment. Even by the late 1990s, approximately 55 percent of China's defense industries were located within the Third Line, yet most of these industries were much less productive than coastal area factories and continued operate in the red.

Another structural impediment affecting the Chinese military-industrial complex was the emergence of a highly compartmentalized and vertically integrated defense industrial base. Such a stovepiped and stratified environment, in turn, had several repercussions for the local defense industry. It restricted the diffusion of advanced, militarily usable civilian technologies to the defense sector. It limited communications between R&D institutes which designed the weapons and the arms factories that produced these systems, between defense enterprises when it came to collaborating on weapons projects, and even between the defense industry and its major consumer, i.e., the PLA, when it came to requirements and specification. It also exacerbated redundancy and the duplication of effort within the arms industry, as each defense enterprise tried to "do it all," resulting in the maintenance of expensive but underutilized manufacturing processes, such as dedicated second- and third-tier supplier networks, and the

establishment of in-house machine shops for parts production, instead of outsourcing such manufacturing to other firms.

Finally, China's military-industrial complex long functioned under an organizational and managerial culture that, in a manner typical of most state-owned enterprises, was highly centralized, hierarchical, bureaucratic, and risk-averse. This, in turn, stymied innovation, retarded R&D, and further added to program delays. In a study on Chinese capacities for innovation [Yuko Arayama and Panos Mourdoukoutas, *China Against Herself: Innovation or Imitation in Global Business?* (Westport, CT: Quorum, 1999)], two Western analysts argued that "Chinese managers do not have either the will, the expertise, or the freedom to take the risks and make the adjustment associated with innovations." Consequently, production management was often highly centralized and "personality-centric," with most critical project decisions being made by a single chief engineer. At the same time, lower-level managers tended to be "conformist, adhering to standard rules and procedures rather than to personal judgments based on their professional experiences." Hence, they were usually reluctant to make "learning mistakes" or to act on their own to deal with problems that might arise on the factory floor, thereby inhibiting experimentation and innovation.

Overall, regarding China's problems with armaments production in the 1990s, a U.S. aerospace industry representative perhaps summed it up best:

> Part of the problem with Chinese [aircraft] manufacturing…is that industrial management in China still relies on 1950s Soviet styles. This involves "batch-building" a full order of aircraft in advance based on state-planned and dictated order for parts and materials. As a consequence of this system, there are no direct lines of accountability for quality control, and no cost-cutting discussions or steps available to mid-level management. There is no competitive bidding for contracts, workers are redundant, and schedules continually slip because state planning doesn't have a fixed required-delivery date for products…Young managers stay risk-averse and are reluctant to change or improve the system [Quoted in Larry M. Wortzel, *China's Military Potential* (Carlisle, PA: U.S. Army War College, October 1998), p. 20].

Reforming China's Defense Industry, 1997 to the Present

To be fair, the Chinese have long been aware of the deficiencies in their defense industry and have undertaken several rounds of reforms to improve and upgrade their defense R&D and production processes. The intention of this overall restructuring effort was to spur the defense SOEs to act as true industrial enterprises and therefore (1) be more responsive to their customer base (i.e., the PLA), and (2) reform, modernize, and "marketize" their business operations.

These goals in particular are central to the PLA's new modernization strategy – as laid out in China's 2004 defense white paper – of "generation leap," that is, to skip or shorten stages of R&D and of generations of weapons systems. This process, in turn, entails a "double construction" approach of mechanization and "informatization" in order to concurrently upgrade and digitize the PLA. Part of this strategy also depends on China's "latecomer advantage" of being able to more quickly exploit technological trails blazed by others, as well as avoiding their mistakes and blind alleys [You Ji, "China's Emerging National Strategy," *China Brief*, November 24, 2004].

In the early 1990s, in an effort to "corporatize" the defense industrial base, the Chinese transformed their military-industrial complex from a series of machine-building ministries into large state-owned enterprises (SOEs). The Ministry of Aerospace, for example, was broken up into the Aviation Industries of China (AVIC, aircraft) and the China Aerospace Corporation (CASC, missiles and space), while the Ministry of Atomic Energy was converted into the China National Nuclear Corporation (CNNC). Other "super-SOEs" within the defense industry included the China Ordnance Industry Corporation (COIC, ground combat systems, often referred to as NORINCO) and the China State Shipbuilding Corporation (CSSC, naval systems). At the same time, control of individual production facilities, research units, and trading companies were transferred to these new corporations.

The most recent round of defense industry reforms began in September 1997, when the Fifteenth Communist Party Congress laid out an ambitious agenda for restructuring and downsizing the state-owned enterprise sector (including the defense industries) and for opening up SOEs to free-market forces – i.e., supply-and-demand dynamics, competitive products, quality assurance, and fiscal self-responsibility. The following March, the Ninth National People's Congress further refined this agenda by announcing plans to reorganize the government's defense industry oversight and control apparatus and establish new defense enterprise groups.

One of the most important decisions to come out of the 1998 NPC was the creation of a new Peoples Liberation Army (PLA)-run General Armaments Department (GAD), with the latter acting as the primary purchasing agent for the PLA, overseeing defense procurement and new weapons programs. As a recent RAND report put it, the GAD is part of a process "to create system that will unify, standardize, and legalize the [Chinese] weapons procurement process" [Keith Crane, et.al., *Modernizing China's Military* (Santa Monica, CA: RAND, 2005), p. 165]. In particular, the GAD is supposed to ensure that local arms producers meet PLA requirements when it comes to capabilities, quality, costs, and program milestones.

Another key element of current defense reforms was the creation in July 1999 of ten new defense industry enterprise groups (DIEGs) (see Table 1). These DIEGs were supposed to function as true conglomerates, integrating R&D, production, and marketing. Breaking up the old SOEs was also intended to encourage the new industry enterprise groups to compete with each other for PLA procurement contracts, which it was hoped would pressure them to be more efficient and technologically innovative. At the same

time, the government's role in the daily operations of the defense industry was to be greatly reduced, and these new enterprise groups were given the authority to manage their own operations as well as take responsibility for their own profits and losses.

Another crucial aspect of these new reform initiatives was the declared intent to significantly downsize the Chinese military-industrial complex, including eliminating (through retirement, attrition, or even layoffs) as much as one-third of the defense sector's workforce. The aircraft industry, for example, intended to downsize by 200,000 workers. The rationalization of the defense industry was also supposed to include factory closings and consolidation as a result of government-encouraged mergers, as part of the policy of "letting the strong annex the weak."

At the same time, Beijing prodded local defense industries to move more into civilian production as a means of acquiring dual-use technologies that also could be used to support armaments production. This strategy goes back to the late 1970s and the enunciation of Deng Xiaoping's so-called sixteen character slogan: "Combine the military and civil/combine peace and war/give priority to military products/let the civil support the military." However, whereas earlier efforts at civil-military integration (CMI) tended to revolve mostly around conversion – that is, switching military factories over to civilian use – China's approach to CMI after 1997 entailed a critical shift in policy toward promoting integrated dual-use industrial systems capable of developing and manufacturing both defense and military goods – or as one Western analyst put it, "swords into plowshares…and better swords" [Paul H. Folta, *From Swords to Plowshares? Defense Industry Reform in the PRC* (Boulder, CO: Westview, 1992), p. 1]. This new strategy was embodied and made a priority in the defense industry's five-year plan for 2001-2005, which emphasized the dual importance of both the transfer of military technologies to commercial use and the transfer of commercial technologies to military use, and which therefore called for the Chinese arms industry to not only to develop dual-use technologies but to actively promote joint civil-military technology cooperation. Consequently, the spin-on of advanced commercial technologies both to the Chinese military-industrial complex and in support of the overall modernization of the PLA was made explicit policy.

The key areas of China's new focus on dual-use technology development and subsequent spin-on include microelectronics, space systems, new materials (such as composites and alloys), propulsion, missiles, computer-aided manufacturing, and particularly information technologies. Over the past decade, Beijing has worked hard both to encourage further domestic development and growth in these sectors *and* to expand linkages and collaboration between China's military-industrial complex and civilian high-technology sectors. In 2002, for example, the Chinese government created a new industry enterprise group, the China Electronics Technology Corporation, to promote national technological and industrial developments in the area of defense-related electronics. Under the Tenth Five Year Plan (2001-2005), many technology breakthroughs generated under the 863 S&T program were finally slated for development and industrialization. Defense enterprises have formed partnerships with Chinese universities and civilian research institutes to establish technology incubators and undertake cooperative R&D on dual-use

technologies. Additionally, foreign high-tech firms wishing to invest in China have been pressured to set up joint R&D centers and to transfer more technology to China.

In this regard, China's military shipbuilding appears to have particularly benefited from CMI efforts over the past decade. Following an initial period of basically low-end commercial shipbuilding – such as bulk carriers and container ships – China's shipyards have since the mid-1990s progressed toward more sophisticated ship design and construction work. In particular, moving into commercial shipbuilding began to bear considerable fruit beginning in the late 1990s, as Chinese shipyards modernized and expanded operations, building huge new dry-docks, acquiring heavy-lift cranes and computerized cutting and welding tools, and more than doubling their shipbuilding capacity. At the same time, Chinese shipbuilders entered into a number of technical cooperation agreements and joint ventures with shipbuilding firms in Japan, South Korea, Germany, and other countries, which gave them access to advanced ship designs and manufacturing technologies – in particular, computer-assisted design and manufacturing, modular construction techniques, advanced ship propulsion systems, and numerically controlled processing and testing equipment. As a result, military shipbuilding programs collocated at Chinese shipyards have been able to leverage these considerable infrastructure and software improvements when it comes to design, development, and construction.

China's nascent space industry has also spurred the development and application of dual-use technologies that are basically commercial in nature but which serve military purposes as well. This includes telecommunications satellites, as well as China's rudimentary *Beidou* navigation satellite system and its *Ziyuan-1* and *Ziyuan-2* earth observation satellites. In addition, many of the technologies being developed for commercial reconnaissance satellites, such as charge-coupled device cameras, multispectral scanners, and synthetic aperture radar imagers, have obvious spin-on potential for military systems.

Finally, the PLA has clearly profited from piggy-backing on the development and growth of the country's commercial IT industry. The PLA is working hard to expand and improve its capacities for command, control and communications, information-processing, and information warfare, and it has been able to enlist local IT firms – many of which have close ties to China's military-industrial complex and were even founded by former PLA officers – in support of its efforts. Consequently, the PLA has developed its own separate military communications network, utilizing fiber-optic cable, cellular and wireless systems, microwave relays, and long-range high frequency radios, as well as computer local area networks.

A Disappointing Track Record

Nevertheless, Chinese efforts since the late 1990s to reform its military-industrial complex have been disappointing. If the intention of creating new industrial enterprise groups was to inject greater competition into China's military-industrial complex – and

therefore spur innovation and greater responsiveness to PLA systems requirement – then these restructuring efforts have largely been a failure. The General Armaments Department, for example, has yet to implement competitive bidding and market pricing into the overall arms procurement process; in particular, competitive bidding is still not apparently used when it comes to major weapons programs, as any purchases over 2 million yuan (less than $250,000) are exempt.

There is also little evidence to suggest that recent institutional reforms have strengthened PLA oversight of armaments manufacturing, particularly when it comes to quality control. RAND notes that the military has long had a Military Representative Office (MRO) system in place in many factories to watch over production, but even it admits that this system is woefully understaffed and ineffective when it comes to overseeing armaments production and quality control, and that the effectiveness of current reform efforts are "far from clear" [*Modernizing China's Military*, pp. 172-173].

Moreover, at one time it was expected that the Chinese would create large trans-sectoral, cross-competing defense conglomerates, similar to the South Korean *chaebols* or, more specifically, to horizontally integrated defense companies like Lockheed Martin or Britain's BAE Systems. Such a strategy would have entailed a much more complicated restructuring of the defense industry, crafting enterprise groups that would have competed with each other to produce a broad array of weaponry. Instead, all Beijing did was break up each of its former defense corporations into two new groups.

With few exceptions, too, China's new DIEGs still do not compete with each other when it comes to defense materiel. Of the two new enterprise groups replacing the old Aviation Industries of China (AVIC), for example, all fighter aircraft production is concentrated within one DIEG, while all helicopter and trainer jet production is centered in the other. The nuclear industry will be split into separate enterprises for either construction or nuclear energy development, while the NORINCO appears to have been subdivided into one enterprise group mostly concerned with armored vehicles and ground ordnance, while the other is almost entirely civilianized, specializing in automobile and motorcycle production. In fact, Beijing appears to have *intended* that these new defense industries do not vie directly with each other. For example, the two new aerospace (missile) enterprise groups do not compete in terms of products, but rather "in terms of their systems of organization and their operational mechanisms" ["Applying Technology to National Defense," *China Space News*, May 26, 1999].

Rationalization of the defense industry has also been much slower than expected. According to one Western estimate, no more than 20 percent of the labor force in the overall defense sector has been laid off ["Chinese Defense Industry: Chinese Puzzle," *Jane's Defense Weekly*, January 21, 2004]. AVIC, for example, has downsized by only 10 percent overall, and this was likely accomplished through retirement and job-leavers. At the same time, there have been few incidents of arms factories being closed or merged. Much of the defense industry continues to suffer from excess capacity, therefore.

It is also unclear how independent these new defense enterprises will be of government control or how responsible they will ultimately be for their own profits and losses. Beijing made it clear from the beginning that arms production is a strategic industry too critical to national security to be privatized, and that it will keep the new DIEGs under much stricter supervision than other types of reformed SOEs. At the same time these same rules will work in favor of the arms industries, as Beijing will likely feel pressured to continue to prop up unprofitable defense enterprises in order to preserve key arms programs.

Above all, the reform initiatives implemented so far do not directly address those impediments affecting technology absorption and upgrading of China's defense industry – that is, the lack of advanced technical skills and expertise, compartmentalization and redundancy within the industrial base, and a bureaucratic/risk-averse corporate culture. As a result, it is doubtful that these reforms will go very far in injecting market forces that would, in turn, drive the modernization of the Chinese military-industrial complex and affect China's ability to develop and manufacture highly advanced conventional weapons systems. It is also doubtful whether there really exists much of a latecomer advantage when it comes to extremely esoteric high-tech sectors such as arms production, where the technological demands are very high and the economic payoffs are very low. Even RAND noted that while "the technological gap between China's military aviation industry and that of the United States and other major aviation producers will likely narrow in coming years, [it] will still remain significant unless China makes fundamental changes in contracting and enterprise management" [*Modernizing China's Military*, p. 180].

Chinese Arms Production: Success In Spite of Reforms?

Interestingly, despite making little progress on reforming itself, the Chinese defense industry appears to be booming. Production and sales are up – 19 percent and 14 percent, respectively, in 2001 (the last year for which we have reliable data) – and China's military-industrial complex technically broke even in 2002 after eight straight years of losses. The missile and shipbuilding sectors have been particularly profitable in recent years ["Chinese Defense Industry: Chinese Puzzle"].

It is also increasingly evident that the Chinese have in recent years greatly added to their military capabilities in terms of power projection, standoff precision-strike, and improved C4ISR (command, control, communications, computing, intelligence, surveillance, and reconnaissance). China's defense industry has begun manufacturing and delivering to the PLA several new types of advanced weapons systems, including the fourth-generation J-10 fighter, an upgraded version of its JH-7 fighter-bomber, the HQ-9 long-range surface-to-air missile (akin to the U.S. Patriot air defense missile), the improved *Song*-class diesel-electric submarine, and the Type-052C destroyer (which incorporates low-observable features and a type of Aegis-type phased-array radar into its design). Moreover, the quality and capabilities of *some* Chinese weaponry has also apparently improved. Recent versions of the *Song*-class submarine, for example, are outfitted with a

skewed propeller for improved quieting and are capable of carrying an encapsulated antiship cruise missile that can be launched underwater.

The shipbuilding industry has made particular progress in modernizing its design and manufacturing capabilities and in spinning-on commercial shipbuilding technologies to its naval construction side. Chinese shipbuilding is domestically and globally competitive, and seems to be profitable – so much so that it is the only sector in the defense industry that appears to *adding* productive capacity, i.e., new shipyards and more workers. This in turn has permitted a significant expansion in naval ship construction since the turn of the century, and since 2000, China has begun construction of least six new destroyers, seven frigates, and eight diesel-powered submarines – more than double the rate of naval ship construction during the 1990s.

Nevertheless, most progress in expanding armaments production, both quantitatively and qualitatively, seems to have come about *despite* defense industry reforms – or at least the more recent attempts at reform – than *because* of them. Many of the so-called successes in generating new-generation weapon systems actually have their genesis in design and development decisions made years, even decades, ago – that is, long before the reforms of the late 1990s were inaugurated. These weapons programs were already in the pipeline and on schedule anyway to enter production in the late 1990s and first decade of the 21st century, and while the most recent reform efforts may have helped to accelerate or expand production of these weapons systems, they certainly did not play any key role in their initiation. For example, the success of the Chinese shipbuilding industry appears to be more the result of decisions made back in the early 1980s to commercialize the shipbuilding sector, to open up the industry to foreign technology inputs, and to compete on the global market.

In addition, it is perhaps premature to make overly optimistic and sweeping statements about recent progress in modernizing the Chinese defense industrial base. In particular, the continuing lack of transparency on the part of the Chinese forces Western analysts to rely too much on scanty, often anecdotal, evidence and inference. Some new weapons systems and platforms may *appear* to be more modern and more capable, but absent sufficient and reliable information (which is perhaps collectable only by covert means), most of us can only guess at any true increase in the capabilities and quality of weapons systems presently coming off Chinese assembly lines. We also continue to lack detailed and consistent economic data regarding the Chinese defense industry (such as sales, profits, capacity utilization, productivity, etc.) when it comes to assessing the success of defense sector market reforms.

Moreover, rising defense spending also likely had much to do with the recent expansion in Chinese arms production as any reform efforts. Chinese military expenditures have nearly quadrupled in real terms since the mid-1990s; China's official 2006 defense budget is 281 billion yuan, or $35 billion – a 14.7 percent increase over the previous year and thus continuing a decade-long trend of double-digit real increases in Chinese military spending. The annual procurement budget alone has increased from $3.1 billion to an estimated $11 billion between 1997 and 2006, and this does not include likely extra-

budgetary spending on R&D and arms imports, which together probably total around $3 billion to $4 billion a year. It could be argued, therefore, that simply throwing more money at the problem has had the most impact on the local defense industry – that is, in increasing procurement spending and therefore production, and by providing more funding for R&D.

Finally, it is also important to note that the sharpest edges of the pointy end of the PLA spear are still mostly foreign – and particularly Russian – sourced, that is, Su-27 and Su-30 fighters, *Sovremennyy*-class destroyers, *Kilo*-class submarines, S-300 surface-to-air missiles, etc. They are, with few exceptions (such as tactical ballistic missiles or nuclear submarines), still the most critical force multipliers when it comes to calculating Chinese military power.

Overall, it appears that Beijing's operational strategy regarding its defense sector is still mainly to muddle through with arms production, with some minor structural tinkering, a healthy increase in defense spending, and a continuing reliance on "pockets of excellence." While past reform efforts have resulted in some technological and structural improvements in weapons R&D and manufacturing, China's military-industrial complex remains in many respect an inefficient and less-than-optimal production model. This will continue to exert a drag on the Chinese military modernization process and make it harder for the PLA to close technology and capability gaps with its rivals.

Table 1

China Defense Industry Restructuring, July 1999

Old Corporate Entity	New Enterprise Group	Major Products
Aviation Industries of China (AVIC)	China Aviation Industry Corp. I (AVIC I)	Fighter aircraft, bombers, transports, advanced trainers, commercial airliners
	China Aviation Industry Corp. II (AVIC II)	Helicopters, attack aircraft, light trainers, UAVs
China Aerospace Corp. (CASC)	China Aerospace Science & Technology Corp.	Space launch vehicles, satellites, missiles
	China Aerospace Machinery & Electronics Corp.	Missiles, electronics, other equipment
China Ordnance Industry Corp. (COIC)/NORINCO	China North Industries Group Corp.	Tanks, armored vehicles, artillery, ordnance
	China South Industries Group Corp.	Miscellaneous ordnance, automobiles, motorcycles
China State Shipbuilding Corp. (CSSC)	China State Shipbuilding Corp. (southern shipyards, based in Shanghai)	Frigates, smaller surface combatants, commercial ships
	China State Shipbuilding Industry Corp. (northern shipyards, based in Dalian)	Destroyers, commercial ships
China National Nuclear Corp. (CNNC)	China National Nuclear Corp.	Nuclear energy development, nuclear fuel and equipment
	China Nuclear Engineering & Construction Group Corp.	Construction of nuclear power plants, other heavy construction