# Chapter 10

# China's defence industries: change and continuity

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China's defence-industrial sector is being transformed by reforms introduced in the interest of enhancing its competitiveness and capacity to meet the ambitious conventional arms requirements of the People's Liberation Army (PLA). China's defence-industrial base is becoming more decentralised, with increasing scope for local state-owned enterprises (SOEs) and privately owned enterprises to contribute to research and development (R&D) and production. This chapter assesses the long-term implications of this structural transformation. The progressive 'marketisation' of R&D and production is strengthening China's capacity for sustained defence-industrial development and helping to narrow its capability gap with major industrialised states, but ingrained attitudes and procedures and enduring concern about the political implications of defence-industrial dependence limit the scope for structural reform. China is not in a position to exploit the full defence potential of its impressive industrial and technological progress in the near term, but its long-term prospects are more positive.

## Defence-industrial development in China

Defence-industrial development has figured prominently in China's efforts to enhance its security in the face of perceived threats to its sovereignty, territorial integrity and national interests. The development of indigenous defence industries capable of supplying modern arms constituted a central pillar of the self-strengthening movement pursued by the Qing Dynasty in the late nineteenth and early twentieth centuries. Similar efforts were a feature of the 1916–28 'warlord period', when competing military leaders struggled for local and national power, and the Nationalist Government of the Republic of China devoted considerable resources to defence-industrial development during World War II.

The new Chinese Government moved quickly to restore and expand the defence-industrial base after 1949. Technological development 'to serve construction of…national defense' was enshrined in Article 43 of the Common Program of 1950, which constituted the initial de facto constitution of the People's Republic of China (Wang 1993:37). By 1950, the defence-industrial sector encompassed 45 factories employing some 100 000 workers (Shambaugh 2002:226). By the end of the decade, China was self-sufficient in terms of a comprehensive range of arms required by the land, air and naval branches of the PLA, with notable exceptions such as major surface combatants and long-range strike aircraft. Though the level of support for defence R&D and production has waxed and waned under the People's Republic and there have been a number of major policy shifts, the need to maintain key defence-industrial capabilities has never been in doubt.

## The established Chinese defence-industrial model

China's post-1949 defence-industrial model was broadly similar to that of the Soviet Union. Defence-industrial activity was the exclusive domain of the State and China's defence-industrial base featured highly centralised control and a very bureaucratic structure. All arms production undertaken by SOEs and defence-related R&D were either allocated to a research institute answering to one of the Ministries of Machine Building responsible for various aspects of China's arms programs or undertaken by academic institutions that answered to the State. There was no apparent requirement to ensure that arms production was economically viable, though the substantial arms requirements of the PLA undoubtedly often resulted in considerable economies of scale. Since the 1950s, for example, China has produced more than 14 000 military aircraft and 50 000 aircraft engines, mostly for the PLA (Matthews and Bo 2002:36). The absence of a profit motive meant that no resources were devoted to developing arms tailored to the particular requirements of export customers.

Where the Chinese defence-industrial model differed from that of the Soviet Union was with respect to the importance attached to technological progress. Defence R&D and production in China were characterised by modest technological objectives. While the Soviet defence industry was geared to the requirements of providing a comprehensive range of arms that was relatively technologically advanced, if not necessarily on a par with comparable Western systems, China's sights were set on much less ambitious requirements. At no point did China strive to even approach foreign arms in qualitative terms, choosing instead to focus on the large-scale production of relatively unsophisticated arms. The Chinese defence industry established a reputation for the quantity of production of arms that were obsolescent, if not obsolete, and for progressing to new product generations long after their introduction elsewhere.

## Defence industrialisation and autonomy

The objective of autonomy has been central to Chinese defence industrialisation. In this, China is by no means unique, but the form that this takes here has been distinct, and reflects China's particular security imperatives and policy objectives. These have been conditioned by its past difficulties in securing arms supplies and by the ideological basis of the ruling Chinese Communist Party. China was the subject of a Western arms embargo between the early 1950s and 1980s and, after 1960, was the target of what effectively constituted a Soviet arms embargo as well. The characteristic features of China's established defence-industrial model testify to the importance attached to self-reliance ('*zili gengsheng*'), which is seen in China as an 'indispensable component…of national security' (Park and Park 1988:119). China long pursued a general developmental approach summed up by the slogan of 'walking on two legs'. This emphasised the importance of relying on China's own capabilities, regardless of the level of efficiency or even the effectiveness that this involved.

The defence-industrial strategy of the People's Republic has been distinguished by the dedication and persistence with which the objective of autonomy has been pursued. In many states, practical efforts to promote defence-industrial autonomy are restricted to production capacity, but in China the long-term development of autonomy with respect to R&D and production is considered crucial. This has involved developing and maintaining a capacity to supply the complete range of arms required by the PLA, including in terms of the local production of all arms components. Studies of the Chinese defence industry generally see its defence industrialisation as being driven by the objective of maximising self-sufficiency (see, for example, Shambaugh 2002:226). It is noteworthy, for example, that China moved to reconstitute its defence-industrial capabilities in the 1950s despite its success in securing large-scale arms transfers from the Soviet Union. China developed its defence industries as a means of ensuring a domestic capacity to meet the material requirements of the PLA. Interest in providing arms as military assistance to friendly states constituted an objective of secondary importance, and there was no apparent interest in the commercial opportunities of arms exports until the 1980s, when China emerged as a major supplier of arms to the Middle East.

The importance attached to defence-industrial autonomy was manifest in the relative isolation of Chinese R&D processes. Defence-related R&D in China did benefit from foreign input, but technological flows were unidirectional and did not involve arrangements that had the potential to generate long-term dependent ties, including collaborative R&D arrangements. This included technology transfers from the Soviet Union during the 1950s. After the termination of Soviet defence-industrial support in 1960, China continued to exploit foreign sources of arms-related technology, but this was limited to the reverse engineering of arms and components, either in terms of the outright copying of foreign designs or the derivation of technological insights contributing to the development of more advanced arms in China. This involved the opportunistic exploitation of opportunities as they arose, rather than any regularised ties. Only towards the end of the Cold War did China supplement such efforts with selective purchases of technology and subsystems from other states. Until recently, none of China's external defence-industrial arrangements threatened its efforts to maintain independent arms R&D and production capabilities. The effective isolation of China's defence-industrial base eliminated the prospect of dependence on potential adversaries, which China had been unable to overcome despite its best efforts during the self-strengthening movement.

China's defence-industrial approach came at some cost. China's reluctance to engage other states on defence-industrial issues other than the terms that it did was inherently limiting in qualitative terms, particularly given China's relatively low technological base and the limited resources it was in a position to devote to defence-industrial development. That China was able to meet its defence-industrial needs with so little foreign support was due in large part to its unique arms requirements. For most of the history of the People's Republic, China pursued a strategy of 'people's war', which emphasised drawing an attacker deep into the Chinese hinterland, where superior numbers and geography could be exploited to China's advantage. This approach obviated the requirement for conventional arms that were on a qualitative par with those of China's potential adversaries. This factor, along with the difficulty involved in supplying China's large military establishment with sophisticated arms and developing the logistical capacity to support them, meant that less-advanced arms that were within the developmental and production capacity of Chinese industry were sufficient.

Even so, China struggled to meet its limited requirements in terms of more complex categories of arms such as combat aircraft. Here, while there was progress in absolute terms, in relative terms China's defence-industrial capacity regressed over time. The 1960s saw China producing the J-6 fighter, which was a derivative of the early 1950s-vintage Soviet MiG-19, but 20 years later it had advanced only to the point where it was producing the J-7, based on the Soviet MiG-21 design from the late 1950s. While the leap involved in progressing from the technological generation of the MiG-19 to that of the MiG-21 was considerable, its failure to advance further than this meant that China steadily fell behind its potential adversaries. China's struggle to advance technologically in areas such as aerospace was exacerbated by the severe anti-intellectualism of the Cultural Revolution, which saw the closure of many academic institutions.

China's defence-industrial approach came under threat only when it became apparent that it was incapable of meeting its changing arms requirements, which resulted from its evolving military strategy. By the 1980s, the utility of the strategy of people's war was being questioned. Its limitations were demonstrated by the Gulf War of 1990–91, when American-led forces soundly defeated numerically superior, relatively well-equipped Iraqi forces within a matter of days. This highlighted the potential conferred by conventional military capabilities that were beyond the scope of China's defence industries to support.

## The Chinese military-industrial complex in the late 1990s

By the late 1990s, China still possessed one of the most technologically backward defence industries in the world; most indigenously developed weapons systems were at least 15 to 20 years behind those of the West—basically comparable with 1970s or (at best) early 1980s-era technology—and quality control was consistently poor. China's defence 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 remains 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 function effectively as a single unit (Medeiros et al. 2005:4–18).

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. China generally confronted considerable difficulties in moving prototypes into production, resulting in extended development phases, frequent program delays and limited production runs. For example, the J-10 fighter jet—China's premier fourth-generation-plus combat aircraft—took more than a decade to move from program start to first flight, and more than 20 years before it entered operational service with the PLA Air Force (Medeiros et al. 2005:161–2; Shambaugh 2002:261–2). Even after the Chinese began 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 about 600 000 workers manufactured only a few dozen fighter aircraft a year, mainly 1960s and 1970s-vintage J-8 IIs and J-7s (Allen 1997:244). 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 a year. Moreover, the lead boat in the Song-class submarine program—China's first indigenously designed diesel–electric submarine—was commissioned only in 1999, eight years after construction began (Jane's Information Group 1999:119–20, 124–5).

Consequently, despite years of arduous efforts, the inability of China's domestic defence industry to generate the necessary technological breakthroughs for advanced arms production meant that Beijing continued to rely heavily—even increasingly—on direct foreign technological inputs in critical areas. It is believed that the J-10 fighter, for example, is based heavily on technology derived from Israel's cancelled Lavi fighter-jet program. Chinese dependency is 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; additionally, current versions of the J-10 are being outfitted with a Russian engine, until the Chinese aviation industry is able to perfect an indigenous replacement (Medeiros et al. 2005:170–1). The new Song-class submarine uses a German-supplied diesel engine, while the Ming and Han-class submarines have reportedly been 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 naval helicopters.

Finally, and perhaps most significant, in the past decade—and particularly since the turn of the century—the PLA has increasingly favoured imported weapons platforms over locally built counterparts. From this, one can infer that the Chinese military remains dissatisfied with the quality and capabilities of weapon systems coming out of domestic arms factories, or that local industry is unable to produce sufficient numbers of the kinds of weapons required by the PLA. 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-8 II, 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 a subsequent purchase of approximately 100 more advanced Su-30 strike aircraft. The PLA Navy (PLAN) is currently acquiring 12 Kilo-class submarines and four Sovremennyy-class destroyers (armed with supersonic SS-N-22 anti-ship 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, advanced air-to-air missiles, airborne warning and control aircraft 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 1998 and 2005, Beijing signed new arms import agreements worth some US$16.7 billion; in 2005 alone, it purchased US$2.8 billion worth of foreign weapon systems (Grimmett 2006:56, 57).

Compounding these technological deficiencies was a number of structural and organisational/cultural deficiencies that impeded the design, development and manufacture of advanced conventional arms. Overall, arms production in China has largely been an inefficient, wasteful and unprofitable affair. One reason for this was over-capacity: 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 times as large as it required (*China Daily*, 3 October 1997). Within the shipbuilding industry, output during the same period was only 17 tonnes a person a year, compared with about 700 tonnes a person in shipyards in more advanced countries (Gangcan 1998:17).

By the mid 1990s, at least 70 per cent of China's state-run factories were thought to be operating at a loss, and the arms industries were reportedly among the biggest money-losers. As a result, most defence firms were burdened with considerable debt, much of it owed to state-run banks (which were obliged to lend money to state-owned firms); at the same time, arms factories were owed money, which was nearly uncollectible, by other unprofitable state-owned companies (Frankenstein 1999:197–9; 'Industry embraces market forces', *Jane's Defence Weekly*, 16 December 1998, p. 28; Jencks 1999:617).

The creation of China's 'third-line' defence industries—that is, the establishment of redundant centres of armaments production in the remote interior of southern and western China—in the 1960s and 1970s only added to the overcapacity, underutilisation 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 per cent of China's defence industries were located within the third line, yet most of these industries were much less productive than coastal factories and continued to operate in the red (Shambaugh 2002:277; Frankenstein and Gill 1996:403).

Another structural impediment affecting the Chinese defence-industrial complex was the emergence of a highly compartmentalised and vertically integrated defence-industrial base. Such a stratified environment had several repercussions for the local defence industry. It restricted the diffusion of advanced, relevant civilian technologies to the defence sector. It also limited communications between the R&D institutes that designed the weapons and the factories that produced them, between defence enterprises when it came to collaborating on weapons projects and even between the defence industry and its major consumer, the PLA, when it came to requirements and specifications. It also exacerbated redundancy and the duplication of effort within the arms industry, as each defence enterprise tried to 'do it all', resulting in the maintenance of expensive but under-utilised 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 functioned for a long time under an organisational and managerial culture that, in a manner typical of most SOEs, was highly centralised, hierarchical, bureaucratic and risk averse. This stymied innovation, retarded R&D and further added to program delays. In a study on Chinese capacities for innovation, two Western analysts (Arayama and

Mourdoukoutas 1999) argued that 'Chinese managers do not have the will, the expertise, or the freedom to take the risks and make the adjustment associated with innovations'. Consequently, production management was often highly centralised 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 (Arayama and Mourdoukoutas 1999).

An American aerospace industry representative best summed up China's problems with armaments production in the 1990s, writing that:

> 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[s] 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 Wortzel 1998:20)

## Reforming China's defence industry, 1997 to the present

Chinese authorities have long been aware of the deficiencies in their defence industry and have undertaken several rounds of reform to improve and upgrade their R&D and production processes. The intention of this overall restructuring effort was to spur the defence SOEs to act as true industrial enterprises and therefore be more responsive to their customer base (that is, the PLA), and to reform, modernise and 'marketise' their business operations.

These goals are central to the PLA's new modernisation strategy, as laid out in China's 2004 defence white paper, of 'generation leap'—that is, to skip or shorten stages of R&D and generations of weapons systems. This process, in turn, entails a 'double construction' approach of mechanisation and 'informisation' in order to concurrently upgrade and digitise 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 technological dead ends (Ji 2004).

In the early 1990s, in an effort to 'corporatise' the defence-industrial base, the Chinese transformed their military-industrial complex from a series of machine-building ministries into large 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 defence industry included the China Ordnance Industry Corporation (COIC, often referred to as Norinco; ground combat systems) and the China State Shipbuilding Corporation (CSSC; naval systems). At the same time, control of individual production facilities, research units and trading companies was transferred to these new corporations.

The most recent round of defence industry reforms began more than a decade ago, in September 1997, when the Fifteenth Communist Party Congress laid out an ambitious agenda for restructuring and downsizing the SOE sector (including the defence industries) and for opening up SOEs to free-market forces—that is, supply-and-demand dynamics, competitive products, quality assurance and fiscal self-responsibility. In March 1998, the Ninth National People's Congress further refined this agenda by announcing plans to reorganise the government's defence industry oversight and control apparatus and to establish new defence enterprise groups.

One of the most important decisions to come out of the 1998 congress was the creation of a new PLA-run General Armaments Department (GAD), acting as the primary purchasing agent for the PLA, overseeing defence procurement and new weapons programs. As a 2005 RAND report put it, the GAD is part of a process 'to create [a] system that will unify, standardize, and legalize the [Chinese] weapons procurement process' (Crane et al. 2005:165). 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 defence reforms was the creation in July 1999 of 10 new defence industry enterprise groups (DIEGs) (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 defence industry was to be greatly reduced, and these new enterprise groups were given the authority to manage their own operations as well as to 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 lay-offs) as much as one-third of its workforce. The aircraft industry, for example, intended to downsize by 200 000 workers. The rationalisation of the defence 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'.

**Table 10.1** China defence 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 Corporation (CASC) | China Aerospace Science and Technology Corporation (CASC) | Space-launch vehicles, satellites, missiles |
| | China Aerospace Science and Industry Corporation (CASIC) | Missiles, electronics, other equipment |
| China Ordnance Industry Corporation (COIC/Norinco) | China North Industries Group Corporation | Tanks, armoured vehicles, artillery, ordnance |
| | China South Industries Group Corporation | Miscellaneous ordnance, automobiles, motorcycles |
| China State Shipbuilding Corporation (CSSC) | China State Shipbuilding Corporation (CSSC) | Destroyers, frigates, commercial ships |
| | China State Shipbuilding Industry Corporation (CSIC) | Destroyers, commercial ships |
| China National Nuclear Corporation (CNNC) | China National Nuclear Corporation (CNNC) | Nuclear energy development, nuclear fuel and equipment |
| | China Nuclear Engineering and Construction Group Corporation (CNECC) | Construction of nuclear power plants, other heavy construction |

At the same time, Beijing prodded defence industries to undertake more civilian production as a means of acquiring dual-use technologies that could also be used to support arms production. This strategy goes back to the late 1970s and the enunciation of Deng Xiaoping's so-called 16-character slogan: 'Combine the military and civil/combine peace and war/give priority to military products/let the civil support the military.' 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 towards promoting integrated dual-use industrial systems capable of developing and manufacturing defence and military goods; or, as one Western analyst (Folta 1992:1) put it, 'swords into plowshares…and better swords'. This new strategy was embodied and made a priority in the defence industry's tenth Five-Year Plan for 2001–05, which emphasised the dual importance of 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 develop dual-use technologies but to actively promote joint civil–military technological cooperation. Consequently, the spin-on of advanced commercial technologies to the Chinese military-industrial complex and in support of the overall modernisation of the PLA was made explicit policy.

The key areas of China's new focus on dual-use technological 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. In the past decade, Beijing has worked hard 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 defence-related electronics. Under the tenth Five-Year Plan, many technology breakthroughs generated under the so-called '863' science and technology program, initiated in March 1986, were finally slated for development and industrialisation. Defence 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-technology firms wishing to invest in China have been pressured to set up joint R&D centres and to transfer more technology to China.

In this regard, China's military shipbuilding appears particularly to have benefited from CMI efforts in the past decade. After 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 towards 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 modernised and expanded operations, building huge new dry docks, acquiring heavy-lift cranes and computerised 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 co-located at Chinese shipyards have been able to leverage these considerable infrastructure and software improvements when it comes to design, development and construction (Medeiros et al. 2005:140–52).

China's nascent space industry has also spurred the development and application of dual-use technologies. 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 exploiting the development and growth of the country's commercial information technology (IT) industry. The PLA is striving 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 with 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, utilising fibre-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 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 requirements—these restructuring efforts have largely been a failure. The GAD, for example, has yet to implement competitive bidding and market pricing into the overall arms procurement process; in particular, competitive bidding is apparently still not used when it comes to major weapons programs, as any purchases of more than CNY2 million (less than US$250 000) are exempt (Crane et al. 2005:167).

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 is 'far from clear' (Medeiros et al. 2005:45–6).

Moreover, at one time it was expected that the Chinese would create large, trans-sectoral, cross-competing defence conglomerates, similar to the South Korean *chaebols* or, more specifically, to horizontally integrated mega-defence companies such as Lockheed Martin or Britain's BAE Systems. Such a strategy would have entailed a much more complicated restructuring of the defence 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 defence corporations into smaller groups.

With few exceptions, too, China's new DIEGs still do not compete with each other when it comes to defence materiel. Of the two new enterprise groups replacing the old AVIC, for example, all fighter aircraft production is concentrated within one DIEG, while all helicopter and trainer-jet production is centred in the other. The nuclear industry will be split into separate enterprises for either construction or nuclear energy development, while Norinco appears to have been subdivided into one enterprise group concerned mostly with armoured vehicles and ground ordnance, while the other is almost entirely civilianised, specialising in automobile and motorcycle production. In fact, Beijing appears to have *intended* that these new defence industries 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 defence', *China Space News*, 26 May 1999). Naval construction is the only defence sector that appears to be truly competitive in that both major shipbuilding companies (CSSC and CSIC) vie with each other for PLAN contracts.

It could even be that the Chinese have abandoned the idea of competing defence firms: in 2008, Beijing announced that AVIC I and AVIC II would merge, creating, again, a single aviation company. This new, reunited AVIC will also establish a cross-corporate subsidiary, similar to Europe's Airbus, dedicated to developing and manufacturing large passenger jets (Minnick 2008).

Rationalisation of the defence industry has also been much slower than expected. Details are sketchy, but according to one Western estimate, no more than 20 per cent of the labour force in the overall defence sector has been laid off ('Chinese defence industry: Chinese puzzle', *Jane's Defence Weekly*, 21 January 2004). AVIC, for example, had downsized by only 10 per cent overall, and this was likely accomplished through retirement and job leavers ('Chinese defence industry: Chinese puzzle', *Jane's Defence Weekly*, 21 January 2004). At the same time, there have been few cases of arms factories being closed or merged. Much of the defence industry therefore appears to still suffer from excess capacity, in terms of the workforce and redundant manufacturing capacity.

It is also unclear how independent these new defence 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 was a strategic industry too critical to national security to be privatised, and that it would keep the new DIEGs under much stricter supervision than other types of reformed SOEs. At the same time, these same rules will work in favour of the arms industries, as Beijing will likely feel pressured to continue to prop up unprofitable defence 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 defence industry—that is, the lack of advanced technical skills and expertise, compartmentalisation 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 will, in turn, drive the modernisation 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 pay-offs 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' (Crane et al. 2005:180).

## Chinese arms production: success in spite of failed reforms?

Despite reforms making little apparent progress, the Chinese defence industry appears to be booming. Production and sales are up—by 19 per cent and 14 per cent, 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 defence industry: Chinese puzzle', *Jane's Defence Weekly*, 21 January 2004; Medeiros et al. 2005:8).

It is also increasingly evident that the Chinese have in recent years greatly added to their military capabilities in terms of power projection, stand-off precision strike and improved command, control, communications, computing, intelligence, surveillance and reconnaissance (C4ISR). China's defence 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 US Patriot air-defence missile), the improved Song-class diesel–electric submarine and the Type-052C destroyer (which incorporates low-observable features and an Aegis-type phased-array air defence radar into its design). Moreover, the quality and capabilities of *some* Chinese weaponry have 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 anti-ship cruise missile that can be launched underwater.

The shipbuilding industry has made particular progress in modernising its design and manufacturing capabilities and in spinning-on commercial shipbuilding technologies to its naval construction side. Chinese shipbuilding is competitive domestically and globally (at least, at the low end of the technology scale), and it also appears to be profitable—so much so that it is the only sector in the defence industry that is actually *adding* productive capacity (that is, 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 at 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, quantitatively and qualitatively, seems to have come about *despite* defence industry reforms—or at least the more recent attempts at reform—rather 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 to enter production in the late 1990s and the first decade of the twenty-first century, and while the most recent reform efforts could 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 the result mostly of decisions made back in the early 1980s to commercialise 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 modernising the Chinese defence-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 could *appear* to be more modern and more capable, but in the absence of sufficient and reliable information (which is perhaps collectable only by covert means), one can only speculate about 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 defence industry (such as sales, profits, capacity utilisation, productivity, and so on) when it comes to assessing the success of defence-sector market reforms.

Moreover, rising defence spending also likely has had as much to do with the recent expansion in Chinese arms production as any reform efforts. Chinese military expenditure has nearly quadrupled in real terms since the mid 1990s. China's official 2007 defence budget was CNY350 billion (US$45 billion)—an increase of nearly 18 per cent from the previous year and thus continuing a trend of double-digit real increases in Chinese military spending extending back more than a decade. PLA annual spending on equipment increased from US$3.1 billion in 1997 to an estimated US$12.3 billion in 2006—a fourfold increase in real spending; at this rate, the 2007 equipment budget would total about US$15 billion (not including likely extra-budgetary funding for foreign arms purchases, which was running at about US$1.5–2 billion a year). It could be argued, therefore, that simply throwing more money at the problem has had the most impact on the local defence industry—that is, in increasing procurement spending and therefore production, and by providing more funding for R&D.

It also is important to note that the sharpest edges of the pointy end of the PLA spear are still mostly foreign—and particularly Russian—sourced, such as the Su-27 and Su-30 fighters, the Sovremennyy-class destroyers and S-300 surface-to-air missiles. 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 formal strategy regarding its defence sector still relies on minor structural tinkering, a healthy increase in defence 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 respects an inefficient and less-than-optimal production model. This will continue to exert a drag on the Chinese military modernisation process and make it harder for the PLA to close technology and capability gaps with its rivals.

It is important to note, however, the long-term potential of China's general industrial transformation. The growing scope for non-state economic activities in China extends to militarily relevant high-technology industries, and there are numerous indications that the private sector is eager to avail itself of the opportunity to develop and produce arms for the PLA and for export. There is some recognition of this potential on the part of Chinese authorities, who are permitting non-state enterprises to enter the defence market. In 2006, for example, it was announced that the State was prepared to subsidise private-sector arms production (Vogel 2006:18). It remains to be seen how this trend will develop or what impact it will have, but if China is able to effectively harness the potential inherent in its dynamic industrialised economy, this could help to offset the limitations of the state defence-industrial sector outlined above.

## Conclusions

China faces major obstacles in developing its defence-industrial capabilities. These stem from its structural basis and its political requirements, which will continue to encourage extensive reliance on autonomous national industries under the close supervision—if not the direct control—of the State. China can, however, be expected to continue to seek foreign technological inputs to help address particular equipment requirements and even to import arms when these could be developed locally, in cases where this is seen as justified by the capability difference involved.

The transformation of China's defence-industrial sector likely will continue to be a gradual, incremental process that is beset by major difficulties. The principal features of China's emerging defence-industrial model are continued strong state direction and a continued reliance on SOEs for a considerable amount of R&D and production, but some acceptance of a defence-industrial role for private enterprise, in terms of meeting China's requirements and those of other states.

China could, in the long term, be in a much better position to provide the PLA with the advanced arms it requires, and to do so in a much more timely manner than currently is the case. How successful its efforts are will depend in no small part on the extent to which it is prepared to adhere to established objectives of defence-industrial autonomy. Opening up defence-related R&D and production to market forces holds great promise, but this will force political authorities in China to carefully consider which sovereign capabilities are crucial and which are not.

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