Other Approaches to Civil-Military Integration: The Chinese and Japanese Arms Industries

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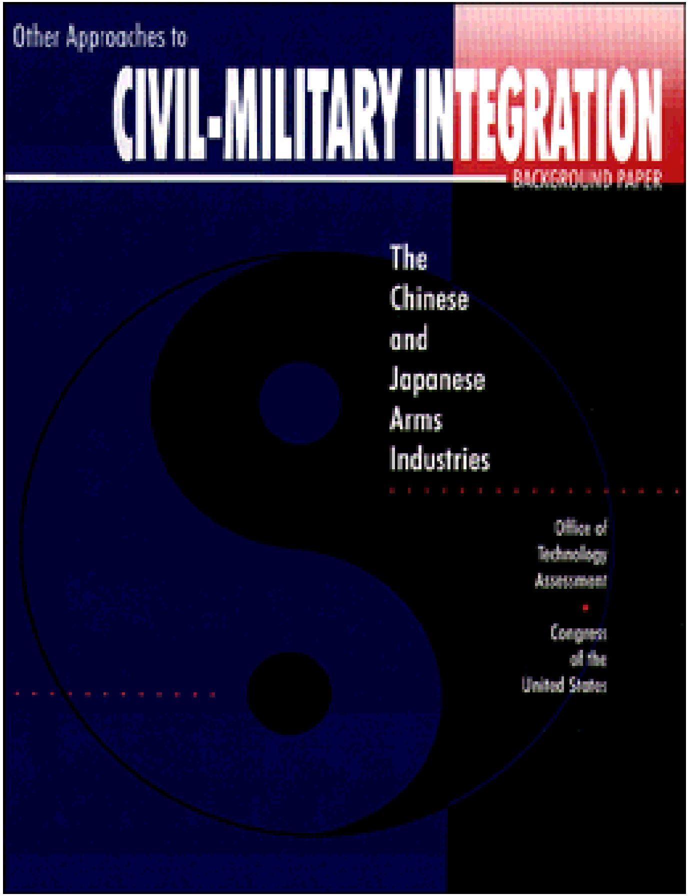

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Foreword

As part of its assessment of the potential for integrating the civil and military industrial bases, the Office of Technology Assessment considered how the People's Republic of China (PRC) and Japan, two Asian states with sizable defense industries, have succeeded in achieving significant levels of civil-military integration (CMI).

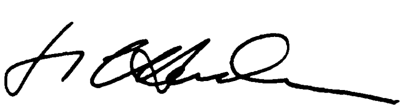
CMI involves the sharing of fixed costs by promoting the use of common technologies, processes, labor, equipment, material, and/or facilities. CMI can not only lower costs, but in some cases, it can also expedite the introduction of advanced commercial products and processes to the defense sector.

The paper is divided into two sections, one on the PRC and one on Japan. Each section describes the structure and management of the respective defense industrial base and then compares it with its U.S. counterpart. The paper then assesses the degree to which lessons from the PRC and Japanese cases can be applied to the U.S. defense technology and industrial base (DTIB).

Although the political and security situations of the PRC and Japan, as well as their CMI objectives, differ from those of the United States, several interesting observations can be made. The Japanese, for example, with a limited defense market and an American security guarantee, emphasize dual-use design as well as the commercial aspects of many defense developments. Dual-use design and high quality are enhanced in some instances by Japanese personnel policies that combine design and manufacturing personnel into product groups that understand the entire design, development, and manufacturing process.

The PRC's experience appears to have less application to the United States because its defense technology is far less sophisticated and large segments of the Chinese economy, and almost all of the Chinese DTIB, remain under state control. Still, the PRC's CMI effort is of interest in its potential impact on economic modernization of the PRC and the potential for technology transfer into the future PRC defense structure.

This report responds to a request from the House Armed Services Committee to investigate the potential for deriving lessons from foreign states to further American efforts at increasing integration in the American DTIB. As with all OTA studies, the content of this background paper is solely the responsibility of the Office of Technology Assessment.



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Preface

America's national security and economic well-being have long rested on its technological and industrial prowess. Over the four-decade-long Cold War, the nation's defense technology and industrial base (DTIB) became isolated from the commercial base. That isolation raised the cost of defense goods and services, reduced the Department of Defense's access to commercial technologies with potential defense application, and made it difficult for commercial firms to exploit the results of the nation's extensive defense science and technology investments.

The integration of defense and commercial technology and industry (often termed civil-military integration—CMI) is advocated as a means to preserve the U.S. defense capability in the face of budget reductions. Under CMI, common technologies, processes, labor, equipment, material, and/or facilities are used to meet both defense and commercial needs.

This background paper examines how the People's Republics of China and Japan, two countries with sizable defense industries, have succeeded in achieving significant levels of CMI.

It is a supplement to a full report, *Assessing the Potential for Civil-Military Integration,* released in September 1994, that assesses the potential for greater CMI in the United States, its benefits, and implementing steps.

Despite several previous initiatives to promote integration, much of the U.S. DTIB remains isolated. Concerns over possible costs and risks to modifying government acquisition to implement CMI have hindered change. The report *Assessing the Potential for Civil-Military Integration* considers three broad policy areas—policies to increase commercial purchases and practices, policies to increase integrated processes, and policies to improve operations in that portion of the DTIB likely to remain segregated—that might lead to greater CMI.

OTA found that some technologies, industrial sectors and product tiers are more amenable to integration than others, and indeed, integration is already occurring in many of the tiers and technologies most amenable to CMI. Increasing CMI will depend in part on the product, process, and tier involved. Prime contractors performing systems integration are less able to integrate their products and processes with commercial counterparts than are producers of components and subcomponents. On the other hand, services appear particularly amenable to commercial purchases.

There are clear benefits to increasing CMI. OTA's analysis indicated significant cost savings resulting from increased use of commercial items and integrating R&D, production, and maintenance processes. Even greater savings might come from changes in military systems design. Further, CMI may improve defense access to new technology in the future.

There are, however, obstacles to further CMI. One major obstacle is the sheer complexity involved. Inmost instances, the barriers to CMI are sufficiently intertwined to demand a comprehensive (and complex) set of policies if projected benefits are to accrue. Efforts to promote integration therefore carry costs and risks as well; one of the most discussed risks is that commercial goods and services may fail in military operations. Increased CMI may also result in greater dependence on foreign goods and services. Changes in oversight might result in increased instances of fraud and abuse. Alternatives exist to deal with such risks, but efforts to increase CMI must carefully balance expected benefits to the DTIB and the economy with potential pitfalls resulting from those same policies.

Assessing the Potential for Civil-Military Integration outlines three strategies for consideration. A Readjustment Strategy involves the least risk but may generate the fewest benefits. It seeks to increase CMI modestly while retaining many of the current procedures for oversight of defense expenditures. It includes increasing commercial purchases for defense needs. The Federal Acquisition Streamlining Act of 1994 (FASA), signed in October 1994, provides the legislative basis for implementing much of the commercial purchase portion of a Readjustment Strategy. A Reform Strategy, building on a Readjustment Strategy, seeks to foster CMI more actively; changing rules to promote the integration of both R&D and production of defense and commercial products. Finally, a Restructuring Strategy that incorporates the two earlier strategies might gain the maximum potential CMI benefits, but would demand major changes in future military acquisition policy, system design, and force structure. This strategy would present correspondingly greater risks.

Both the main report and this background paper found that successful implementation of CMI requires a long-term commitment. It involves careful design and planning of systems, components, and subcomponents, and extends to all tiers and throughout the planning and production process. While the potential benefits are significant, they will take time to accrue. Patience and a steady effort are paramount requirements for successful CMI.

Copies of the full report, *Assessing the Potential for Civil-Military Integration,* are available from the U.S. Government Printing Office for $13.00 (200 pp, S/N **052-003-01394-1). Call GPO at (202) 512-1800.**

For *congressional* requests, call OTA's Congressional and Public Affairs Office at (202) 224-9241.

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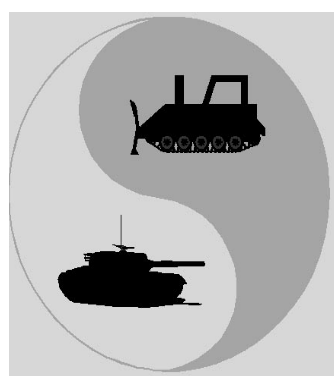
Other Approaches to Civil-Military Integration: The Chinese and Japanese Arms Industries

The end of the Cold War has not necessarily heralded the end of prospects for conflict for the United States, as the Gulf War showed. It is generally recognized that a strong American defense-industrial base should be preserved as insurance against potential future conflicts. There is, however, also a desire to gain a technological and industrial "peace dividend," through the redirection of resources from defense needs to the civilian economy. These somewhat conflicting objectives confront not only the United States, but also other countries. Useful lessons might, therefore, be learned from examining other countries' approaches to defense procurement, particularly the degree to which their defense and commercial technology and industrial bases are integrated.

In 1994, the Office of Technology Assessment (OTA) issued its assessment report, *Assessing the Potential for Civil-Military Integration: Technologies, Processes, and Practices.*[1] An earlier OTA background paper examined the French defense industry.[2]

This background paper addresses the People's Republic of China (PRC) and Japan, which are of interest for several reasons. First, they both have extensive defense-industrial bases that allow them to support their militaries with predominantly domestically produced weapons (although in both cases, many of these weap-



[1] See U.S. Congress, Office of Technology Assessment, *Assessing the Potential for Civil-Military Integration: Technologies, Processes, and Practices,* OTA-ISS-611 (Washington, DC: U.S. Government Printing Office, September 1994).

[2] U.S. Congress, Office of Technology Assessment, *Lessons in Restructuring Defense Industry: The French Experience,* OTA-BP-ISC-96 (Washington, DC: U.S. Government Printing Office, 1992).

ons are based on foreign designs). Second, both states' defense and commercial-industrial bases are somewhat integrated. That is, in both states, at least some defense items are produced with the same methods, sources, equipment, and personnel used to produce certain civil items.[3] (see box A). Because civil-military integration (CMI) has been suggested as one way to achieve the disparate objectives of preserving a defense-industrial base while gaining a peace dividend, some have suggested the PRC's and Japan's approaches may offer useful lessons for the United States.

Secretary of Defense William Perry, for example, has shown great interest in the Chinese[4] conversion effort and its effect on the national technological-industrial base by initiating several discussions with the Chinese on the subject.[5] Indeed, the Chinese have been pursuing a form of conversion and integration since Deng Xiaoping's ascension to the top leadership in the late 1970s. Although this effort has been motivated by factors considerably different from those at play in the United States, the Chinese effort may provide some insights into both the benefits and pitfalls of the conversion and integration processes.

The Japanese, meanwhile, have created an advanced economy, including technological and economic leadership in several technological sectors, with little emphasis on military production. Indeed, the United States has sought to acquire commercial Japanese technology since at least 1980. The relatively small Japanese military (both in terms of absolute size and relative to the Japanese population) enjoys the support of a fairly comprehensive defense-industrial base. Tokyo is, therefore, believed by some analysts to have successfully integrated its commercial technology and industrial base (CTIB) and its defense technology and industrial base (DTIB) (see figure 1).

The proportions of defense and commercial industries in the Chinese, Japanese, and American economies differ. These differences reflect several circumstances. Each country began the post-World War II era with a different level of overall technological sophistication within its economy, as well as widely disparate economic and human resources. As of 1950, for example, the Chinese were the poorest of the three countries, as well as the least sophisticated. Japan had a trained work force but was still recovering from the devastation of World War II, and the United States had the wealthiest economy and the most available resources, both human and technological. In the postwar period, Beijing, Tokyo, and Washington each placed a different degree of emphasis on the development of military-industrial power, relative to its commercial base. Each state's decisions about economic and technological resources have yielded different results.

The PRC's top priority, until the 1980s, was developing its military capabilities. Commercial development was slighted as the best available Chinese resources were directed toward the development of the country's defense industries. With the rise of Deng Xiaoping, however, the Chinese have shifted their focus toward a more broad-based industrial-development program. Part of this effort has involved directing much of the Chinese DTIB to produce commercial products.

On the other hand, the Japanese in the post-World War II period have focused primarily on developing commercial technologies and industries. This has been due to several factors. The Japanese have pursued a more pacifist foreign and defense policy, codified in their Constitution. This has been possible, in turn, because of the American security umbrella that allowed the Japanese to de-

[3] In this background paper, the modifiers *"civil," "civilian,"* and *"commercial"* are used interchangeably when discussing the portion of the national technology and industrial base that sells non-military goods on the basis of price.

[4] In this background paper, the terms *Chinese* and *PRC* are used interchangeably.

[5] B. Gertz, "Perry Approves Helping China's Defense Conversion," *Washington Times,* p. 3, Feb. 1, 1994, and S. Mufson, "U.S. To Help China Shift Arms Output to Civil Use," *Washington Post,* p. 28, Oct. 18, 1994.

BOX A: Civil-Military Integration Concepts

There is no single definition of civil-military integration (CMI), This background paper uses the definition of CMI that is in the OTA report *Assessing the Potential for Civil-Military Integration: Technologies, Processes, and* Practices, [1] There, CM I is defined as:

> The process of uniting the Defense Technology and Industrial Base (DTIB) and the larger Commercial Technology and Industrial Base (CTIB) into a unified National Technology and Industrial Base (NTIB)

Under this definition, CMI Involves the sharing of fixed costs, incurred in the course of both defense and commercial product and process development, by promoting the use of common technologies, processes, labor, equipment, material, and/or facilities. This includes cooperation between government and commercial facilities in research and development (R&D), manufacturing, and/or maintenance operations; combined production of similar military and commercial items, including components and subsystems, side by side on a single production line or within a single firm or facility; and use of commercial off-the-shelf items directly within military systems,

The desire to increase economic efficiency through reductions in redundant fixed costs may lead to CMI. Political or social goals, particularly the preservation of existing organizations or labor pools, may also call for CMI. In pursuit of such goals, CM I can involve the alternative use of defense facilities, infrastructure, or work forces for commercial applications when past Investments in training, experience, R&D, equipment, and structures might be useful, even if they are not economically efficient or profitable,

CMI may occur at three levels The most thorough form of integration is at the **facility level.** Facility-level Integration Involves the sharing of personnel, equipment, and materials within a single facility In an Integrated facility, ideally, defense and commercial goods are manufactured side by side, with differences in production processes and parts dictated solely by differences in product function

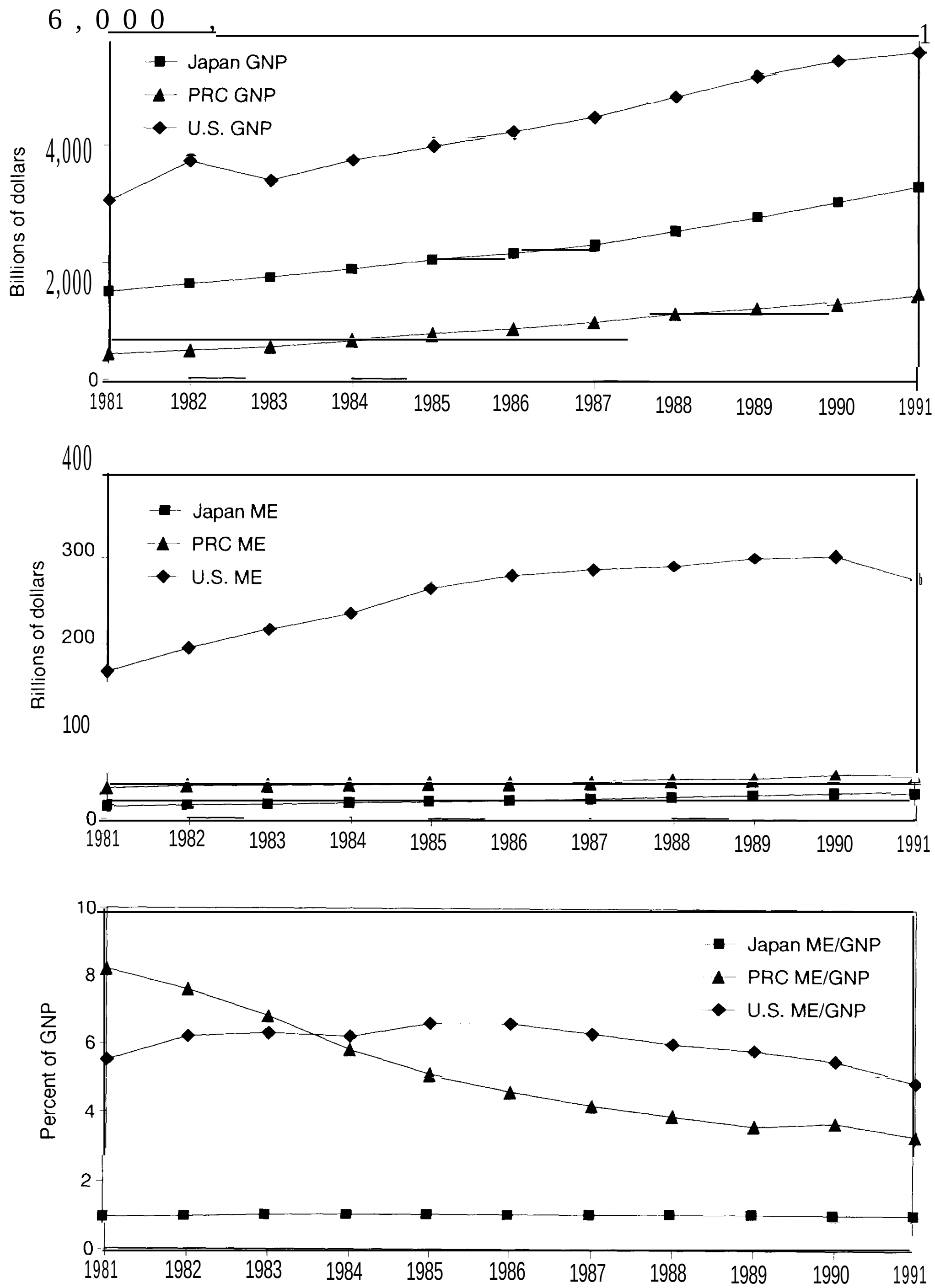
Another form of integration can occur at the **firm level.** Firm-level integration involves the use of corporate resources to meet both defense and commercial needs Under this scenario, defense and commercial product lines have access to the same management, workers, research centers, equipment, stocks, and perhaps even facilities. A corporation that has integrated facilities is, by definition, also integrated at the firm level. An integrated firm might have segregated facilities, however, because it might separate its operating divisions along commercial and defense product lines. Within an integrated firm, however, there are, ideally, no barriers to the flow of staff, information, and product and process technologies among the divisions.

Sector-level integration IS somewhat more abstract than the other levels. An Industrial sector IS considered to be integrated if defense and commercial goods and services are developed from the same pool of technologies, specialized assets, and processes. In particular, a sector IS considered integrated if the same standards and manufacturing processes are used for both defense and commercial product and service lines, Sector-level integration, however, does not necessarily imply that the resulting products and services are Identical or that they are produced at the same firms or facilities

[1] U S Congress, Office of Technology Assessment, *Assessing the Potential for Civil-Military Integration: Technologies, Processes, and Practices,* OTA-ISS-611 (Washington, DC U S Government Printing Office, September 1991), p. 5

SOURCES: A Alexander, Japan Economic Institute, August 1994; Office of Technology Assessment, 1994

FIGURE 1: GNP and Defense Expenditures for the PRC, Japan, and the United States



PRC, Japanese, and U S GNP 1981-1991
PRC, Japanese, and U S Military Expenditures 1981-1991
PRC, Japanese, and U S Military Expenditures as Percent of GNP, 1981-1991

SOURCE Arms Control And Disarmament Agency, *World Military Expenditures And Arms Transfers 1997-1992,* 1994 vote more resources to commercial development without endangering Japanese national security. The constrained size of the Japanese Self Defense Forces (SDF), coupled with a decision not to export arms, has also limited sales opportunities for the Japanese DTIB. Therefore, although the Japanese have a DTIB that produces a wide variety of products, it is neither a substantial portion of the Japanese national technological-industrial base (relative to its CTIB) nor the primary focus of Japanese technological development.

The United States followed a third path between these two extremes. Over the course of the Cold War, extensive U.S. security considerations required a large, robust DTIB. Domestic political considerations and security doctrine emphasized technological sophistication over sheer mass and led to the development of advanced, and expensive, weapons. Commercial interests and the American political structure, meanwhile, ensured that the defense sector would not dominate the economy. As a result, although the American DTIB is ahead of the CTIB in some areas of technology, the opposite is true in other areas. A further consequence was that portions of the DTIB became segregated from the CTIB (see box B).

This background paper focuses on integration in the PRC and Japan. It begins by outlining the Chinese and Japanese defense procurement systems. It then assesses the extent to which they are affected by the same obstacles that shaped the American system, particularly those factors that led to segregation of the American DTIB from the CTIB: acquisition laws and requirements, military specifications, militarily unique technologies, and emphasis on military performance. The extent of integration at each level of production—sector, firm, and facility—is then considered. The paper concludes by assessing the relevance of the Chinese and Japanese experiences to the American CMI effort.

THE PEOPLE'S REPUBLIC OF CHINA

A fundamental aspect of the Chinese People's Liberation Army's (PLA) ideology is that "the Army and the People are one." The PLA has, therefore, long been integrated into the general development of the Chinese economy. PLA construction troops, for example, were responsible for developing much of the Chinese transportation infrastructure in the first decades of the People's Republic.[6] Similarly, most Chinese amphibious forces have been integral to Chinese riverine trade on a day-to-day basis. "Typical employment of the [military] ships includes haulage of cement for civilian construction projects, imported foodstuffs from one region to another and bulk cargoes not easily handled by other haulage means."[7]

Such integration, however, did not initially extend to the Chinese DTIB. At the time of the founding of the PRC, the Chinese had only a minimal defense-industrial base. This was due, in part, to the predominantly agrarian nature of the Chinese economy in 1949, coupled with the devastation of both World War II and the subsequent Chinese Civil War. The PLA was primarily equipped with weapons captured from either the Imperial Japanese Army or the Nationalist Army.

With the signing of the Sino-Soviet Treaty in 1950, the Soviet Union became the primary arms supplier of the Chinese military. Soviet aid included not only the provision of complete weapons, but also involved the transfer of Soviet-designed arms factories, among them those for "aircraft, naval vessels, electronic equipment, and

[6] From 997,600 km of highway and 22,512 km of railroads in 1950 to 6,500,000 km and 40,000 km, respectively, in 1970. M.D. Eiland, "Military Modernization and China's Economy," *Asian Survey* 17(12): p. 1148, 1977.

[7] G. Jacobs, "China's Amphibious Capabilities," *Asian Defence Journal*, p. 64, January 1990.

BOX B: Sources of Segregation in the American Defense Technology and Industrial Base

As the OTA report *Assessing the Potential for Civil-Military Integration: Technologies, Processes, and Practices* Indicated, the American defense technology and industrial base (DTIB) and commercial technology and industrial base (CTIB) exhibit signs of segregation. That is, there are clearly limits to the extent to which common technologies, processes, labor, equipment, material, and/or facilities can be used to meet both defense and commercial needs.

Several factors have led to the segregation of the American DTIB from the CTIB. The factors that are most relevant to this background paper are discussed below.

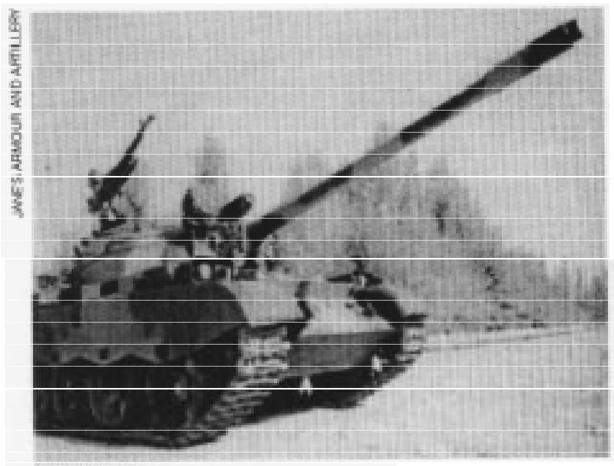
Acquisition Laws, Regulations, and Culture. In the four decades of the Cold War, an acquisition culture arose in the American defense procurement system, marked by special accounting rules and regulations. Many of these rules and regulations are the results of past acquisition abuses and scandals. The resulting network of rules and regulations has separated the DTIB from the CTIB by imposing additional reporting burdens on any venture interested in providing defense products or services In some cases, these reporting requirements have included demands for details (e g., technical data rights) that are central to a firm's competitive advantage.

Military Specifications and Standards. In pursuit of standardization after various logistical difficulties experienced in World War 11, and to ensure interoperability and uniform quality of components and systems from diverse sources, the Department of Defense (DOD) created a plethora of military specifications and standards. The resulting system of military specifications and standards allowed the American DTIB to support a globally deployed military, operating in environments ranging from the Arctic to the tropics. However, the system eventually came to dictate methods of production as well as performance standards, however, as it grew more bureaucratized over the subsequent 40 years. Significant divergences between military and commercial specifications and standards developed, particularly as commercial quality control and production processes evolved, which led to segregation of the DTIB from the CTIB.

Militarily Unique Technologies. In some cases, segregation is due to the militarily unique nature of a given technology. Items are militarily unique where there is no commercial demand for a technology, either because the technology is classified, as with weapons of mass destruction, or because the relevant systems and technologies have no commercial market, as with military explosives, missiles, and armored fighting vehicles. In many cases where the final product may be militarily unique, however, and particularly with advanced weapon systems, although the final product may not have a commercial market, its components and subsystems and production technologies and processes might have commercial applications. Moreover, in the course of product and process evolution, technologies that were once militarily unique may become integrated.

Emphasis on Military Performance. American military equipment has tended to emphasize high performance; in particular, it has sought to gain the greatest possible performance margin. Not only is this additional performance not necessarily sought in commercial products (e.g., commercial engines have little need for an afterburner), it often imposes an additional cost. This additional cost was often considered acceptable during the Cold War because the United States sought to gain military advantage through superior quality rather than through superior quantity. It is unclear the degree to which that will remain true in the post-Cold War environment.

SOURCES: U S Congress, Office of Technology Assessment, *Assessing the Potenial for Civil/Military Integration: Technologies, Processes, and Practices,* OTA-ISS-611 (Washington, D.C.: U. S. Government Printing Office, 1994), Office of Technology Assessment, 1994



Most Chinese military equipment, including tanks, is derived from earlier Soviet designs.

land armaments. . . ."[8] The Soviets also trained large numbers of Chinese engineers, designers, and other members of the intellectual infrastructure (including those involved in the Chinese nuclear program). As a result, the Chinese defense-industrial base was organized and managed along lines similar to those of the Soviet DTIB.

In the wake of the Sine-Soviet split in the early 1960s, the Chinese were forced to rely on their own efforts. Chinese leaders decided to develop a wholly indigenous arms industry to ensure that they would never again be as dependent or as vulnerable as they felt they had been during the heyday of the Sine-Soviet relationship. This decision was strengthened by concerns over Soviet and U.S. military intentions.

Thus, the Chinese began-a major expansion of the DTIB in the mid-1960s. This effort was overseen by a newly expanded group of eight Ministries of Machine Industry (MMI), which were responsible for the development of heavy industry in all sectors. Of the group, only one was responsible for civilian economic development; the rest were devoted to development for national (and primarily military) purposes of such sectors as electronics, aerospace, shipbuilding, nuclear weapons, and energy. During this period, Chinese defense production is believed to have constituted at least 10 percent of overall national industrial production (by volume).[9]

Chinese efforts during the 1960s included the construction of "hundreds—possibly thousands-of small, medium and large-scale [defense] industrial projects in every region of the country, including the remote interior."[10] Such dispersion, however, coupled with the limited Chinese technological, financial, and trained-personnel base, meant that the available resources were not necessarily exploited efficiently. Instead, Chinese weapon systems, particularly relatively sophisticated ones, were often only available in very limited quantities. Indeed, "the total output of the more complicated pieces [of equipment] can be traced to a single industrial complex and in some cases a single factory."[11]

Furthermore, the DTIB was not very sophisticated. For example, although the Chinese developed a substantial machine-tool industry, it was primarily weighted toward the low- and medium-grade end, rather than toward the precision tools needed for production of sophisticated items, whether military or civil. The level of sophistication did not improve significantly during the 1960s and 1970s.

The lack of sophistication in the technological, financial, and trained-personnel base was exacerbated further by the isolation of the Chinese DTIB from its CTIB. This isolation was due, in part, to

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[8] D. Shambaugh, "China's Defense Industries: Indigenous and Foreign Procurement," *The Chinese Defense Establishment,* P.H.B. Godwin (cd.) (Boulder, CO: estview Press, 1983), p. 44.

[9] S. James, "Military Industry," *Chinese Defence Policy,* G. Segal and W.T. Tow (eds.) (Chicago,l: Univesity of Illinois Press, 1984), p. 121.

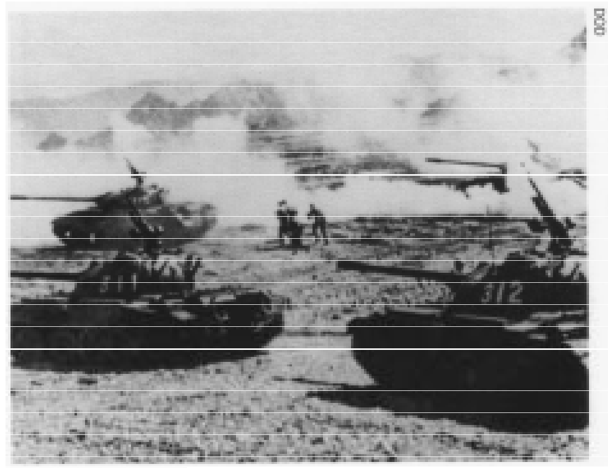
[10] Ibid., p. 118.

[11] J.R. Blaker, "The Proc\duction of Conventional Weapons," *The Military and Political Power in China in the 1970s,* W.W. Whitson (ed.) (New York, NY: Praeger Publishers, 1972), pp. 223-224.

the secrecy associated with the Chinese arms industry, which restricted information flow and technological developments within the DTIB and kept the DTIB separate from the larger commercial economy. During the 1960s and 1970s, the Chinese did not express significant interest in developing a consumer economy. Indeed, the political chaos of the Cultural Revolution during the late 1960s and early 1970s further strengthened the isolation of the military-industrial base (some of which was deliberately insulated by the PLA and the highest echelons of the Chinese Communist Party from rampaging Red Guards). From the Sine-Soviet split to the end of the Cultural Revolution, the PRC's CTIB and DTIB were also isolated from global technological developments, due to Beijing's isolated stance and deliberate pursuit of autarky.

That isolation was not necessarily considered a problem at the time, however. In the first place, given the pervasive Soviet influence, the Chinese DTIB resembled the Soviets'. Practicing "vertical integration, . . . each plant was composed of as many departments as the whole manufacturing process required."[12] The Chinese DTIB was, therefore, in many ways autonomous, depending on neither the CTIB nor the general economy to function.

The demands on the DTIB were limited. The PLA at this time was focused on the Maoist doctrine of "People's War," which was the result of lessons learned from the War of Resistance against Japan (1937-1945). It emphasized the preparation of masses of foot soldiers and militia (which China had in abundance) to engage in prolonged guerrilla warfare in China's interior. The focus was on basic, infantry-oriented equipment, which the Chinese DTIB was well-suited to provide. Indeed, the doctrine essentially made a virtue of the relatively primitive state of the Chinese DTIB. "People's War" as a doctrine, therefore, provided both customers for the DTIB's products and a rationale for their continued production.



Chinese strategy until the 1980s relied on massed forces wielding basic weapons.

"People's War" also emphasized the continuation of war even in the wake of Soviet (or American) nuclear strikes. This view of prolonged warfare, coupled with the need to support and sustain forces even if Chinese industrial centers were occupied or devastated, exploited the vertically integrated nature of Chinese defense production facilities by ensuring that production did not depend on provision of parts, components, or other supplies from facilities that might be destroyed or otherwise isolated. Much of the Chinese DTIB was deliberately located in the (relatively) inaccessible Chinese interior. This deployment, despite the absence of transportation links, was deemed a defensive measure, enabling the militia to always have access to at least basic weapons even in a protracted war. Such a view, again, also made a virtue of a preexisting condition because sophisticated weapons presumably would be difficult to produce, much less maintain, in the absence of an intact logistical and support structure.

After the death of Mao, however, and in the wake of the subsequent power struggle that brought Deng Xiaoping to power, Chinese policymaking hewed to a less ideological line. At the national level, this was marked by Deng's reiteration

[12] D. Shambaugh, op. cit., footnote 8, p. 44.

of the "Four Modernizations": to modernize agriculture, industry, science and technology, and national defense, in that order. The Chinese economy would no longer be autarkic, but would instead establish links with the outside world to gain access to global technological and economic developments. Only through such efforts could the Chinese avoid becoming completely irrelevant in the political, economic, and technological realms.

As part of this national modernization effort, resources were shifted from military to commercial economic development through both conversion and outright diversions away from the military.[13] To make this shift palatable to the PLA, the national authorities essentially proposed a long-term bargain. The strengthening of the national economy and the technological base by the short-term transfer of funds, resources, and personnel from the DTIB to the CTIB would ultimately benefit defense by establishing a more sophisticated national technological, industrial, and scientific base from which to develop future defense capabilities.

The PLA embraced the shift. The poor performance of the PLA in the 1979 "pedagogical war" with Vietnam had demonstrated the primitive nature of the Chinese military's doctrine and equipment. The subsequent organizational restructuring resulted in a reduction of the role of ideology in the PLA's thinking. This triumph of "expert" military thinkers (i.e., military professionals) over the more ideological, or "red," elements, in turn, brought to the fore PLA officers who were interested in gaining access to more sophisticated weapons and in developing a doctrine with more nuance.

To acquire more sophisticated weapons, the PLA recognized that national economic and technological development was necessary. Essentially, the PLA was prepared to tolerate short-term pain, including lower budgets and reductions in numbers of forces and dedicated industrial assets, on the premise that it would eventually recoup those losses through improved equipment in future years.

This combination of changes, including the short-term deemphasis on military production and modernization, implied a radical alteration of the Chinese approach toward not only military acquisition and procurement, but the relative importance of the Chinese DTIB and CTIB. Rather than single-mindedly pursuing an improved DTIB to the exclusion of the CTIB, the Chinese would seek to develop their overall technological sophistication, with an emphasis on the CTIB, in order ultimately to improve the DTIB's capabilities.

Such an approach, though, presented two enormous problems, as Chinese defense planners themselves recognized. The first was how to modernize an industry that for two decades had produced few new weapons but that had relied instead on designs provided by the former Soviet Union in the 1950s, designs that themselves dated from World War II. The second was how to cut or cancel existing production lines and retain the work force, and still generate arms-export orders in order to allow some production plants to remain open in the event of hostilities.[14]

As the Chinese defense budget subsequently shrank, it became imperative to both the Chinese government in general and the PLA leadership in particular that the resources available to them be used more efficiently. One of the first signs of this effort involved the replacement in the late 1970s of the leadership of the MMIs, up to then composed of senior military personnel, with civilian administrators.[15] This was followed by the estab-

[13] "Conversion" involves commercial application of defense facilities; it occurs when the fixed costs are paid for by the military.

[14] G. Jacobs, "The PLA—From Doctrine to Organizations," *Jane's Intelligence Review*, p. 373, August 1993.

[15] H.W. Jencks, "The Chinese 'Military-Industrial Complex' and Defense Modernization," *Asian Survey* 20 (10): p. 987, 1980.

lishment of a commission to "tighten central supervision of the machine-building industries and to coordinate their production."[16] In 1983, in an apparent move to "erase special treatment of the military in the allotment of scarce resources," the various Chinese organizations and committees charged with oversight of defense production were merged into a single body, the Commission for Science, Technology and Industry for National Defense (COSTIND).[17] Concomitant with this, the Chinese military was cut by some million people, from 4 million to 3 million.

In the early 1980s, Beijing also began to convert many of the available defense-oriented plants into commercially oriented ones. Industries that were not producing critical hardware or that were unable to attract export markets were targeted for conversion to civilian production. This effort was aided by the release, in the course of economic liberalization, of massive, pent-up demand for various consumer (and later, light-industrial) goods. This massive demand ensured that at least an initial market existed for many of the commercial goods produced by the DTIB during this transition.

The conversion of redundant defense-industrial plants was further facilitated by the Chinese government's promulgation of several guidelines aimed at furthering integration of the civilian and military economies. These included the mandate that "civilian goods manufactured by their defense industry must use production technologies similar to military products, and must be goods which are in short supply and have market potential."[18] This ensured that the manufacture of commercial goods would involve minimal changes to the current plant (requiring, in turn, minimal capital and technological investments). It also meant that those goods that **were** produced would be goods that were desired (i.e., a market existed for them). To further assist the shift toward civilian production by military industry, the China Industrial and Commercial Bank set aside money for loans aimed at transferring military technology to civilian purposes.[19] This shift soon began to bear fruit. Between 1978 and 1983, civilian production on military lines rose 90 percent, until it amounted to nearly 20 percent of the defense industry's total output (by volume).[20] By the early 1990s, civilian production had risen to over 70 percent of Chinese defense-industrial production (by volume).[21]

PLA Procurement

The current Chinese military procurement process is oriented toward two specific goals: improving the PLA's combat capabilities and using the defense base to generate income. Although the Chinese defense budget has risen by over 10 percent annually for the past several years (see figure 1), Chinese resources for military modernization remain badly constrained. Much of the increased spending has gone toward salaries (a substantial outlay in a military still numbering over 3 million), rather than acquisitions. Furthermore, the heated state of the Chinese economy has meant a high inflation rate, further minimizing the real effect of defense-budget increases. Consequently, the primary focus of the Chinese military has generally involved upgrading available equipment, rather than purchasing new or additional items.

Overall PLA equipment holdings have improved only slowly. The slow pace of improvements is exacerbated by the need for hard currency

[16] E. Joffe, *The Chinese Army After Mao* (Cambridge, MA: Harvard University Press, 1987), p. 101.

[17] S. Jammes, op. cit., footnote 8, p. 125.

[18] E. Joffe, op. cit., footnote 15, p. 102.

[19] *China Today: Defense Science and Technology,* Volume 1 (Beijing: National Defence Industry Press, 1993), p. 160.

[20] E. Joffe, op. cit., footnote 15, p. 102.

[21] Chong-Pin Lin, "The Stealthy Advance of China's People's Liberation Army," *The American Enterprise*, p. 33, January/February, 1994.

because most Chinese equipment upgrades have required foreign assistance. The upgrade of the A-5 aircraft, for example, centers on the addition of French inertial guidance and attack systems, including a heads-up display and laser range-finder.[22] Similarly, the new *Luhu*-class destroyers have extensive foreign equipment, including American gas turbines (for dash power) and French surface-to-air missiles (to remedy the dearth of air defense within the Chinese surface navy).[23]

The Chinese goal of using the defense base to generate income applies not only to the PLA as a whole (through such means as arms exports), but also to individual factories, units, and commands (which usually involve commercial production of some sort). These groups are further motivated to generate income by the bureaucratic competition within the Chinese procurement system. All of the major players of the Chinese procurement process sponsor their own firms, which in some cases now have competing product lines (discussed below).

The PRC's current procurement structure comprises several players (figure 2). The important ones are the PLA, the MMBs (the Ministries of Machine-Building, formerly the MMIs), and the Committee on Science, Technology and Industry for National Defense (COSTIND). Each player is not only involved in procurement for the PLA as a whole, but also heads up commercial organizations aimed at generating income, especially hard currency.

The PLA is the most important player of all, both due to the prominent role of the military in Chinese politics and because the PLA is charged with developing requirements for new equipment, thereby setting the agenda to some extent. The PLA answers to the Central Military Commission (CMC). The most important of the three elements within the PLA is the General Staff Department's Equipment Department (GSD/ED). The GSD/ED draws up operational parameters for PLA equipment acquisitions and coordinates demands from the three services. The PLA's General Logistics Department (GLD) is responsible for logistics and quartermaster duties, primarily food and uniforms. The third element, the General Political Department, has no direct influence on PLA weapons procurement.

Both the GSD/ED and the GLD control their own private corporations, which use the defense factories under their jurisdiction to produce not only weapons for the PLA, but also goods for export, including weapons and commercial items. The GSD/ED controls Poly Technologies Inc., a major corporation at least loosely affiliated with the China International Trade and Investment Corp. (CITIC), one of the first corporations established under Deng Xiaoping's reforms and still one of the largest and most well-connected. The GLD controls China Xinxing Corp., which numbers among its products food, clothing, and construction materials.[24]

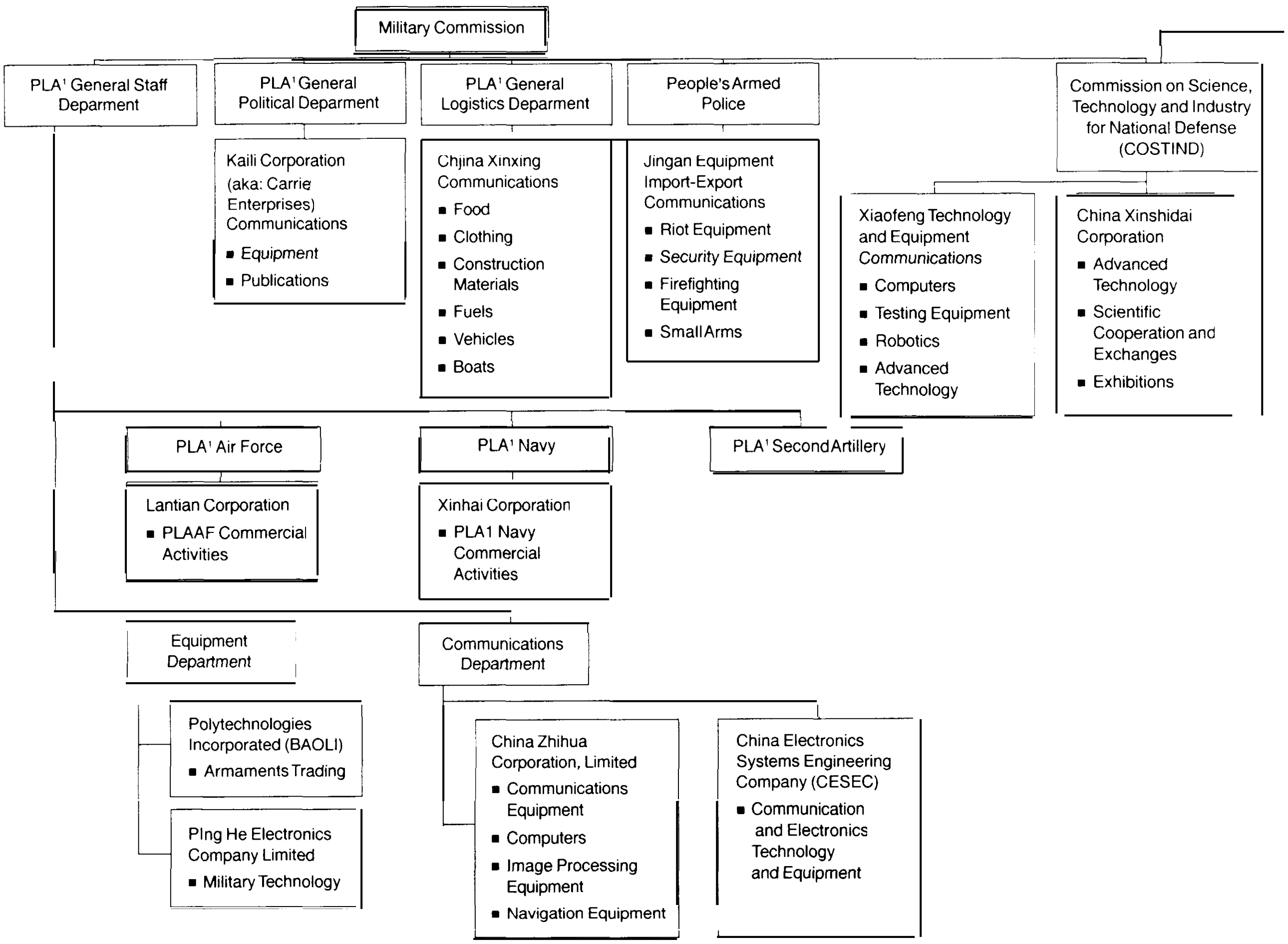
Although it is the PLA that sets requirements, it is the MMBs that fulfill them. The six "defense-industrial ministries" answer to the State Council: the Ministry of Nuclear Industry, the Ministry of Aviation Industry, the Ministry of Electronics Industry, the China State Shipbuilding Corporation, the Ministry of Space (Astronautics) Industry, and the Ministry of Ordnance Industry. Each of these, in turn, controls at least one corporation. Thus, for example, China North Industries Corp. (NORINCO) is affiliated with the Ministry of Ordnance Industry, while the Great Wall Corp. and China Precision Machinery Import/Export Corp. (CPMIEC) are associated with the Ministryof Space Industry. The ministries and their subordinate corporations

[22]Mao Jingli, "Replacing the Old with the New—on Upgrading China's Qiang (A)-5 II Aircraft," *Xiandai Bingqi* [Beijing] 7, pp. 4-5, July 8, 1993, in Joint Publication Research Service report (hereafter JPRS) 93-075 (Oct. 12, 1993) p. 36.

[23]"New Ships for the PLAN," *Jane's Defence Weekly,* p. 88, Jan. 18, 1992.

[24]Tai Ming Cheung, "On Civvy Street," *Far Eastern Economic Review,* 155:41, Feb. 6, 1992.

FIGURE 2: China's Defense Industrial Trading Companies



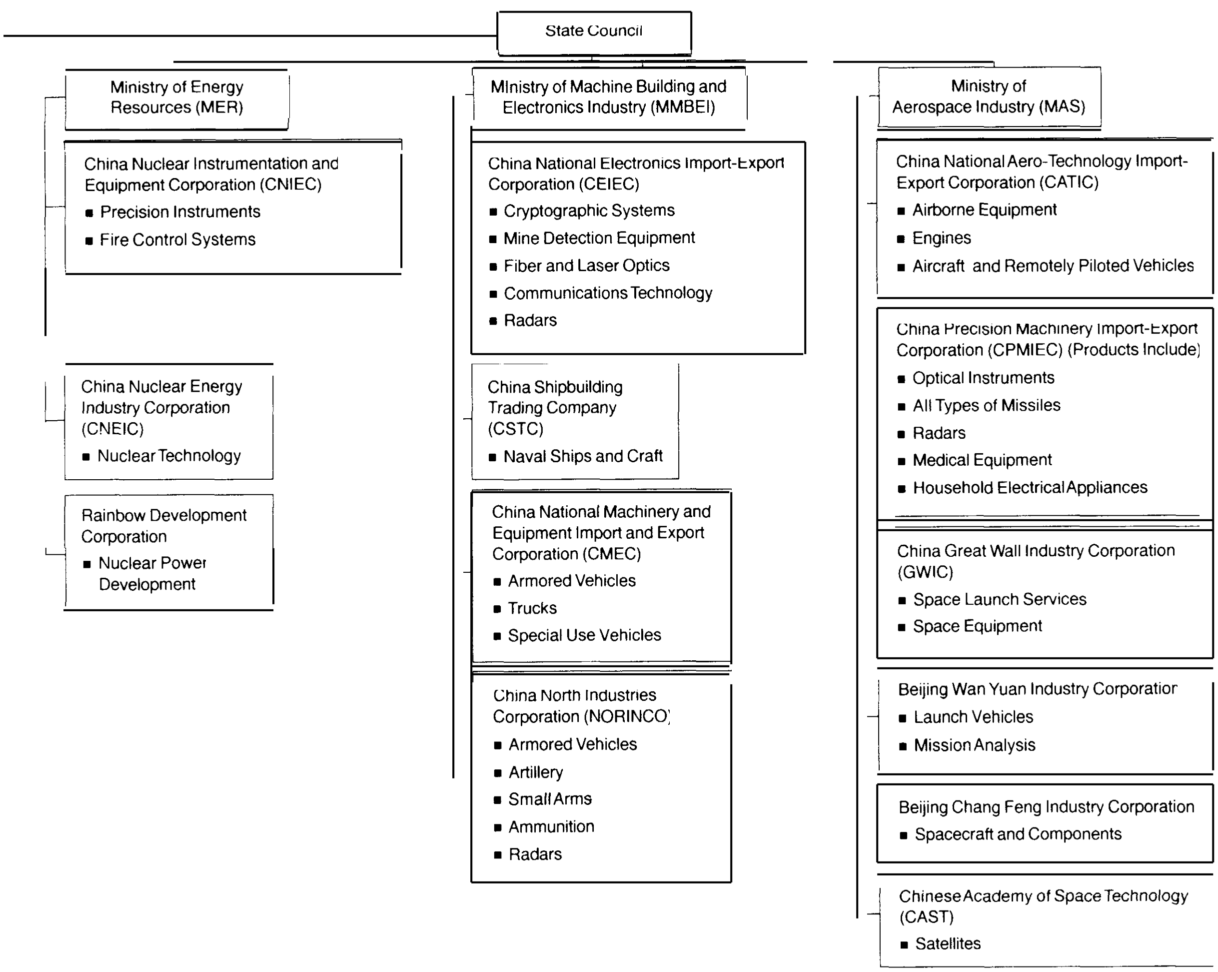
"own" China's DTIB, except for the portion that is under the control of the PLA and COSTIND.

In the past, the GSD/ED and the MMBs have often failed to see eye to eye. In particular, the GSD/ED's officers were not necessarily concerned with budgets because production costs were frequently the responsibility of the state, rather than the military per se. Nominally, this allowed military users to set requirements without having to worry about budgetary stresses.[25]

GSD/ED officers were also often unfamiliar with the production process. At the same time, the MMBs often did not necessarily understand operational requirements. As a result, the MMBs paid little attention to either potential combat needs or maintenance requirements. Instead, equipment was produced according to MMB capabilities, rather than to a plan for greater sophistication (with its ideological implications). This was most evident with aircraft production. The Ministry of

25 A.J. Alexander, "National Experiences: A Comparative Analysis," *Disarmament, Topical Papers #5, Conversion: Economic Adjustments in an Era of Arms Reduction,* Vol. 2 (New York, NY: United Nations, 1991), p. 19.

FIGURE 2 (Cont'd.): China's Defense Industrial Trading Companies



SOURCE Defense Intelligence Agency, 1990

Aviation produced thousands of combat aircraft, most of which were obsolescent, if not obsolete, rather than attempt to develop better designs.

With the commercialization of the Chinese economy over the past 15 years, however, the Chinese procurement process has changed somewhat. The PLA now has greater responsibility for the budgetary aspects of acquisition, and the PLA's requests for more sophisticated arms must now be reconciled with other demands. At the same time, the MMBs now have a far greater incentive to procure and develop more sophisticated technologies. This does not mean that the MMBs are necessarily more responsive to the demands of the military, however. Instead, the "ministries tend to seek out technology that will directly affect industrial modernization."[26] They have, therefore, often subordinated military production to com-

26 J. P. Gallagher, "China's Military Industrial Complex," *Asian Survey* 28(9):998, 1987.

mercial requirements. COSTIND's role is to mediate between the PLA and the MMBs.

COSTIND combines research and development (R&D) functions. In some ways, it resembles the Director of Defense Research and Engineering (DDR&E) office within the Office of the Secretary of Defense in the United States. It is, however, granted a much wider purview. COSTIND is responsible for the specification, assessment, and application of all advanced technologies within the Chinese military and DTIB. The political power of COSTIND, moreover, is far greater than that of DDR&E. Several of COSTIND's members sit on both the State Council and the CMC.

Like both of the other players, COSTIND also controls its own corporations. These include China Xinshidai Corp. and Xiaofeng Technology and Equipment Corp.. The former is primarily oriented toward advanced technologies generally, whereas the latter is more narrowly focused, with special interests in computers, testing equipment, and robotics.

Comparison of the PRC with the United States

The Chinese DTIB differs in several important respects from its American counterpart. Initially, starting in 1949, the Chinese DTIB—indeed, the entire Chinese economy—was state-run. The Chinese economy was also heavily militarized. For decades, the DTIB had priority for receiving the highest-quality raw materials, trained personnel, and advanced technology. Although the Chinese economy has changed drastically since the advent of Deng Xiaoping and the introduction of economic reform and liberalization measures, significant portions, particularly the heavy-industrial sectors, remain centrally planned. Such differences clearly limit the relevance of the Chinese experience for the United States.

In the past decade, however, the Chinese have striven to liberalize their economy and to increase its sophistication. This has involved the acquisition of more sophisticated technology from abroad. At the same time, the Chinese have sought to make greater use of their current work force and available industrial plant. As a poor country, the PRC seeks to maximize its use of available labor and resources. Thus, there is a great emphasis on transferring DTIB resources to the CTIB (hence the Chinese emphasis on conversion). Those efforts, particularly in the areas of conversion and increasing the use of the same production lines for both civilian and military items, may offer some useful comparisons with the American case.

Acquisition Laws and Procedures

One of the most important obstacles to integrating civil and military procurement in the United States involves acquisition law.[27] The myriad requirements for reporting various costs have discouraged integration by imposing additional expenses on firms that seek to produce goods for the military. Even highly successful commercial firms are, therefore, frequently reluctant to undertake military production for fear of incurring these costs.

One aspect of the acquisition-law problem is technical data rights. The Department of Defense (DOD) frequently demands extensive rights to technical data to ensure that a given system can continue to be produced even if the original contracting corporation goes out of business. Thus, DOD may request not only data about the system itself, but also information on the manufacturing processes, which the company may well have developed on its own, often at significant expense.

The Chinese suffer from fewer such problems. In the past, this may have been due to state ownership of the bulk of the means of production. Indeed, within the Chinese DTIB, the State con-

[27] U.S. Congress, Office of Technology Assessment, *Assessing the Potential for Civil-Military Integration: Technologies, Processes, and Practices* (Washington, DC: U.S. Government Printing Office, 1994).

trolled and supplied all of the relevant industrial elements. As long as the DTIB was ahead of the CTIB, therefore, technical data rights were hardly a problem because the government possessed most technical data rights from the outset and was under no pressure to share them with the CTIB.

Furthermore, the Chinese DTIB was shrouded in secrecy. Thus, there was only a limited flow, if any, of technical data rights to the CTIB. Because the Chinese emphasized the military sectors over their commercial sectors, technical data, especially for relatively advanced processes, rested in the DTIB.

Military Specifications and Standards

In the PRC, although operational parameters are set by the PLA, the standards involved in actual production have been, and still are, set by the MMBs. This is due, in part, to the different backgrounds of PLA officers and MMB officials. The latter are far more versed in engineering, whereas the former have generally been capable only of setting out operational requirements without necessarily understanding the industrial demands involved. Thus, production standards have been the responsibility of the producers, rather than the users.

Chinese manufacturers set fairly high standards for the manufacture of their weapon systems within the capabilities of the Chinese DTIB. As was true for their Soviet counterparts, quality has generally been higher on military than on commercial production lines. The difference has been due, in part, to the Chinese DTIB receiving the best raw materials and facilities and the best-trained labor force. In addition, the priority accorded the DTIB by political authorities for material and political support may have obviated somewhat the need for extensive military specification. The government expected that only the highest-quality items would be provided for military production lines and that only the highest-quality products would be made.

Questions have been raised about the quality of Chinese military items, however. There have been reports, for example, that Chinese aircraft manufacturers' quality control has tended to be uneven. Entire Chinese aircraft types were recalled to their factories in 1975. In the 1980s, Chinese combat aircraft were reported to have serious problems that involved contamination of their hydraulic systems.[28] In the wake of joint ventures with the United States and Europe in the area of civilian aircraft (particularly the MD-80 and MD-90 at Shanghai Aircraft Industries Corp. (SAIC)), though, the general level of Chinese aircraft workmanship has apparently risen. Indeed, the certification by the U.S. Federal Aviation Administration of Chinese-manufactured components for McDonnell-Douglas aircraft, including fuselages and nose cones, for sale in the United States would seem to suggest that the Chinese work force at SAIC is now capable of meeting Western commercial standards. Because Western commercial standards are more stringent than previous Chinese specifications, the overall level of Chinese quality control, at least at this facility, would appear to have improved.

At the same time, Chinese combat aircraft are now reported to have a much smoother surface, or skin, than before.[29] This suggests that there is a flow of personnel and expertise from civilian to military production lines, at least in situations where the former had become more advanced than the latter. Such a flow would amount to "spin-on" of (relatively) more advanced techniques and capabilities from the commercial to the military side.

The Chinese modernization program currently focuses on the acquisition of more-advanced foreign weapons technology, such as the Su-27 fighter. Right now, these efforts do not involve any

[28] R. J. Latham and K.W. Allen, "Defense Reform in China: The PLA Air Force," *Problems of Communism*, p. 46, May-June 1991.

[29] Professor P. Godwin, National Defense University, Washington, DC, personal communication, March 1994.

Chinese manufacturing, nor have the most recent acquisitions yet led to either production of reverse-engineered equipment or purchase of production facilities. Mastering the production of such equipment, by either method, will undoubtedly take several years. Because current Chinese efforts are aimed at producing much more sophisticated equipment, with higher tolerances, than the country had previously manufactured, it is likely that better quality control will be necessary. If requirements exceed current Chinese standards, new specifications, essentially military specifications and military standards, may be necessary.

Militarily Unique Technologies

Another obstacle to U.S. civil-military integration involves militarily unique technologies, which necessarily limit the degree of commonality between commercial and military goods and services. Although militarily unique technologies usually have no direct civilian applications in the United States (e.g., ballistic missiles and electronic warfare programming), in the PRC military technologies have tended to be rendered "unique" because certain resources have been in limited supply. That is, the PLA had priority for receiving many of the more advanced and expensive technologies and facilities (e.g., computers and wind tunnels) until Deng Xiaoping's economic liberalization raised the Chinese CTIB's status. It is likely, for example, that the Chinese air-defense network has a more advanced set of air-traffic-control capabilities than does the Chinese civilian air-traffic net.[30] Similarly, until the liberalization program commenced, one-half to two-thirds, if not more, of all Chinese-produced electronics were dedicated to military use.[31]

The decision to promote defense-industrial participation in the commercial market, however, would suggest that those items and qualities once reserved for the PLA, such as high-quality steel and better-trained workers, may now be seeping into the CTIB. Even now, however, the MMBs have sole control over many areas of Chinese technology that were once primarily military. Thus, the means of producing communications equipment remain concentrated in the hands of the DTIB, although the products are being dispersed into the CTIB at large. The arrival of Western telecommunications corporations in China may alter that situation further in the coming decade, although Chinese demands for co-production suggest that the MMBs may retain a large degree of control over any technologies and processes transferred from the West.

Emphasis on Military Performance

Since the beginning of the Cold War, the United States has placed a greater emphasis on military-product performance than on cost, whereas in the commercial sector, quality and performance were balanced against the likely costs incurred. The emphasis on high performance not only raised costs, but in some cases, minimized the commonality between functionally similar military and commercial goods.

In the PRC, significant effort does not seem to have been made to acquire or develop state-of-the-art weapons technologies. This is due, in part, to the relatively primitive state of the Chinese DTIB and, in part, to political and bureaucratic pressures, particularly within the MMBs. As a result, despite the Chinese DTIB's favored status compared with the Chinese CTIB's, for high-quality raw materials and tools, Chinese defense products have generally not been significantly more advanced than products of the Chinese CTIB as a whole, particularly in such areas as electronics and communications. According to one Chinese assessment, "In the realm of firepower and control

[30] Chinese aviation officials noted in conversations that only one Chinese civilian airport has the more advanced Type 2 instrument landing rules (ILR) equipment. All others are equipped with only Type 1 ILR equipment. December 1993.

[31] D. Shambaugh, op. cit., footnote 8, p. 58.

systems, the Chinese fighters are lagging some 15 years behind advanced foreign levels."[32] The electronics in the most sophisticated domestically produced fighter aircraft, the J-8II, are comparable to American 1970s-level technology. Although the DTIB has tended to have priority for receiving higher-quality items (e.g., higher-quality machine tools), the quantities available have been so limited that they have had little effect on the overall quality of the DTIB, much less the CTIB.

The situation has been exacerbated by the PLA's own lack of interest in technologically advanced weapon systems. Only relatively recently has the PLA leadership demanded access to high-tech weaponry and advanced capabilities for its nonnuclear forces. These demands were then rapidly preempted by the Four Modernizations. As a result, it is only in the past four years that the PLA has had both the interest in and the wherewithal to obtain more sophisticated weapon systems. These have, in turn, primarily involved acquiring foreign technology. Thus, the Chinese DTIB's state-of-the-art weapon systems still lag behind Russia's, and even further behind the West's.

Integration of Levels of Production

In light of the circumstances enumerated above, what is the degree of integration between the Chinese DTIB and CTIB? As noted earlier, the PLA has played an important role in the economic development of the PRC. Conversely, the PLA also relies on the civilian infrastructure. The Chinese military, for example, evidently continues to use the national communications network, including the telephone system, microwave radio, telex, and multiplex wireless.[33] The PLA's Tibetan garrison is supported by China Southwest Airlines, which has ferried rotating formations of troops in and out of the region.[34] Thus, at a minimum, it appears that the Chinese military and popular economies are closely linked.

With economic liberalization, however, the additional impetus of making money has arisen, pushing all the ministries, corporations, and subsidiaries into seeking and exploiting commercial opportunities. Consequently, the output of civilian goods made on military production lines has risen sharply since economic liberalization began in the late 1970s and early 1980s. Indeed, according to some estimates, "profits generated in 1992 by more than 20,000 military-run companies [alone] totaled around 30 billion yuan [renminbi]—. . . with just six billion yuan given to the central military authorities."[35] The result has been a form of integration at all three levels (sector, firm, and facility; see box A). The Chinese version of integration, however, does not necessarily correspond with that in the United States.

Sector Level

At the sector level, most industrial sectors are integrated, insofar as they are involved in both military and commercial R&D, production, and operations and maintenance (O&M). The Chinese have emphasized the exploitation of their defense R&D facilities and resources in pursuit of overall national economic growth. One government effort aimed at facilitating this shift is the Torch Program, which promotes the shift of scientists and engineers from traditional research institutes and projects to those with greater commercial potential.[36]

The PLA itself is pressuring such centrally directed programs to promote R&D in a more commercial direction. In particular, given the semiau-

[32]Zhang Yongqian, "Brief Look at China's Fighter Aircraft Development Level," *Xiandai Bingqi* [Beijing], Oct. 10, 1993, in JPRS 94-008, Jan. 31, 1994, p. 21.

[33]D. Shambaugh, op. cit., footnote 8, p. 60.

[34]"Making a Modern Industry," *Jane's Defence Weekly*, Feb. 19, 1994, p.27.

[35]"Balancing the Books," *Jane's Defence Weekly*, Feb. 19, 1994, p.35.

[36]R.D. Humble, "Science, Technology and China's Defence Industrial Base," *Jane's Intelligence Review*, January 1992, p. 8.

tonomous nature of many PLA units, there is an almost grass-roots quality to some of the PLA's R&D projects, which tend to emphasize commercially profitable ventures. Thus, the *Liberation Army Daily* reported on an "All-Army Enterprise Scientific and Technological Research Achievements Fair" in Beijing. At the fair, over 2,000 projects and experiments, few of which were for military customers, were displayed.[37]

In the heavy-industry sectors, it is reported that 68.8 percent of the output from Ministry of Ordnance Industry facilities and 80 percent of shipbuilding and repair activities are now for nonmilitary use.[38] In Chinese shipbuilding, integration of the military and commercial sides is quite explicit: the China State Shipbuilding Corp. owns all Chinese shipyards and shipbuilding and marine-equipment firms.[39] Thus, shipyards that once built warships are now turning their expertise and facilities to the construction of freighters and other vessels for commercial purposes.[40] Similarly, in the automotive sector, NORINCO, the largest Chinese arms corporation, which produces much of the PLA's heavy equipment including tanks and self-propelled guns, is also responsible for some 50 percent of Chinese motorcycle production and 30 percent of all minivans.[41] In fact, three-quarters of all minivans now apparently come from military sources.[42]

In the area of O&M the Chinese also appear to have achieved some degree of integration. Once equipment is procured, its upkeep becomes the responsibility of the PLA's GLD. Although the GLD controls a few depot-level maintenance facilities, primarily for heavy vehicles, there is no analogue in the PRC to the extensive depot structure that provides O&M support in the U.S. Instead, maintenance is primarily the province of the "owning" formation, or PLA unit. Extensive repair operations, particularly for aircraft and naval vessels, apparently involve the manufacturers (in the case of shipbuilding, the manufacturers control the primary shipbuilding and repair facilities).

Although the Chinese appear to have succeeded in integrating many of their sectors, it also appears that few of the lessons they have learned are transferable to the United States. Chinese efforts at the sector level exploit what are, at best, limited technologies and capabilities within the Chinese science-and-technology infrastructure. The Chinese themselves recognize this. In a recent article in *Xiandai Bingqi* (*Modern Weaponry*) assessing the newest domestically produced fighter plane, the author notes that "China's manufacturing technology was exceedingly backward; their stock of relevant technology was obviously inadequate, and this had a direct impact on model development."[43] The Chinese consider the attainment of international standards of sophistication in such areas as aerospace as a triumph in and of itself.[44] The levels of military and commercial tech-

[37] Nie Zhonglin and Ma Chunlin, "First All-Army Enterprise Scientific and Technological Research Achievements Fair Opens in Beijing," *Jiefangjun Bao* (Oct. 19, 1993), p. 1, in Foreign Broadcast Information Service China daily report (hereafter FBIS-CHI) 93-211, Nov. 3, 1993, p. 40.

[38] D.J. Blasko, "Beijing's Big Bang," *Far Eastern Economic Review*, 157(8):37, 1994.

[39] R.D. Humble, op. cit., footnote 36, p. 6.

[40] Cao Huanrong and Jia Yong, Xinhua (Dec. 6, 1993), in FBIS-CHI 93-239 (Dec. 15, 1993), p. 27.

[41] Tai Ming Cheung, op. cit., footnote 24, p. 40.

[42] Cao Huangrong and Jia Yong, op. cit., footnote 40, p. 27.

[43] Zhang Yongqian, op. cit., footnote 32, p. 20.

[44] See, for example, Sun Mao-qing, "Air Force Test Base Advances to World Rank," *Renmin Ribao* (June 10, 1993), p. 3, in JPRS 93-014 (Aug. 17, 1993), p. 12, and Chang Ko, "China's Largest Drone Base," *Kuang Chiao Ching* (Hong Kong) 254 (16) Nov. 1993, in FBIS-CHI 93-221 (Nov. 18, 1993), p. 46.

nological sophistication in the PRC, for the most part, are below the global average. In only a few areas are the Chinese even maintaining parity.

The limited applicability of the Chinese situation to the American case is made more so by the very different nature of Chinese economic organization. Even after a decade of economic reform and liberalization, the state continues to own and manage the "commanding heights" of the Chinese economy, particularly heavy industry. The MMBs even now effectively exercise control over their respective sectors (e.g., shipbuilding, steel making, and electronics), a situation exploited by their subsidiaries. Each sector is, therefore, integrated, but only because the government controls virtually all production, both commercial and military, in that sector. Integration under such circumstances is more akin to consolidation of the means of production and diversification of products than to the sharing of product and process technologies that is typical of Western efforts. The Chinese approach to integration, involving the participation of the relevant ministries and their attendant corporations, is, therefore, probably unique to command economies and of limited relevance to capitalist ones.

Finally, the Chinese did not necessarily set out to integrate their CTIB and DTIB. Instead, in many cases, they are seeking to develop capitalist economic relations. A report from Shaanxi Province, for example, argues that the infrastructure for "science, technology and industry for national defense" within Shaanxi should be devoted to helping fulfill the "Shaanxi people's wishes to get rich." Indeed, the article goes so far as to suggest that the military industry should be eliminated in favor of national production of "high-technology products and export-oriented management."[45] The profits thus derived, presumably, would be allocated first to Shaanxi and only then to the rest of the nation. Similarly, factories in Guizhou Province appear geared toward provincial rather than national markets.[46]

Firm Level

At the firm level, the Chinese also appear to have become "integrated," or at least diversified. The Shanghai Aircraft Industry Corp., for example, sells everything from automobile jacks to pressurized tanks to refrigerators.[47] Discussions with COSTIND officials about their subordinate industries revealed a product line that included ships and cigarette-manufacturing machines at many corporations. Similarly, much of the Chinese chemical industry's pumps and seals are made by the Chinese Space Industry Corp. because it is accustomed to dealing with highly corrosive chemicals. By 1989, only 10 percent of defense firms remained committed solely to defense production; 16 percent produced only commercial products, and the remaining 74 percent produced both commercial and military products.[48]

As with sector-level integration, however, Chinese examples of firm-level integration may not be comparable to those in the West. In particular, if only firms that are actually profitable are considered successful examples of firm-level integration, there appear to have been more failures than successes. The efficient allocation of the available technological and human resources, however, appears to be only one of the PRC's criteria for successful integration.

Another important criterion for the PRC appears to be the preservation of jobs and, to a lesser degree, of industrial infrastructure, wherever possible. This is very different from Western integration efforts, which almost inevitably involve plant closings and increased unemployment. A high

[45] Zhang Ke, "Roundup," Zhongguo Xinwen She (Sept. 12, 1993), in FBIS-CHI 93-183 (Sept. 23, 1993), p. 39.

[46] Liang Fang, *Beijing Review* (41) Oct. 11-17, 1993, in FBIS-CHI 93-202 (Oct. 21, 1993), p. 36.

[47] Officials of the Shanghai Aircraft Industry Corporation, Shanghai, personal communication, December 1993.

[48] A.J. Alexander, op cit., footnote 24, p. 21.

priority for Chinese authorities appears to be to retain workers and keep equipment employed. As a result, for example, certain enterprises that have been unable to find a suitable product to manufacture have contracted their work force to highway construction and other projects.[49] Similarly, the Chinese DTIB has diverted several tens of thousands of technical facilities to light industry, including the petrol chemistry, chemical fertilizer, and chemical fiber industries.[50]

Although such reallocation has kept plants and personnel occupied, it has come at a price. In particular, there are few good measures of the extent to which the plants and personnel that are converted to commercial production are efficiently used. It is reported, for example, that perhaps no more than one-third of the military industry's capacity is being used efficiently, despite strenuous efforts.[51] More disappointing to the central authorities, only about half of Chinese defense firms have succeeded in manufacturing civilian goods at acceptable prices.[52] Thus, according to one report, "two-thirds of all aerospace enterprises are unable either to produce any marketable civilian products or compete in the civilian market without state subsidies."[53] These firms, however, apparently remain in business regardless of whether they are suceeding in actually producing marketable products.

The low efficiency of some Chinese plants and personnel is due to their location. As noted earlier, many of China's largest defense-industrial facilities (and many smaller ones) are located in the relatively remote interior, constituting the so-called "third line" of production from the days of the "People's War" doctrine. As a result, getting goods to market is, at best, difficult, and getting access to raw materials, in a commercialized economy, is problematic. Corporations that rely on such facilities, therefore, are faced with a daunting task from the outset. Although they may be able to keep their doors open (thanks to subsidies from various governmental sources), that does not necessarily mean that their products are commercially viable. Indeed, it may well be that subsidies are as important as products in ensuring the continued utilization of Chinese DTIB resources and labor. There are indications that at least some production is being shifted away from inland locations closer to transportation links. In some cases, entire plants are being moved.[54]

Facility Level

The prospect of finding relevant lessons for the West in the PRC's conversion and integration experiences may be the most promising at the facility level. Chinese military factories reputedly produce commercial and military goods side by side on the same lines. The production of equipment that varies primarily in the coat of paint applied is the epitome of integration. Chinese military-vehicle factories have in some cases, for example, simply changed the colors available for the commercial market. Thus, Chinese command cars, resembling jeeps, may now be found in both civilian and military livery on the streets of Beijing. Chinese-produced motorcycles, once intended for military dispatch riders, are now provided primarily to the civilian motorcycle market.[55]

At a somewhat higher technological level, some Chinese aerospace products are also reportedly produced in an integrated manner. The Y-7,

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[49]Liang Fang, op cit., footnote 46, p. 35.

[50]*China Today,* op. cit., footnote 19, p. 163.

[51]"Making a Modern Industry," p. 29.

[52]Tai Ming Cheung, op. cit., footnote 24, pp. 40-41.

[53]Ibid., p. 42.

[54]Liang Fang, op. cit., footnote 46, pp. 35-36.

[55]C. Hollingworth, "China's Arms Industry," *NATO's Sixteen Nations* 32 (2): 52, 1987.

the Chinese version of the AN-24 turboprop transport aircraft, has been part of both the PLA Air Force and Chinese commercial flight lines since the early 1970s.[56] The Y-8 military transport is reportedly now also available as a civilian aircraft. Similarly, the Harbin Aircraft Manufacturing Corporation produces the Z-9, a modified version of the Aerospatiale AS365. This aircraft is provided not only to the Chinese military, but also to the "government forestry service, and state-owned general aviation and offshore oil support companies."[57]

The roots of this situation, however, are again significantly different from those in the West. The Chinese commercial market has long been suppressed. A primary reason for the success of the Chinese conversion effort has been the desperate demand for consumer goods. Chinese defense plants that engaged in commercial production benefited further by the absence of competition, at least in the initial stages. Indeed, the combination of monopolistic control in various sectors, the absence of competitors, and large markets creates a commercial situation markedly different from that of any capitalist economy.

Most Chinese facilities have not achieved integration as defined by the West, however. Indeed, many of the products from the various MMBs are not derived from defense products or even from defense production lines. At least during the initial conversion process, Chinese defense facilities "produced whatever they could lay their hands on, such as electric fans and blankets, meat grinders, kitchen utensils, and even desks and chairs. Most of the products were low-quality, low-grade items with little output value."[58] Even now, much of the product line of the Ministry of Ordnance is composed of civilian products made at facilities owned by the Ministry but using different equipment from that used for defense production. Although such arrangements keep facilities and workers engaged and may constitute successful examples of *conversion*, they are not examples of *integration*. There is little use of common technologies and equipment to meet both defense and commercial needs; instead, available personnel and, to a certain extent, common facilities are used to meet commercial demands.

JAPAN

While the PRC has focused primarily on defense production for much of its postwar history, Japan has followed an almost opposite course. At the end of World War II, the United States and the other occupying powers moved to ensure that Japan had no DTIB. They sought to dismantle the remaining Japanese aircraft and shipbuilding industries to prevent the country from becoming a threat to the region again.

The Korean War, however, pushed the United States to reconsider its attitude toward Japanese rearmament. Indeed, in 1950 and 1951, John Foster Dulles sought to persuade Japan to rebuild its military as a bulwark against the PRC and the U.S.S.R. Although then-Prime Minister Yoshida resisted this move, he ultimately agreed to the creation of a Japanese military, euphemistically termed the Self Defense Forces (SDF) in light of prohibitions within the American-imposed Japanese constitution against the possession of armed forces.

Although there was little interest in the reestablishment of a military capable of overseas operations, the Japanese government recognized the potential usefulness of a military industry. The Korean War had pumped enormous resources into the Japanese economy. American orders for military-support equipment, including trucks and landing craft, as well as expenditures for O&M

[56] *Jane's All the World's Aircraft, 1989-1990,* J.W.R. Taylor (ed.) (London, England: Jane's Information Group Ltd., 1989), p. 45.

[57] P. Proctor, "Harbin Uses New Helicopter Program to Advance Global Manufacturing Role," *Aviation Week & Space Technology,* Feb. 3, 1992, p. 50.

[58] Liang Fang, op. cit., footnote 46, p. 35.

and for housing troops, had sped Japan's economic recovery. Much of the Japanese automotive industry, for example, was revived by the maintenance and rebuilding of American equipment for the Korean War effort. Thus, Japanese industrialists believed that "military production would be the center of Japanese industrial development."[59]

Unlike the Chinese, or even the United States, however, defense production was not made a priority of the defense authorities. Instead, under the Law for Enterprises Manufacturing Aircraft and the Law for Manufacturing Weapons and Munitions, materiel production was placed under the jurisdiction of the Ministry of International Trade and Industry (MITI). These laws required "private firms to provide detailed information about locations, ownership, type of technology used, capitalization, and more to MITI."[60] MITI's Aircraft and Ordnance Division was effectively granted (and retains) oversight for the production of all aircraft and parts, as well as munitions and weapons. These two laws remain the primary laws specifically concerning defense procurement in Japan.

The Japanese could afford to avoid becoming a major military power, in large part, because of the extension of the American security guarantee. Under the 1960 U.S.-Japan Treaty of Mutual Security, the United States effectively extended a unilateral commitment to Japan's security. This security umbrella allowed the Japanese, in turn, to focus more narrowly on economic development without having to worry too much about military security.

The decision not to become a major military power, however, did not eliminate Japan's interest in developing the ability to produce weapons indigenously. Indeed, with the American decision to begin charging the Japanese for defense products in the 1960s, the Japanese, like the Chinese, pushed hard for local manufacture of most of their equipment to avoid reliance on foreign suppliers. This fear of vulnerability was highlighted by the Japanese drive for *kokusanka*—having domestic systems (i.e., those domestically developed and designed as well as produced) in preference to importing complete weapons. The term *kokusanka* carries with it nationalist overtones, and, according to some observers, is one of the most important elements in Japan's defense-procurement debates.[61]

In addition to bureaucratic and security concerns, Japanese corporations were interested in defense production. Japanese business leaders did not, however, view the Japan Defense Agency (JDA) as simply another market. Rather, the defense budget was considered a means of raising Japanese business's general level of technological expertise. For example, the Japanese Federation of Economic Organizations (*Keidanren*) established the Defense Production Council (DPC), whose "major purpose was to create a better climate of opinion between business and the SDF," in 1965.[62] The DPC was interested in the possibilities of technological innovation within military production, rather than military products per se. Thus, its 900 members numbered few weapons producers.

By the early 1970s, Japanese producers had concluded that commercial technology would be a more vibrant source of technological advancement than military technology. This shift was given additional economic impetus by the formal Japanese enunciation of a policy effectively banning arms exports. With the decision not to allow exports of weapons, any prospect of economies of scale through the focused development of military equipment vanished. To ensure steady revenue, the Japanese defense industry focused on getting

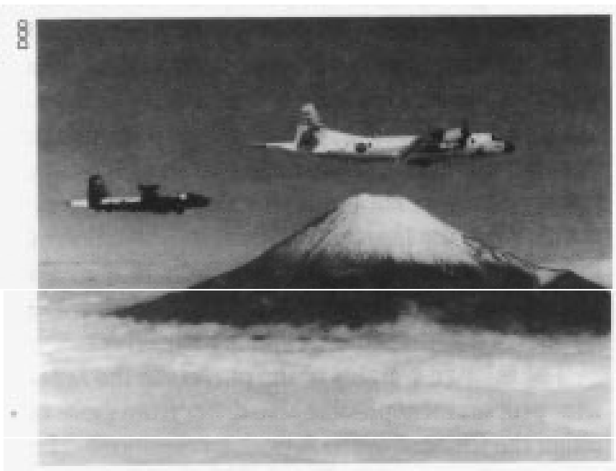
[59]R. J. Samuels, *Rich Nation, Strong Army* (Ithaca, NY: Cornell University Press, 1994), p. 142.

[60]T. Kataoka and R.H. Myers, *Defending An Economic Superpower* (Boulder, CO: Westview Press, 1989), p. 68.

[61]M.W. Chinworth, *Inside Japan's Defense* (New York, NY: Pergamon-Brassey's, 1992), p. 19.

[62]P. Katzenstein and N. Okawara, *Japan's National Security* (Ithaca, NY: Cornell University Press, 1993), p. 74.

long-term commitments from the government, increasing government funding for defense-related R&D, and, perhaps most important, raising the proportion of the content of Japanese military -equipment made domestically. At the same time, elements of the Japanese DTIB were integrated firmly into the CTIB to ensure its continued viability.



The Japanese have license-produced many American weapons, including the P-2J and the P-3C anti-submarine aircraft.

The process of indigenization of Japanese defense production continued apace over the next 20 years. Japanese industry has been very successful in expanding the range of components and systems that are locally produced and used in various weapons. By the 1980s, for example, most Japanese missiles were manufactured indigenously, although many were produced under license. Similarly, the Japanese Maritime Self Defense Force (JMSDF) is almost entirely equipped with locally designed combatants, armed in the main with domestically produced (and often domestically designed) weapon systems. Indeed, in terms of defense products, the Japanese DTIB, like the Chinese DTIB, produces a wide range of land, sea, and air Systems, many analgous to American systerns, as well as military electronics and a space-launch capability. Only in the nuclear weapons arena, in fact, is a Japanese capability entirely absent (although there are few doubts that Japan has the wherewithal to design and build nuclear weapons and delivery systems, or that Japan could convert its civilian nuclear and space programs to military purposes should it choose to do so).

■ Japanese Procurement

The Japanese economy is heavily weighted toward civilian production; defense production is relatively minuscule. Japanese defense spending, for example, since the 1970s has generally been under 1 percent of Japanese gross national product (see figure 1). In the 1970s, Japanese defense industries represented only about 0.5 percent of total Japanese industrial output, and in the mid-1980s, that proportion had increased to about 2.0 percent.[63] Only about 0.1 percent of the total Japanese work force (or about 70,000 workers) is directly employed by Japanese defense industries.[64]

The Japanese corporations engaged in weapons manufacture are not preoccupied with defense work. Indeed, few Japanese defense corporations are entirely dependent on defense contracts for their profits, or even for their income. For most Japanese corporate equivalents of American prime contractors engaged in military work during the 1970s, defense contracts represented less than 10 percent of total earnings. By the 1980s, even after a decade of growth in defense spending, less than 20 percent of the revenue of Japanese firms such as Mitsubishi Heavy Industries (MHI) and Kawasaki Heavy Industries (KHI) originated from JDA contacts. Indeed, no major Japanese corporations are purely, or even primarily, defense-oriented. In the case of MHI, for example,

[63] U.S. Congress, Office of Technology Assessment, *Arming Our Allies: Cooperation and Competition in Defense Technology* (Washington, D.C.: U.S. Government Printing Office, 1990), P. 104, and P. Katzenstein and N. Okawara, op cit., footnote 62, p. 66.

[64] T. Aoki, "Japan's Defence Industry," *Military Technology,* July 1986, p. 49.

defense contracts represent only some 14.3 percent of income.[65] The largest proportion of defense business in any major Japanese corporation is held by Japan Steel Works, and it represented no more than 33 percent of the company's total sales in Japan's fiscal year 1989.[66]

Within such large defense contractors as MHI and KHI, moreover, the defense "exposure" is limited to certain divisions. The defense division within a major Japanese corporation may depend on military sales for up to 90 percent of its sales.[67] The divisions themselves, however, are part of an integrated firm, and the facilities under their control are almost certain to be integrated as well. Thus, although MHI's Shipbuilding & Steel and Aircraft & Special Vehicles divisions are especially exposed to the vagaries of defense budgeting, their total revenue represents less than half of the company's income (and not all of the contracts in either division stem entirely from the JDA).[68] The company as a whole remains broad-based.

The Japanese DTIB is not as central to the national economy as is the Chinese DTIB, and the Japanese approach to arms procurement is different from that of the United States. In the United States, there is an emphasis on cutting-edge military performance, sometimes imposing very high costs. In Japan, on the other hand, some analysts have indicated that military roles and missions have been secondary to other considerations.[69] The Japanese focus is not necessarily on the production of the most advanced weaponry per se, nor even on the fielding of superior defense technology. Rather, the Japanese procurement process treats production of defense equipment as an adjunct to the civilian economy. Some observers suggest that defense production serves as a stable consumer base for new products, a means of gaining (and disbursing) R&D money, and a means of developing advanced technologies and capabilities. Unlike the United States, Japan has chosen to forego the marginal additional cutting-edge performance in order to preserve an up-and-running indigenous base.

Although Japanese weapon systems often contain extremely advanced products (e.g., advanced radar technologies and new composites), the weapons themselves are not necessarily as capable or as advanced as those of their American counterparts. Thus, it has been said that "the JDA fields neither technology nor weapons, but products."[70] For the Japanese, initiating production of given products or spurring research in a given technology is as important a reason to develop weapon systems as the weapons themselves.

The relative weights of the players in the Japanese procurement process also differ from those in either the Chinese or the American situations. The primary characters are JDA, MITI, the Ministry of Finance (MOF), and the Japanese defense manufacturers.

JDA, unlike the Chinese PLA or the American DOD, is the weakest of the players. Unlike MITI or MOF, JDA is not a full-fledged ministry. Rather, it is an agency, a part of the Prime Minister's Office. Not only is it of lower bureaucratic standing, therefore, but it has less control over its own fate than do full ministries. Thus, of the 10 bureaucratic appointments to JDA, at least four are assigned from other ministries. This situation is the result of a deliberate effort to ensure continued civilian control and to underscore the relative unim-

[65] P. Finnegan, "U.S., Europe Part Paths on Defense Challenges," *Defense News*, p. 6, July 20, 1992.

[66] "A Basis for New Growth," *Jane's Defence Weekly*, Aug. 17, 1991, p. 283.

[67] Fujii, "End to Long-Term Stable Growth—Defense Industry at Crossroads," *Nihon Keizai Shimbun*, morning ed., June 25, 1991, p. 13., in FBIS-EAS 91-126-A (July 1, 1991), p. 6.

[68] "Analysis: Mitsubishi Heavy Industries," *Jane's Defence Weekly*, Nov. 18, 1989, p. 1128.

[69] R. Samuels, op. cit., footnote 59, p. 170.

[70] M. Chinworth, op. cit., footnote 61, p. 47.

portance of the military in postwar Japan. It has also meant in many cases, however, that considerations of technological development or commercial opportunity have had more influence on procurement decisions than they have in the American system (see figure 3).

The definition of JDA's strategies and mission is coordinated by the Policy Bureau, which is as likely to be headed by an official of the police as of MOF. The staff departments of the three services (Air, Ground, and Maritime Self Defense Forces) then draw up their budget requests in relation to the guidance promulgated by the Policy Bureau. These requests are then forwarded to the Defense, Equipment, and Finance Bureaus. The latter two bureaus are headed permanently by officials assigned from MITI and MOF, respectively, while the Defense Bureau is headed by a JDA official. The Equipment Bureau determines whether a given product will be produced domestically or purchased abroad, and the Finance Bureau judges all requests relative to JDA budgets. The respective bureau heads often have no background in defense per se, so they are more likely to view requests from their own bureaucratic perspective, rather than from JDA's (although they do coordinate with the Policy Bureau).

In the budget-formulation phase, MITI provides its input. MITI has tended to concentrate on technological development, rather than on defense per se. Its decisions in this regard are informed by its close links with the defense contractors. These links are, in part, formed by its Aircraft and Ordnance Division, which keeps MITI informed about the current capabilities of the Japanese DTIB. MITI is further assisted by various Japanese industrial associations, including the Japan Defense Industry Association (sponsored by JDA and MITI) and the Japanese Aircraft and Space Industry Association (under the jurisdiction of MITI).

MITI is also kept informed of developments and attitudes within the Japanese DTIB by the *Keidanren*, especially the DPC, which continues to advocate essentially the same policies it has pursued since its inception. Since 1989, the DPC has spoken with the full authority of the *Keidanren*. MITI's interests in the defense area are aligned with those of the *Keidanren*, and particularly the DPC's—namely, development of advanced, dual-use technologies assisted by defense production and research. MITI and *Keidanren* are also interested in preserving a viable production base.

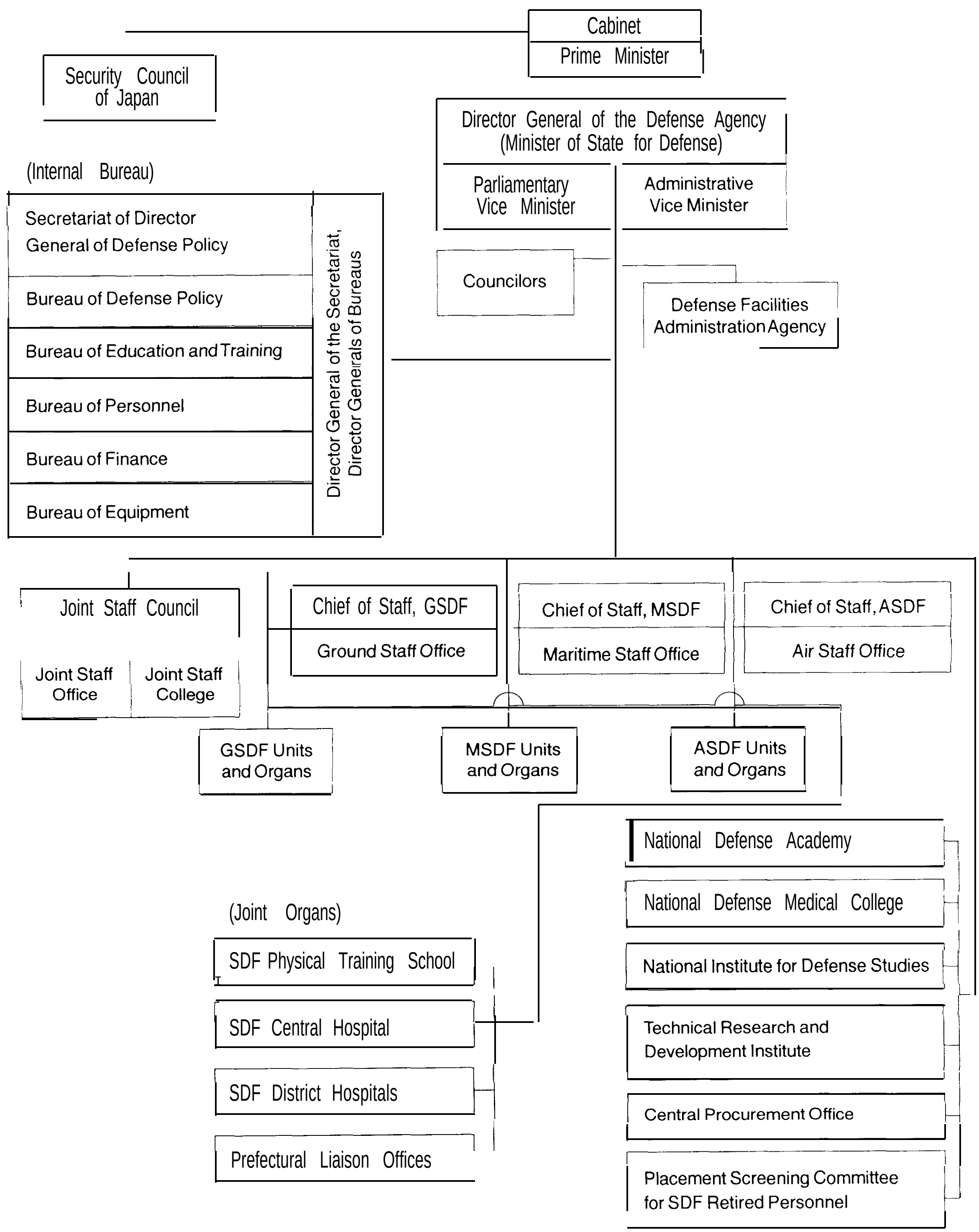
After the resulting differences are resolved within JDA, the requests are forwarded to MOF. The Ministry has generally pursued a hard line on defense requests, seeking to keep defense expenditures at a minimum. When MoF and the other relevant agencies have resolved their differences, the JDA budget is then forwarded as part of the Government Budget Proposal to the Diet and is generally approved without much subsequent comment. The JDA budget is then administered by the Central Procurement Office (CPO).

In the course of this process, Japanese defense efforts appear to be aimed at several goals. One is the development of technologies, with a particular emphasis on domestic production. Another is the preservation of a viable defense base per se, and a third is the development of equipment for JDA. To support these goals, the Japanese have sought maximum leverage from the resources committed to the DTIB and the CTIB by integrating the two as much as possible. These efforts have been facilitated by government policies and corporate structures that draw few distinctions between commercial and defense efforts, particularly at the component and subsystem levels.

Comparison of Japan with the United States

The Japanese have clearly undertaken a very different approach toward the defense-acquisition process than either their Chinese or their American counterparts. This is due, in part, to the relatively unique Japanese defense situation. Japanese defense considerations, for the most part, are dominated by the United States. Japanese forces need only concern themselves with self-defense in the most local sense, that is, defense of the Home Islands. Even that role is supported by significant U.S. forces. In the nuclear arena, for example, the

FIGURE 3: Organization of the Japan Defense Agency and Self-Defense Forces



SOURCE Japan Defense Agency, *Defense Of Japan, 1993*, 1993

Japanese are wholly dependent on American forces. Similarly, Japan relies on the United States for guarding Japan's sea lines and for some logistical support.

Japan's approach toward its arms industry is reinforced by the international situation around Japan. Few states directly threaten the Home Islands. Although the post-World War II era had seen both Beijing and Moscow characterized as the primary threats to Japanese sovereignty, this was in the context of the ideological confrontation of the Cold War. Even then, in neither case was there likely to be an invasion of the Home Islands, at least absent a wider, global conflict. With the passing of the Cold War, even the nominal threats posed by the Soviet Union and the PRC have receded.

Japanese planners have had the luxury of focusing primarily on economic, rather than defense, concerns. They have been able to make actual warfighting capabilities a lower priority than building a technological and industrial base that strengthens the economy and ensures the existence of a defense base. This approach has been reinforced by the development of very strong links between Japan's corporate and government segments. The Japanese DTIB has, therefore, avoided some of the aspects of segregation that hinder the American DTIB.

Acquisition Laws and Procedures

The United States and Japan have developed different bodies of acquisition law. The United States has sought to ensure accountability of defense dollars through extensive, and often unique, accounting requirements. These regulations, in many cases the consequences of past efforts to limit waste, fraud, and abuse, frequently impose a criminal penalty for failure to delineate and abide by the separation of commercial and defense investments, equipment purchases, and other expenditures. As a result, they serve to segregate the DTIB and CTIB by imposing on defense firms additional costs for doing business.

Japan has taken a different approach. Although the Japanese government has nominally insisted on separating defense and commercial projects within corporations, the barriers between the two elements are often very porous. This situation has been possible, in part, because of the intimate relationship between Japanese government and Japanese industry. Indeed, the greatest example of Japanese integration involves the interaction between the public and private sectors, rather than between the DTIB and CTIB.

In some cases, JDA (with the acquiescence of MITI and MOF) actually purchases items to foster the development of aspects of a given industry. Thus, for example, the National Defense Academy commissioned a "shock wind tunnel" from Ishikawajima-Harima Heavy Industries (IHI) for testing ultra-hypersonic vehicles at high Mach numbers. The tunnel has been useful both in developing Japanese space launch vehicles and, for IHI, in obtaining valuable experience in developing basic technologies.[71] This experience will presumably benefit IHI's commercial as much as its military business.

Such cooperation is also evident in JDA-funded R&D. Although JDA funding is supposed to be restricted to military-related items, it often is not. As a recent director-general of JDA's Technical Research and Development Institute (TRDI) acknowledged, "We tend to let the firm . . . use the information and technology as they wish. Sometimes firms will use the jigs and test equipment provided by our funding at the production stage (or for other activities), but it is not usually so easy to do this."[72]

Another example of close Japanese corporate-government relations involves production contracts. By value, 85 percent of Japanese procurement contracts are sole-source awards. Another 14 percent is awarded through limited competi-

[71] *IHI Engineering Review,* April 1993, in JPRS-JST-93-070-L, Sept. 13, 1993, p. 42.

[72] R. Samuels, op. cit., footnote 59, p. 194.

tion, in which all the designated companies usually win some portion of the final production runs. Only 0.21 percent, by value, of contracts are awarded in unrestricted competition.[73]

With both sole-source and limited competition, prices and bids can be based on market costs when comparable products are available from which cost data can be drawn. In light of the pervasiveness of dual-use technology in the Japanese DTIB and CTIB and the relative separation of R&D from production in the costing phase, it is not surprising that procurement contracts based on market costs are possible even in instances where the contract is for a military program. When there is no commercial cost counterpart, the contracts have a profit margin that peaks at 6.5 to 10 percent, and costs are calculated on a cost-plus basis in which a combination of elements is used. These include:

- materials costs,
- direct labor costs,
- other direct costs,
- indirect manufacturing costs,
- general managerial and sales expenses,
- direct sales costs,
- interest payments,
- profits,
- packing costs, and
- transportation costs.[74]

The Japanese do not require extensive, separate, special documentation of costs incurred for any of these procurement contracts. Rather, they apparently rely on "generally accepted accounting practices" or on Japanese cost-accounting standards. Moreover, the Japanese Central Procurement Office follows a very liberal depreciation policy, which includes a tendency to allow accelerated depreciation on facilities involved in the production of defense-related items even when those facilities may also be involved in production of the same items for commercial purposes. Production contracts nonetheless apparently offer one means for the DTIB to recoup costs incurred by R&D.

Despite the opportunities offered by defense production contracts, competition for them by Japanese corporations is not necessarily cutthroat. As one Japanese executive noted, the Japanese and American approaches toward awarding prime contractorship are very different. In the Japanese case, "Battles between businesses to win [production] contracts are almost unheard of."[75] This is hardly surprising because defense contracts are almost never awarded in a "winner-take-all" fashion. "Even firms losing out on bids as prime contractors for major programs often end up with a significant piece of business as subcontractors," according to one analyst.[76] Because these contracts tend to be for extended periods of time, even the loser is likely to recoup initial investments.

Another difference between Japanese and American acquisition procedures, which allows greater integration in the Japanese case, involves Japanese R&D. Unlike in the United States, the primary source of JDA power is through the allocation of R&D, rather than production, contracts. Administered by TRDI, R&D contract awards are directly related to weapons-production contracts; winning the former almost guarantees the latter, if the weapon system is approved for purchase. Thus, the most intense competition in the Japanese DTIB is usually for R&D contracts. As with production contracts, however, JDA "often designates a few firms to submit proposals at the development stage for new projects." (See figure 4).[77]

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[73] M. Chinworth, op. cit., footnote 61, p. 56.

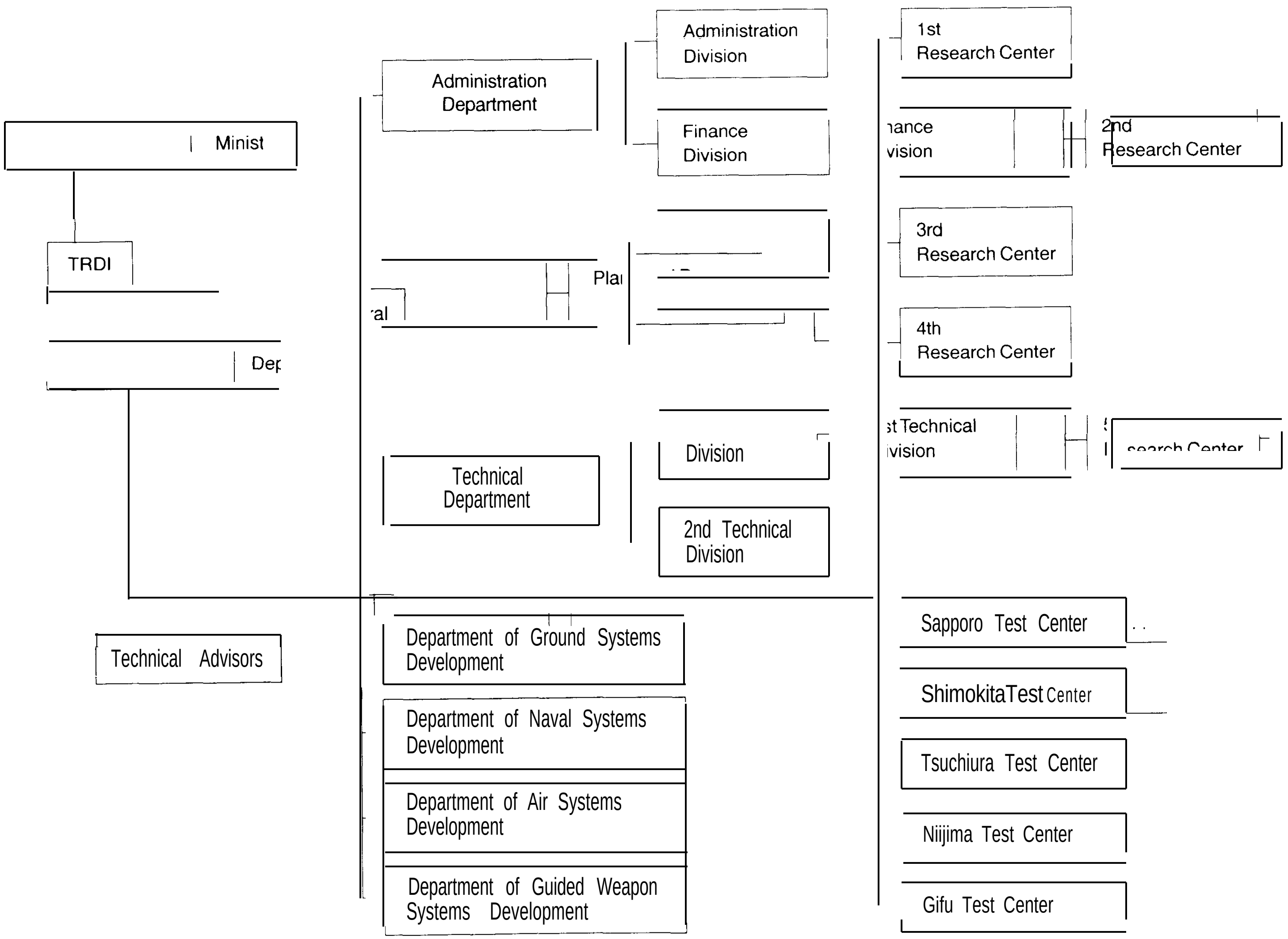
[74] M. Chinworth, op. cit., footnote 61, pp. 55-56.

[75] "In Self Defense," *Business Tokyo,* February 1988, p. 52.

[76] M. Chinworth, op. cit., footnote 61, p. 57.

[77] A. Alexander, *Of Tanks and Toyotas: An Assessment of Japan's Defense Industry,* RAND Report N-3542-AF (Santa Monica, CA: RAND, 1993), p. 20.

FIGURE 4: Organization of the Technical Research and Development Institute



SOURCE: Japan Defense Agency 1993

These R&D contracts, however, only rarely cover the entire cost of R&D; they represent seed money. An R&D contract is usually targeted on a given area of interest, such as electronics or aerospace. For JDA, this provides an opportunity to exert some influence over what technologies are explored and developed, with more of an emphasis on militarily useful capabilities. For MITI and other elements of the Japanese DTIB and CTIB, though, the emphasis is on developing dual-use, high-level technologies, with an emphasis on commercially remunerative possibilities. Thus, in contrast to the United States, "TRDI focuses on basic research and development up to prototype stage whereas the private sector either continues the R&D process up to production or is involved in deriving a military application from civilian technology."[78] The objective with defense contracts in both R&D and production is as much to establish a technological niche or a production line for eventual supply of the Japanese CTIB (and beyond) as it is to produce for JDA. Japanese firms have a correspondingly greater interest in seeking out commercial applications for products and processes than do their American counterparts.

Japanese firms are aided in developing commercial applications for technologies by Tokyo's acquisition and accounting policies, particularly in the area of technical data rights. Although some acquisition regulations are nominally counterparts of the American Federal Acquisition Regulations (FAR), several analysts have noted that there are few restrictions, either imposed by the government or by corporations, on the flow of information and personnel between divisions within a company. Although all data and patents produced from government-funded research are nominally the property of the Japanese government, they are almost always left in the hands of the developing corporation. Indeed, unlike MITI, JDA does not attempt to determine the state of a given contractor's technological base in order to determine JDA's portion of ownership. In fact, TRDI alone has less than one-quarter of nearly 2,000 patent applications resulting from TRDI-supported research. In many cases, firms will not even inform JDA of potential commercial applications resulting from TRDI-sponsored or -supported research, nor does JDA try to determine what the applications could be.[79]

The Japanese accounting requirements appear to have exerted far fewer pressures on segregating their DTIB from their CTIB than have the American requirements on segregating the U.S. DTIB and CTIB. In the area of data rights in Japan, it appears that there has, in fact, been significant commingling of R&D resources and personnel at the workbench level. Toward this end, **JDA has not pursued ownership of technical and intellectual information, even in cases where it has helped fund development**. Instead, it has allowed the corporations to profit from both the development of such technologies and their subsequent sales. This approach is similar in some respects to the kind of industrial-government cooperation currently sought in the United States by the Department of Energy, the Advanced Research Projects Agency, and the National Institute of Standards and Technology.[80]

Military Specifications and Standards

Military specifications and standards also appear to be less of a barrier to integration in Japan than in the United States. For the Japanese, the primary concern is with the product itself, rather than with

[78] R. Drifte, *Arms Production in Japan* (Boulder, CO: Westview Press, 1985), p. 35.

[79] R. Samuels, op. cit., footnote 59, p. 194.

[80] For further discussion of American efforts such as the Cooperative Research and Development Program and the Advanced Technology Program, see U.S. Congress, Office of Technology Assessment, *Assessing the Potential for Civil-Military Integration: Technologies, Processes, and Practices,* op.cit., footnote 1.

the means of its production. Japan has therefore not developed an extensive body of military specifications and standards dictating how defense goods and services are produced. Rather than creating a separate set of military specifications, JDA is apparently comfortable with using the standards promulgated by the International Organization of Standards and will accept them or compliance with DOD military specifications and standards as sufficient.[81]

The Japanese have often succeeded in producing American-designed equipment to American standards even though they have not specified precisely how that equipment is to be produced. Of course, having a previously established standard rather than a domestically set one maybe a factor in obviating the need for a domestic military specification. It may also be, however, that Japanese quality control on the civilian side is sufficient to fulfill military requirements, at least for some technologies, products, and services. Japanese carbon-fiber composites manufactured by Toray, for example, appear to meet both commercial and military requirements. The composites are produced on a single line, according to one observer, "without distinguishing commercial from military applications. Only quality assurance procedures are different."[82] This is apparently true for much of the Japanese DTIB: separate testing and quality-control facilities but common production lines for commercial and military goods and services.

The Japanese Maritime Self Defense Force's ships are built to domestic designs.

Militarily Unique Technologies

The Japanese have little interest in militarily unique technologies. They have chosen instead to emphasize the development of more dual-use-capable technologies. The financial incentives are certainly weighted in that direction, particularly in light of the Japanese ban on exporting weapon systems. At the same time, Japanese definitions of militarily unique technologies seem to be fairly narrow, that is, the Japanese do not consider many technologies to be militarily unique.

For Japan, pursuing technologies that have both military and commercial uses makes greater financial sense than pursuing technologies that are primarily military in application. In the absence of a major military establishment, development of militarily unique technologies would impose prohibitively high costs. Avoiding excessive development of militarily unique technologies also benefits commercial establishments because there are fewer barriers between commercial and defense contracts. Defense contracts may, therefore, serve to tide corporations over during lulls in commercial demand. Available facilities and work forces in the Japanese shipbuilding industry, for example, have been kept busy with JMSDF orders when their order books have not been filled by commercial demand.

Finally, the Japanese perspective that there are few militarily unique technologies, coupled with the structure of government subsidies of military technological research, allows Japan to use weapons research programs as one way to provide experience in important areas, such as systems integration, or to provide an initial demand for

[81] C. M. Aquino and C. D. Vollmer, *Japan's Defense Market,* UP001RDI (Logistics Management Institute Report), p. 20.

[82] R.J. Samuels, op. cit., footnote 59, p. 306.

future commercial technologies, as with gallium-arsenide chips. Both of these considerations were motivating factors for Japan's FS-X and various missile programs. In the view of some analysts, disseminating the subsequent experiences gained from such programs through both the commercial and defense sectors is facilitated by the interlocking structure of Japanese conglomerates.

Emphasis on Military Performance

Military performance, in the sense of cutting-edge military capabilities, has been less important for Tokyo decisionmakers than has ensuring that a Japanese DTIB remains in existence. Toward this end, Japan has been prepared to accept high costs for indigenously manufactured weapons, even when cheaper counterparts are available from abroad. The Type 90 tank, for example, costs several times that of an American M-1A1, due at least in part to its much smaller production run.

In general, Japanese weapons show little evidence of being superior to foreign systems in terms of their performance. The Japanese F-1 fighter of the 1960s, for example, despite high costs, showed no performance advantage over the F-104 or the F-4, both of which entered the Air Self Defense Force (ASDF) at approximately the same time as the F-1, or the Anglo-French *Jaguar*, upon which the F-1 is modeled.

Higher weapons costs are accepted because of the incentives under which the Japanese DTIB and the overall defense structure are operating. The Japanese rank production of cutting-edge military equipment, with a preponderance of militarily unique technologies, relatively lower than does the United States. The primary Japanese interest, instead, is the development of dual-use technologies, particularly those that might have great financial rewards as well as potential military applications. The F-1 gave the Japanese at least some experience in the design of an aircraft, particularly systems integration. The American security guarantee has allowed the Japanese to focus on the development of the commercial aspect of advanced product and process technologies, particularly their efficient production, rather than on the military aspects. MITI, for example, places much greater emphasis on developing superior technologies than on building better weapons.

Integration of Levels of Production

There is much more interplay between the commercial and defense sectors in Japan than there is in the United States. Indeed, it is probably safe to say that the Japanese DTIB is firmly embedded within the CTIB. This would seem to be the case, moreover, at all three levels of analysis—the sector, firm, and facility levels.

The degree of integration of Japan's civilian and military efforts is not necessarily solely the result of deliberate policy choices, but rather is the function of several factors, including, as noted previously, the presence of American support throughout the postwar period, limited military budgets, political discomfort with military exports, and a different perception of the nature of the government-industry interaction. The result is a different DTIB from that found in either the United States or the PRC.

Sector Level

At the sector level, the Japanese have pursued a de facto integrated approach, as industrial sectors emphasize dual-use. For most sectors, defense represents less than 1 percent of total sales, and only the ammunition and aircraft manufacturing sectors have sales to JDA exceeding 5 percent of total sales. In contrast, in the United States, major portions of certain industries' sales are made to DOD, such as radio and TV communications equipment (42 percent of sales), industrial trucks and tractors (45 percent), and shipbuilding and repair (77 percent).[83]

[83] U.S. Department of Commerce, Economics and Statistics Administration, Bureau of Economic Analysis, National Income and Wealth Division and Government Division , "National Income and Product Account Tables," *Survey of Current Business*, August 1993, pp. 52-119.

Japan's interest in dual-use technologies, both in products and processes, is not new. In the 1950s, IHI obtained a vacuum heat-transfer furnace for high-precision forging for the J-47 military engine. Other Japanese corporations subsequently purchased license-built copies of the furnace (manufactured by IHI) for automotive and machinery manufacture. Thus, high-precision forgings became pervasive in Japanese industry, rather than being restricted to military-engine manufacturing. In other defense-related industrial sectors, TRDI's R&D and contract-award processes (as described previously) were designed specifically to provide incentives for the development of commercial as well as defense applications. For example, Japanese producers of carbon composites manufacture them not only for the FS-X, but also for fishing rods and golf club shafts.[84] By providing seed money but no guarantee of defense production, the Japanese government has effectively channeled corporations into developing in a commercial manner certain advanced technologies that MITI and JDA jointly believe are worthy of interest.

The skills and technologies involved in such high-technology areas as composite materials and aerospace are considered to be of such potential usefulness to the overall Japanese economy, and particularly the CTIB, that they must be developed domestically. Development of a domestic aerospace industry, for example, has long been a Japanese objective. The FS-X was originally conceived as a way to facilitate this development, with particular emphasis on systems-integration capabilities. Foreign components would be used only after Japanese sources had been exhausted. The originally planned aircraft would have been much more expensive than the current design (based on the F-16), but only marginally more capable than modified F-16 fighter aircraft purchased directly from the United States. The acquisition of the relevant skills, however, was believed to be sufficiently important to justify the enormous cost differential.

Similarly, the Japanese have sought to design and build their own missiles. Domestic development of an autonomously guided air-to-air missile, a Japanese version of the American Advanced Medium-Range Air-to-Air Missile (AMRAAM), has been accorded high priority by MITI and JDA. Successful domestic design and production of this air-to-air missile, according to one source, is considered "absolutely necessary even if the product is not used by the Air Self Defense Force."[85]

In the R&D process, Japanese corporations find it in their own interest to pursue an integrated approach. In particular, given that even successful military R&D programs may not guarantee a sale to JDA, a corporation will have great incentives to find additional uses for products from R&D programs in order to recoup the initial investment. Indeed, one analyst reported that "business practices in commercial development figure prominently in defense-related R&D. Many of the practices evident in commercial business are carried over into defense research, development and production as well."[86] One aim of Japanese defense R&D is the production of commercial products. TRDI, in essence, hopes to promote the use of private sector expertise in order to conduct R&D in advanced areas of technology. At the same time, corporations hope to use TRDI funds as a subsidy for their research.

Such efforts are further supported by the Japanese system of O&M. The Japanese, like the Chinese, have not developed the elaborate depot structure that the United States has, in part because of the small equipment holdings of the Self Defense Forces. It would be uneconomical for the

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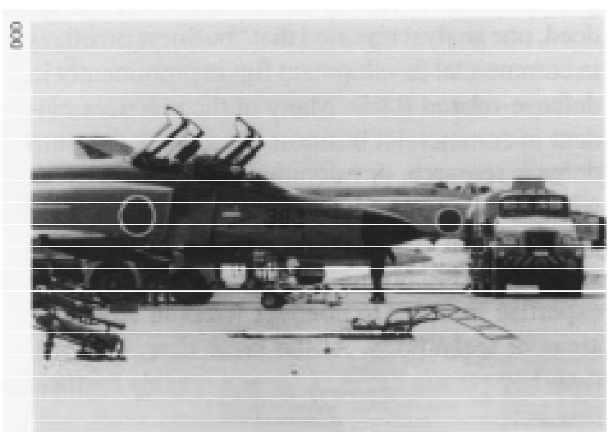
[84]Takashi Hata, "Will FS-X Take Off?" *Air World* (Tokyo) (January 1993), in JPRS-JST 93-068-L (Aug. 30, 1993), p. 20.

[85]*Nikkei Sangyo Shimbun,* Aug. 14, 1993, p. 1, in JPRS-JST-93-071L, Sept. 21, 1993, p. 34.

[86]M.W. Chinworth, op. cit., footnote 61, p. 39.

SDF to spend scarce resources on creating art elaborate depot structure to support its relatively limited forces. Powerful elements of the Japanese bureaucracy have opposed the creation of such a structure. MOF, which has begrudged every yen spent on defense, has had little interest in seeing additional budgetary line items dedicated to the SDF. MITI, too, has opposed the development of an independent maintenance capability because it has not wished to see the development of a separate authority for defense production or maintenance in light of its responsibilities under the two weapons-manufacturing laws. This combination of factors has served to block the creation of an elaborate depot structure.[87]

Responsibility for the maintenance of most military equipment is divided between the military units and the manufacturer. Units are primarily responsible for basic upkeep and relatively minor repairs. All Japanese depot-level O&M, on the other hand, is the responsibility of the various



Japanese prime contractors upgrade and rebuild the engines on the A) Self-Defense Force's F-4Js.

manufacturers. Indeed, this is a primary source of profit for certain defense contracts; the prime contractor, in one case, won all the overhaul and repair work.[88] Japanese corporations are happy to conduct maintenance operations because of the added opportunity to recoup initial costs that such operations provide.

The prime contractors for various engines, for example, are responsible for the engines' upgrading and rebuilding. The ASDF'S J-79s, for example, which power Japan's F-4 Phantoms, are rebuilt by IHI, their manufacturer.[89] Similarly, the new Ground Self Defense Force Command System is expected to provide a steady income of several billion yen annually for many years to come for the primary and subsidiary contractors, based on both production and upkeep, including subsequent upgrades.

This situation, however, has not necessarily proven completely satisfactory from JDA's perspective. Inventory control, for example, appears to be a problem.[90] At the same time, JDA apparently lets contracts for the purchase of such low-technology items as automobile tires and other items, rather than purchasing them directly from the commercial sector. To resolve these situations, however, it was suggested that more maintenance-related work be assigned to the private sector, effectively making it even more integrated.[91]

Finn Level

At the firm level, Japanese corporations engaged in defense work are mostly integrated, insofar as they seek both defense and commercial work, and try to use their resources to meet both commercial

[87] R. Samuels, op. Cit., footnote 59, p. 147.

[88] Ibid., p. 313.

[89] "JDA Defense Research, Contracts Outlined," in Foreign Broadcast Information Service East Asia daily report (hereafter FBIS-EAS) 92-098-A, May 20,1992, p. 25.

[90] Naoski Usui, "Japan Will Streamline Acquisition Process,'' *Defense News*, August 19,1991, p. 3.

[91] Ibid.

and defense needs. As noted previously, no major Japanese defense corporations are entirely dependent on defense contracts for their profits, or even for their income. Even the divisions within the major defense contractors seek to diversify their customer base, which can include commercial areas. Thus, Kawasaki Heavy Industries is seeking to apply the technology involved in aircraft production, especially in reducing wind resistance, to the production of linear railcars.[92] Similarly, MHI's Nagoya Controlled Propulsion System Laboratory, responsible for license production of the Patriot system, "is now seeking markets for jet engines and hydraulic systems used in aircraft doors."[93] Such efforts are not limited to aerospace and other high-tech areas; other Japanese weapons makers have also sought to expand their product lines. The ammunition manufacturer Asahi Seiki Industries Co. hopes to develop a market for its advanced-press technology, which it derived from the production of cartridges and bullets. Such efforts are facilitated by the absence of imposed barriers, which would separate commercial and defense operations.

Conversely, Japanese manufacturers of civilian goods often apply their technology to the production of military items. The primary producers of Japanese rocket fuel, for example, are the large Japanese paint manufacturers, including Nippon Oil & Fats, Asahi Chemical Industry, and Nissan Paint. The reason for this conjunction is that their product line already contained nitrocellulose. Thus, "the paint industry achieved a breakthrough . . . on rocketry."[94] Indeed, virtually every major Japanese corporation does some defense manufacturing, although, as noted previously, in only a few cases is the income generated a significant portion of corporate revenue.[95]

Firm-level integration involves more than products, facilities, and equipment. Japanese personnel, too, are trained to have an expertise that is application-specific, encompassing all relevant portions of the field. In this manner, they can move from defense to commercial projects with minimal retraining. Engineers, for example, are exposed to all aspects of a given sector—aeronautical engineering, design, and electronics. They will then be moved as project requirements demand. According to one analyst, "In 1981, for example, the top officials of the MHI Nagoya Works Second Technology Department (former designers of the T-2 trainer) supervised eleven divisions and projects that included all structure and design for civilian and military projects."[96] Similarly, when MELCO was developing its active phased-array radar system, it dispatched engineers from its radar group to its semiconductor division so that they could gain the skills involved in gallium-arsenide chip fabrication, then returned them to the radar section with their new-found knowledge.

This is not to suggest that the Japanese have deliberately chosen to pursue a more integrated approach, or that they have necessarily done so purely based on commercial considerations. As some analysts have noted, because the Japanese apparently consider that few of their technologies are militarily unique, free flow of information and personnel makes a great deal of economic sense. Many Japanese corporations have the view that most technologies offer at least some potential commercial opportunities. This viewpoint is further reinforced by the generally tightknit nature of

[92] Nonichi, "Changing Defense Industry," in FBIS-EAS, p. 7.

[93] Keisuke Sawada, "Defense Industry Perplexed by Post-Cold War Budget Cuts," *Tokyo Shimbun,* morning ed., June 25, 1992, p. 3, in FBIS-EAS-92-127-A, July 1, 1992, p. 5.

[94] Kokubo, private translation, November 1986.

[95] P. Katzenstein and N. Okawara, op. cit., footnote 62, p. 67.

[96] R. Samuels, op. cit., footnote 59, p. 291.

Japanese conglomerates, which allows for cross-fertilization in nondefense areas as well as defense areas.

Facility Level

At the facility level, Japanese integration is often far beyond that exhibited within the United States. Japanese firms are encouraged to use a facility for both defense and commercial production. In the case of aircraft parts, for example, Fuji Heavy Industries manufactures F-15 landing gear, P-3 main wing spars, Boeing 767 main wing cowlings, and the whole UH-1B helicopter in the same facility.[97]

In some cases, integration is the result of limited defense demand. At MHI's tank-production facility, for example, the Type 90 tank's production equipment is shared with the manufacture of forklift trucks and heavy-construction equipment. The same test and measuring equipment and tools, including jigs, are used on the commercial and military sides.[98] This approach is to be expected, however, in light of the limited orders for the Type 90. Such integration allows MHI to leverage its investments in heavy equipment. The result is a much more integrated production line.

Some Japanese high-technology military items are also purportedly obtained from dual-use production lines. This is, to a certain extent, facilitated by the absence of military specifications that impose different manufacturing processes. Thus, the active phased-array radar developed by Mitsubishi Electric (MELCO) for JASDF is "made entirely of commercial components."[99] In the absence of military specifications, there was never a separation of the commercial and military production processes. The radar components were, therefore, of commercial origin. Similarly, MHI's Nagoya facility contains a giant autoclave designed to cure composite materials that works on both military and commercial projects. Mitsubishi's MU-300 aircraft apparently uses many of the same component-fabrication methods and lines as does the company's F-15Js. Only the final assembly lines are separated.[100]

In this regard, the Japanese fully recognize that integration is a bottom-up, rather than a top-down, process. Dual-use technology, as the chief engineer for MELCO noted, occurs primarily at the component level, rather than at the system level. It is more likely that opportunities for dual-use technology will "share much commonality at the component level but that at the system level, the interflow between the civilian and defense sectors is not easy."[101] This will, of course, vary by technology. As one Japanese observer noted, "In the field of electronics technology, the wall of military and civilian conversion is comparatively low, and the development of various civilian operations is also possible."[102] Nonetheless, the Japanese emphasize cross-fertilization at the component level first and foremost. Japanese designers, regardless of the nature of their projects, are interested in applying technology to the issue at hand, without paying undue attention to whether the technology is "commercial" or "military." This, in turn, facilitates facility-level integration.

COMPARISON OF THE PRC AND JAPAN WITH THE UNITED STATES

Having examined the Chinese and Japanese cases, what lessons, if any, can the United States draw from them for the integration of its own DTIB and CTIB? Both the Chinese and Japanese cases clear-

[97] R. Samuels, op. cit., footnote 59, p. 295.

[98] Ibid., p. 296.

[99] Ibid., p. 195.

[100] Drifte, p. 62.

[101] T. Tamama, *Defense Research Center* (III, 2, August 1, 1993), in JPRS-JST-93-083L, Oct. 29, 1993, p. 34.

[102] *Nikkei Sangyo Shimbun* (August 14, 1993), p. 1, in JPRS-JST-93-071L, Sept. 21, 1993, p. 35.

ly differ greatly from the American one; in particular, both Asian states have a history of very intimate relations between their commercial and governmental sectors, to a degree that is not generally present in the American economy. In the PRC, this is due, at least in part, to the state ownership of the means of heavy-industrial production, whereas in Japan, this is primarily a matter of policy and history, rather than ideology.

Both states' assessment of their security situations differ from that of the United States. Both Beijing and Tokyo believe that they currently face a relatively benign security situation, especially in the wake of the collapse of the Soviet Union. At the same time, there has been less pressure on either state to emphasize the development of militarily unique capabilities over either dual-use capabilities or the application of commercial technologies and processes to military products. Indeed, development of indigenous defense industries in both Asian states is much more the result of conscious, planned choices on the part of central authorities to develop a DTIB for explicit defense and commercial purposes, rather than the evolution of DTIBs in response to external security developments.

Both states also have a very different perspective on the public good from that of the United States. There are few signs that socioeconomic goals, as understood in the American context (e.g., assisting small or minority-owned businesses), exert influence on the structure of the Chinese or Japanese acquisition processes. In the PRC, the focus is primarily on raising the level of technological sophistication within the overall Chinese economy. In Japan, a higher priority is placed on furthering technological goals than on ensuring equal access for corporations to JDA's budgets.

This combination of considerations has produced in both China and Japan relations between their respective DTIBs and CTIBs that are very different from the American situation. That, in turn, has affected the development of integration policies. In China, for example, the emphasis, until the advent of Deng Xiaoping, was so heavily weighted toward development of their DTIB that the Chinese CTIB was neglected. Indeed, the Chinese DTIB and CTIB were almost completely segregated until the Four Modernizations shifted human and material resources from defense to commercial and civilian economic development.

As a result, however, Chinese efforts at integration are distinct from those occurring in the Japanese or American economies. In particular, the PRC's efforts are taking place in the context of state-run industrial sectors that are moving into an impoverished commercial sector. The Chinese defense industrial sectors thus have a "captive audience" of consumers, as well as financial and political support from the state, to facilitate the process of integration. Both of these considerations limit the applicability of Chinese experiences to the American case, although some lessons might be drawn for public sector facilities.

Although the Japanese case is more akin to the American situation, there are also significant differences between the Japanese and American DTIBs and, therefore, between their respective integration policies. The Japanese DTIB developed in the shadow of the American security commitment and thus was never expected to be the sole source of military equipment and resources. Indeed, throughout the postwar period, the Japanese have relied upon the United States not only for military support but also for provision of many weapons and component designs.

As with the Chinese DTIB, therefore, the Japanese DTIB is the product of explicit government efforts to create a domestic defense industrial and technological capability. In the Japanese case, however, the primary emphasis was on developing high-technology industrial capabilities in certain sectors, rather than on the supply of weapons per se to the Japanese SDF. Thus, while the Japanese have a very robust DTIB and domestic arms industry, it is uneven; in some areas, the Japanese have pursued *kokusanka*, while in others they have been satisfied with licensed production of foreign (primarily American) designs.

This selective approach, wherein the Japanese chose to focus on only certain defense technologies and capabilities, has facilitated the Japanese effort at integrating their DTIB and CTIB. By picking and choosing which products and processes to pursue, the Japanese could, from the outset, design for dual-use. This process was further encouraged by the Japanese decisions to limit the size of their armed forces and to prohibit arms sales. These factors constrained the development of any economies of scale for the Japanese arms industry and gave further incentive to development of dual-use, rather than militarily unique, technologies and processes. MITI and JDA could, and did, agree to seek weapons that would utilize commercial technologies, as well as promote commercial processes that would have defense benefits (i.e., both spin-on and spin-off technologies). Japanese corporations, recognizing the lucrative potential of high technology and the limits of the restricted Japanese defense market, in turn, learned to pursue de facto integration, particularly at the firm and facility level. They extended this not only to components and subcomponents, but also to personnel training and quality control.

In the course of developing its DTIB, the United States responded to very different pressures and policies. The result was the creation or development of practices that have tended to promote segregation and the development of weapons that are more specialized and, in most cases, more advanced than those fielded by either the PLA or the SDF. These practices include acquisition laws, militarily unique technologies, and military specifications and standards.

Acquisition Laws and Regulations

Acquisition laws, regulations, and culture are a major contributing factor in the segregation of the American DTIB from the CTIB. In both Japan and the PRC, integration appears to have been facilitated by the absence of a discrete acquisition culture of the extent developed in the United States. The absence of a more bureaucratized acquisition structure allows for greater common use of facilities and personnel, that is, sector-level integration.

In both the PRC and Japan, the history of corporate-government relations has been less adversarial than it has been in the United States. In both Asian states, there is a willingness to accept greater commingling of defense and commercial business, at sector, firm, and facility levels. The consequent blurring of the lines between private and public use of facilities and resources is accepted as an acceptable price, if not a subsidy, for technological innovation and economic development.

Military Specifications

If the Chinese and Japanese are somewhat less concerned with tracking every renminbi and yen, they are apparently also somewhat less concerned with specialized specifications and standards. Indeed, the evidence is unclear as to whether either state has imposed a set of military specifications and standards—dictating not only operational parameters but also methods of manufacture—as extensive as those of the United States.

In Japan, the objective appears to be to meld the commercial and military segments of a whole market for a given technology or item. Thus, Japanese quality control is structured to fulfill very high standards, standards sufficiently stringent to satisfy military as well as commercial requirements. In some cases, there may be additional checks and inspections for certain items intended for military end-users. These additional quality-control measures are more easily accommodated in the context of integration, however, than in an entirely separate system of military specifications and standards.

The same approach applies to Japanese personnel policies. Japanese designers are familiarized with the entire spectrum of applications within their specialty, ensuring that those processes that are successful in the defense realm will be applied to the commercial side and vice versa. A single baseline of standards is applied to many technologies, products, and processes, further facilitating cross-fertilization and integration.

Militarily Unique Technologies

Militarily unique technologies exist in the arsenals of both Japan and the PRC. Neither the PLA nor the SDF, however, has the same requirements for, or the ability to provide, the unique military capabilities that the American Armed Forces do.

This is due, in part, to Japan's and the PRC's different expectations of their armed forces' missions and roles. As a result, cutting-edge technological capabilities within their defense establishments are accorded lower priority than they are in the U.S. military.

The PRC simply does not have the wherewithal to provide the PLA with cutting-edge technology, either in terms of the necessary scientific and technological expertise or the financial resources to support it. Indeed, Chinese resources are strained simply by the effort to mechanize and standardize their current force structure. Instead, the Chinese military has shown a propensity to rely upon available technologies, within both the CTIB and the DTIB, to fulfill military missions.

The Japanese have chosen to emphasize, as noted previously, development of dual-use technologies, rather than militarily specialized ones. Purely military research offers limited market potential. Furthermore, Japan restricts the sale of weapons abroad; it prohibits sales of completed weapons and allows weapons technology to be sold only to the United States. Purely military technologies have, for the most part, a market comprising solely the SDF. The Japanese appear content, instead, to develop technologies that, although perhaps oriented toward military missions, will nonetheless also have commercial applications.

Whether or not Japanese national security has necessarily been served by such a policy remains to be seen, however. Japanese weapons have not been tested in combat since World War II.

Emphasis on Military Performance

Neither Japan nor China has introduced military technology that is significantly more advanced than its commercial technology. Until the 1980s, for the PRC, this was a doctrinal issue, with "red" and its emphasis on simple weapons in vast quantities taking precedent over "expert" and its emphasis on sophisticated weapons. As the PRC tilts toward "expert," it has become evident that the Chinese DTIB, as currently constituted, is not capable of producing cutting-edge weapon systems. Where the PLA emphasizes performance over costs, this has generally involved the acquisition from abroad of technologies—both military and nonmilitary—that are more advanced than those within the Chinese DTIB.

Japan, on the other hand, has a national technology base that is fully capable of producing very advanced systems and components. Rarely, however, are such systems demanded solely for military production. Indeed, both the Japanese defense procurement system and Japanese corporations are oriented toward the commercial exploitation of advanced technologies, including those that might be developed for military purposes. Where cutting-edge performance is demanded, it is sometimes for the sake of developing dual-use technologies and skills. As with militarily unique technologies, however, it is unclear, at best, how well the Japanese Self-Defense Forces would fare in any confrontation.

RELEVANCE OF THE CHINESE AND JAPANESE EXPERIENCES TO THE UNITED STATES

In light of the differences between the Chinese, Japanese, and American cases in their defense acquisition structures and degrees of integration between their DTIBs and CTIBs, the potential for direct application of Asian experiences to the American situation is limited. Nonetheless, some observations are possible. For example, the absence in Japan of the extensive use of military specifications and standards that have marked the American DTIB suggests that **a reliance on high-quality production from the commercial sector is possible**.

The Asian cases also suggest that greater integration of the research, development, and manufacturing of defense and commercial goods is possible. In particular, **the more fundamental the technology, the easier it is to integrate**. The Chinese appear to have generally succeeded at their attempts at integration because they have been integrating low-level technology (and because of enormous demand).

The Japanese experience reinforces the observation made in the U.S. base that it is easier to integrate the manufacturing of components and subcomponents (e.g., composites and computer chips) than it is to integrate the assembly of systems (e.g., commercial and high-performance aircraft). Manufacturing components and subsystems would, therefore, seem to be very amenable to integration where artificial barriers are not imposed between commercial and military production.

Along these lines, too, the **more basic processes may be more amenable to integration**. This involves not only the production of components, but also their initial design. It is evidently possible to exploit the common backgrounds and training among designers and engineers for both commercial and military ends. With this in mind, the design as well as the assembly of even technologically advanced military equipment might be integratable with commercial counterparts if accounting rules allowed such measures. This amenability to integration is likely to be most successful at dual-use production facilities. The Japanese case suggests that there are few inherent reasons that dual-use equipment, embodying technologies common to both the DTIB and the CTIB, could not be produced on a single production line and assembled, or even simply inspected, on separate lines in light of the different quality-assurance requirements. Such integration, however, presumes that commercial-quality standards are sufficient to support military requirements. Thus, an implicit lesson is that integration demands stringent degrees of quality control, regardless of the end user.

Both Asian states are clearly interested in integration at the workbench level, that is, in integrating their commercial and defense research efforts. This would appear to be a logical pursuit because the results of research efforts, both defense and commercial, might benefit both commercial and defense efforts. Moreover, it allows more efficient use of scarce, and usually expensive, personnel, equipment, and facilities.

The Japanese case suggests that **there are many component technologies and processes that are not truly militarily unique**. Too often, militarily unique technologies are cited as a reason for military specifications, and military specifications are considered necessary for the production of militarily unique technologies. However, as seen in Japan and the PRC, regardless of the level of technological sophistication, many technologies, particularly those at the lower tiers, have dual-use potential. In addition, it is not necessary to organize or manage production of such components differently for commercial and military end users. Were performance specifications (i.e., those relating to form, fit, and function) to predominate, rather than manufacturing and other specifications detailing how an item is to be manufactured and assembled, it is likely that there would be far fewer militarily unique technologies at the lower tiers.

Militarily unique technologies certainly do exist. Those related to the design, development, and production of weapons of mass destruction, for example, are almost certainly militarily unique. Similarly, there may be some technologies (e.g., those behind radar-absorbent materials and electronic-warfare programming) whose dissemination to the CTIB might be detrimental to national security. These would tend to be the exception, rather than the rule, however.

Finally, both Asian cases indicate that **CMI is not cost-free**. Although the Chinese and Japanese economies are more integrated than the American economy, this is achieved at a price. In particular, there are questions about the quality of the weapons produced by both the Japanese and Chinese DTIBs. There is reason to suspect, at least, that American equipment performs better than either their Chinese or Japanese counterparts. The extent to which the high quality of American equipment is due to the structure of the American DTIB, and whether the same level of quality could be maintained in an integrated environment, is unclear.[103]

The Chinese and Japanese structures of government-industrial relations are very different from that of the United States. Replicating in the United States the degree of integration in the PRC or Japan would probably impose political and economic costs that are absent, minimal, or acceptable in the PRC and Japan but that would not be acceptable in the United States. In particular, it is unlikely that the American system would support the ambiguity inherent in the commercial use of public facilities and, more importantly, of public resources. The slighting of socioeconomic goals would also be unlikely to be acceptable to Americans.

[103] U.S. Congress, Office of Technology Assessment, *Assessing the Potential for Civil-Military Integration: Technologies, Processes, and Practices*, op.cit., footnote 1, especially ch. 2.