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China: Changes in Military-Industrial Development Policy

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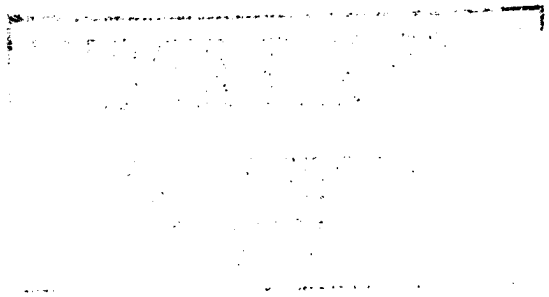
An Intelligence Assessment



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March 1984

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This paper was prepared by Office of East Asian Analysis. Comments and queries are welcome and may be directed to the Chief, China Division, OEA,

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China: Changes in Military-Industrial Development Policy

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Key Judgments

Information available as of 30 January 1984 was used in this report.

China has pressed the merger of its military and civilian R&D organizations in order to force the development of indigenous scientific and technological research. At the same time, the military industries, most notably the six military machine-building industries, are being integrated with civilian industry. The aim is to lift the technological levels of military industry and enlarge its contribution to overall development of the economy.

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Resistance within the People's Liberation Army (PLA) and the military-industrial establishment had prevented reform of military industry until 1981, although the civilian sector had been committed to reform as early as the Third Plenum of the CCP Central Committee in 1978. The 1979 attack on Vietnam, however, showed that Chinese weaponry was inferior and demonstrated the need to abandon the traditional Chinese emphasis upon quantity in favor of higher quality military production:

- The military subsequently was given assurance that defense programs would continue to be given a high, if not the highest, priority in Beijing's decisions on how its limited resources will be allocated.
- The military was also assured that it would have initial use of all new technology developed or acquired abroad.

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We believe the organizational and policy changes introduced since 1981 will have major impact on future Chinese military and civilian industrial activity:

- Planning of military and civilian S&T and industrial activity will be increasingly centralized.
- Military and civilian research institutes and factories will be consolidated into specialized research and production combines.
- Acquisition of advanced foreign technologies and equipment will be stepped up.

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The relationships among the many new organizations that are to implement the new policies are still evolving, and we believe the process will not go smoothly. Some elements in the military still resist the new policies, and bureaucratic inertia and organizational rivalries continue to slow the effort. Nevertheless, we believe that Beijing will benefit:

- There will be a more systematic ordering of priorities. This could eliminate some of the wasteful duplication of past Chinese efforts to acquire technology and equipment abroad.

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- Although military needs will remain paramount, civilian industry will also profit from increased access to technology developed or acquired for military purposes.
- Increased production of civilian goods by military industry should also be a plus—for the military in terms of greater use of idle capacity and increased revenues; for the civilian economy in terms of larger quantities of badly needed producer and consumer goods.

The concentration on key industrial and S&T projects implied by these policy changes may already be starting to bear fruit. China's new "Galaxy" computer was developed by combining the talents of both military and civilian research organizations and using both domestically produced and imported components.

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The closer military-civilian relationship will pose new problems for the United States in monitoring Chinese weapons programs and in implementing the export control system:

- The merger of military and civilian institutes and factories into specialized combines will further obscure Chinese progress in the strategic and special mission areas as will newly tightened security measures in Chinese research and production facilities and on Chinese personnel.
- Determining the military or civilian status of end users of US and Western technology exports will become far more difficult.
- If China follows through on its stated preference for acquiring US technologies, other members of COCOM may become even more reluctant to agree to further liberalization of export restrictions.
- The new policies also increase the likelihood of closer military linkages to joint ventures and similar technology transfer mechanisms. These types of transactions may become a more sensitive issue in COCOM deliberations than the export of particular pieces of equipment and machinery.

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Laying the Groundwork (1978-81)

The Need for Policy Change. When China began to develop its military-industrial base during the First Five-Year Plan (1953-57) it drew heavily on Soviet organizational experience. The defense industrial and scientific establishment operated as an independent and self-sustaining entity well insulated from the civilian industrial sector. By late 1965, the heart of China's military-industrial establishment comprised six consecutively numbered defense industrial ministries, the Second through Seventh Machine Building Ministries.[1] These were tasked respectively for the research, development, and manufacture of nuclear weapons, aircraft, electronics, land armaments, naval ships, and ballistic missiles. The defense industrial system enjoyed greater financial and political support than the non-military-industrial sector. It received special treatment in the allocation of scarce resources—scientists and technicians, precision machinery and instrumentation, and high-quality materials—to the detriment of the civilian economy. Military research and development (R&D) was kept separate from manufacturing throughout most of the defense industrial ministries, however, and this tended to slow technological progress in weapons production.

Until 1979, China's policy for both military and civilian industrial development emphasized large-scale expansion of capacity through both indigenous construction and importation of turnkey facilities. Various domestic construction programs, such as the Great Leap Forward (1958-60), had little effect on military industry. In contrast, the so-called war preparations effort that began in 1961 had a long-lasting impact on military industry. For 10 years or more China invested massive amounts of labor and capital into moving its heavy industrial and defense facilities from coastal and central areas to remote locations, including mountain valleys and caves, to make them less vulnerable to foreign attack.

[1] The First Ministry of Machine Industry was established in 1952 and, although its production tasking has frequently been modified, is charged with design and production of machinery used in the civilian sector.

Acquisitions of foreign plants and equipment—from the Soviet Union in the 1950s and from Japan and Western Europe in the 1960s and 1970s—significantly increased China's industrial capacity and provided the basis for a fairly sophisticated industrial complex. Little attention was given, however, to improving the technological capabilities of these facilities. After the first generation of merchandise was produced, there was no follow-on research and development of new product types. In some cases the products of civilian and military industry have remained unchanged for decades.

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Many of these problems were the result of the Soviet-style planning introduced in the 1950s, under which factory managers paid attention to output quotas and little else. With few, if any, rewards for technical innovation, factory managers had little incentive to develop close ties with research units. Those links that did develop were usually conducted through unofficial channels and were aimed at maintaining the existing level of production rather than developing new products or more efficient manufacturing methods.

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The gap between research and production was particularly acute within the defense industrial system. The problem resulted from a division of responsibility, beginning in the late 1950s, between the National Defense Industries Office (NDIO) and the National Defense Science and Technology Commission (NDSTC). The NDIO ostensibly was responsible for serial weapons production, while the NDSTC was charged with research and development. The NDIO, however, had also assumed control over conventional weapons research in the mid-1960s, and there was little pressure from the NDIO's primary customer,

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the General Logistics Department of the PLA, for new weapons development. Moreover, the ministries under direct NDIO administration—the Third through Sixth—did not want to risk failure attempting any new weapons designs. Because there were few strategic weapons available for series production in the 1960s, the NDSTC retained the manufacturing functions of the Second and Seventh (nuclear weapons and missiles) MMBs, in addition to its remaining research and development responsibilities.

After the death of Mao Zedong in September 1976 and continuing until early 1978, Beijing's military and civilian planners pursued industrialization policies of expanding industrial capacity. Growth of China's major defense industrial facilities continued, and large quantities of obsolete weaponry were serially produced. And with new emphasis being given to acquiring weapons technology from abroad, indigenous R&D continued to be slighted. An ambitious program, however, was being undertaken on the civilian side to import entire industrial complexes from abroad.

By early 1978 Beijing began to reassess its military and civilian industrial programs and to question the need for additional capacity to manufacture an increasing amount of obsolete equipment. In January 1978 the theoretical group of the NDSTC argued publicly that the key to a modern national defense was priority development of science and technology and the national economy. At the same time, critics of China's policy of importing complete plants were debating the wisdom of relying totally on foreign suppliers for turnkey facilities when portions of these plants could be produced domestically. The implication of these arguments became clearer in December 1978 when Beijing called for a closer coordination of military and civilian resource allocation and greater military involvement in nonmilitary manufacture.

Reforming the Industrial Base

The December 1978 meeting of the Third Plenum of the 11th Central Committee and the decisions made for readjustment, reorganization, and reform of the economy in general and the machine-building industry in particular marked a major turning point in military and civilian industrial cooperation and prepared the way for China's current economic restructuring effort. These proceedings reaffirmed earlier calls for the defense industrial sector to direct its work to both military and civilian purposes. 25X1

the principles governing military production of civilian goods adopted by the Beijing leadership in mid-1978 were 25X1

aimed at 25X1

maintaining a large standby defense production capacity during peacetime that would be supported and camouflaged by commercial activity and civilian production. In addition, military production was to focus on strategic tasks, and more emphasis was to be placed on research and development of new weapon systems. 25X1

Effects of Readjustment. China's efforts to reorganize and reform its machine-building industry began to accelerate with the establishment of the State Machine Building Commission (SMBC) in February 1980.[3] The responsibilities of this commission—which was headed by Vice Premier Bo Yibo—were to restructure and upgrade all machine-building industries in China. 25X1

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The SMBC made substantial progress throughout 1980 and 1981 restructuring the various industries under its control. In addition to the Electronics and Shipbuilding Ministries, the SMBC also was tasked to oversee readjustment and reform of the Ministries of Machine Building and Agricultural Machinery, the machine-building bureaus within the Ministries of the Coal Industry, Petroleum Industry, Building Materials Industry, Textile Industry, Light Industry, Marine Transport, and the Ministry of Railways. 25X1

[3] The State Machine Building Commission was subsequently abolished in May 1982 and its readjustment responsibilities were assumed by the State Economic Commission. 25X1

Many small plants were merged or consolidated with other facilities to enhance specialized production. Improvements also were made in the organizational structure and management of larger facilities. A number of economic combines formed on the basis of product specialization were established within the machine-building industries. Several were given authority to function beyond respective ministerial and provincial boundaries and to engage in foreign trade.

Significant progress was made in readjusting the electronics and shipbuilding industries. Readjustments within the electronics sector resulted in increased output through specialized production, new product lines, production of new civilian goods, and improved industrial technologies and product quality through closer cooperation between research and production.

Reshaping Science and Technology

Need for New Technology. Despite the accomplishments in some sectors of the machine industry, there was a growing awareness within the leadership that most of China's military and civilian industrial facilities suffered severe technical deficiencies. To promote a revitalization of these enterprises, actions recommended by the Beijing reformers included a greater diffusion of R&D achievements, and a direct transfer of technology from the military to the civilian sector. Methods for transferring technology to the civilian sector were to include: (1) using part of the military production capacity to manufacture civilian goods that were badly needed; (2) transferring military research and design personnel to civilian facilities to provide technical service and technological support; (3) providing the civilian sector with the results of military research as technological spinoffs for nonmilitary production.

In April 1981 the Chinese Government adopted a new science and technology policy for the development of the national economy. The new policy stressed China's need to: intensify research and development of new production technology; increase the spread of R&D achievements for use in advanced industrial and agricultural production; and to assimilate foreign S&T achievements into the domestic S&T establishment.

Convincing the Critics. The 1979 Chinese attack on Vietnam played an important role in weakening military opposition to moving China's military industry into new ways of operating. Vietnamese weaponry was more advanced and superior to Chinese arms. 25X1

a major conclusion 25X1
emerging from Chinese postmortems was the need to abandon traditional emphasis upon quantity in favor of higher quality military production. This would require new efforts to strengthen China's capabilities 25X1
for both military and civilian research and development. 25X1

The change in the military's position began to emerge at the December 1981 sessions of the National People's Congress (NPC). In his published report to the NPC, Premier Zhao Ziyang amended the S&T policy announced in April with a plan that was more appealing to the military in terms of its initial use and 25X1
application of all new technology and achievements. The plan emphasized four types of technology transfers: from laboratory to production; from military use to both military and civilian use; from coastal regions to the inland; and from foreign countries to China.

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relations between 25X1
the Army and state and between Army and people were at an alltime low and that the military's continued resistance to the new policies had become a particularly serious matter. 25X1

The PLA deputies and other members of the NPC reportedly acceded to party and government demands that China's defense industry in peacetime would concentrate research and development on new weaponry but that the bulk of the defense industry's 25X1
production capacity would be diverted to nonmilitary manufacture. 25X1

there was also agreement 25X1
that: (1) major defense industrial facilities would retain the capability to design, develop, trial-produce, and manufacture small quantities of weaponry; (2) military factories within the defense industrial system would be incorporated into economic combines along with nonmilitary enterprises, based on their particular specialization; and (3) that these economic combines

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would be given a certain autonomy in foreign trade and a share of the foreign exchange earnings. There was also agreement that the defense industry would be included as part of the unified state plan, with the provision that the weapons manufacturing responsibilities of defense facilities would be given appropriate attention when these plans were made.

Organizing the Bureaucracy

Many NPC members reportedly expressed concern that the government would be unable to implement its new policy because of resistance from middle-level cadre to programs that they believed endangered their vested interests. Beijing pushed forward with its industrial integration and technology development plan despite these misgivings. In March 1982 Zhao Ziyang announced a major reorganization of the state bureaucracy. A subsequent shakeup shifted the orientation of the machine-building ministries from servicing primarily heavy industrial and military construction to advancing the technological level of the entire country.

The State Council's new structural organization provides China the necessary framework to coordinate military and civilian research, development, and production program (see figure 1). As in the past, major policy decisions are made by the Politburo and Central Committee and, in the defense area, the Military Commission of the Chinese Communist Party.

Under the State Council, four commissions are known to be involved in coordinating plans for China's industrial modernization effort.[4] These are the State Planning Commission (SPC), the State Science and Technology Commission (SSTC), the State Economic Commission (SEC) and the National Defense Science, Technology and Industry Commission (NDSTIC). The SPC is responsible for formulating long-term plans and an annual plan for national economy and social development. The SEC is responsible for the day-to-day implementation and coordination of annual plans and also for the adjustment and reform functions previously assigned to the SMBC.

[4] So far, there is no evidence that the new State Military Commission, established in December 1982, plays a role in these activities.

Perhaps the single most powerful entity to emerge from the bureaucratic reshuffling was the NDSTIC, which was formed through a merger of the NDIO and the NDSTC. The NDSTIC is responsible for the managing and coordinating of all military research, development, and production. With the SPC and the SEC, it jointly formulates the national defense industry plan and a national defense science and technology plan. The NDSTIC also is the focal point for major redirections of military-industrial and scientific resources and has considerable influence in the selection and purchase of military and dual-use technologies.

In January 1983 a special supraministerial body was established directly under the State Council to coordinate national scientific and technological activities. This organization, the Science and Technology Leading Group, is headed by Premier Zhao Ziyang and is composed of senior representatives from all leading economic, education, research, and defense R&D sectors as well as the various commissions of the State Council. Its major tasks include improving the links between defense and civilian scientific and technological entities, coordinating the program for foreign technology acquisition and technical transformation of enterprises, and overseeing all scientific and technological planning and policy formulation from a unified perspective. One of the research bodies to which the leading group funnels research projects and from which it gets feedback is the SSTC's National Research Center for Science and Technology for Development (NRCSTD), which plays a major role in formulating China's science and technology research and development strategy.

China also announced in March 1983 the establishment of a Special Defense Coordinating Committee that would be in charge of both military research and the armament industry. this new organization may serve as a liaison between defense and civilian industries on production problems. It is still unclear how this organization's function fits in with the responsibilities of the NDSTIC.

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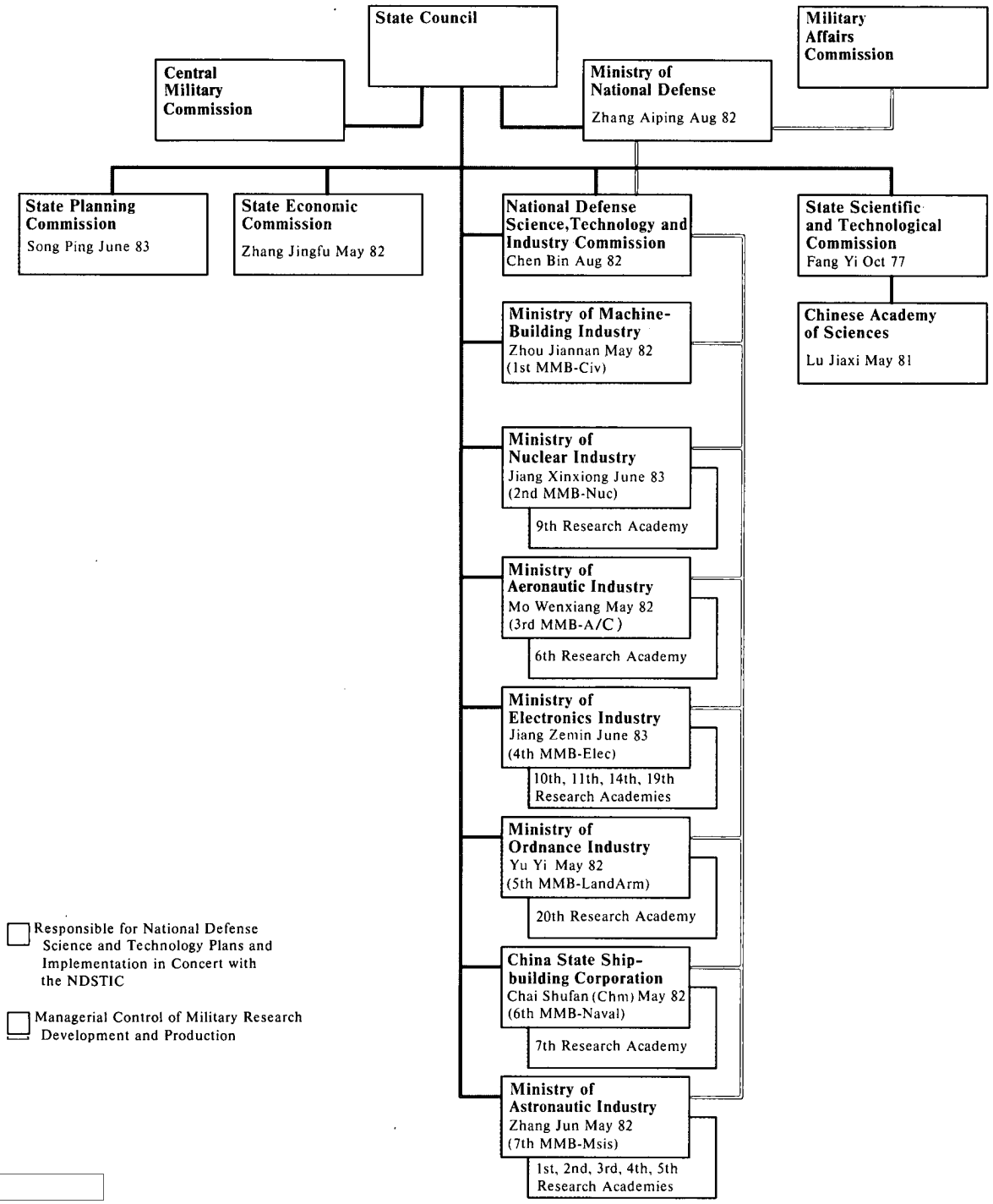
Figure 1
China's Military Industrial/Scientific Complex



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Beijing's determination to pursue a new course of military industrial development was underlined by the appointment of Gen. Zhang Aiping as Minister of Defense in August 1982. As director of the former NDSTC, Zhang had been a key figure in the Chinese military R&D establishment since the mid-1970s. Since 1982 he has been the most prominent spokesman for the new policies and has been instrumental in persuading military officials and officials in the ministries of nuclear industry, aeronautics, ordnance, and astronautics to cooperate in using defense production capacity for national economic construction.

A Plan for Action. By August 1983 Beijing apparently was confident that it had garnered enough support within the military-industrial system to press its military-civilian merger plans publicly. In an unusually candid article in *Liberation Army Daily*, Zhang presented a number of sweeping proposals for speeding up the modernization of China's national defense. These proposals embodied the decisions reached in December 1981, as well as many additional suggestions that the Defense Minister had made in the 12 months after his appointment. Zhang noted that although China's defense research and industrial base was extensive, its capabilities were considerably behind those of developed countries, and its weaponry and equipment did not meet the demands of modern war. Zhang noted that, since the state had to concentrate its money and material on key construction projects and could not allocate additional funds to military construction, the only alternative was for the defense industry to accomplish its modernization under existing conditions. He proposed the following steps:

- In peacetime the armed forces would cut troops and streamline operations.
- Outmoded weapons and equipment would be discarded and, apart from meeting the needs of border defense units and training, no old weapons would be held in reserve.
- The defense industry's production capacity would be diverted to civilian manufacture and armament production urgently needed in military training.
- Military research activity would increase with the focus on specific R&D projects.
- Renovation of existing military equipment would be stepped up.
- The research and manufacturing capabilities of defense facilities would be used to develop and produce civilian goods for domestic use and foreign export.
- Savings made through reduced production of military equipment would be used to develop new weapons and equipment. Some of the revenue generated through civilian production would be used to develop technology-intensive defense industries.

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Zhang's proposals are consistent with the major changes that have occurred in overall Chinese defense modernization strategy and are now occurring within the defense industry.[5] Resources and material that have in the past been dedicated to supporting defense production are now beginning to be diffused throughout the economy. In nonferrous metals, for example, factories that were previously subordinate to an individual defense-related industrial ministry, such as the Ministry of Aeronautic Industry, are now being administered at the national level by the China Nonferrous Metals Industrial Corporation through affiliates such as the China Huaxing Tungsten Corporation. The Huaxing Corporation is responsible for coordinating the planning, pricing, purchasing, and supplying of all tungsten metal throughout China in addition to popularizing new products and promoting scientific research within the industry.

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In September 1983, the SPC, SEC, and NDSTIC held a conference with China's military and provincial industrial leaders. The conference formally endorsed Zhang Aiping's earlier proposals and discussed a

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military-civilian industrial cooperation plan. The purpose of the meeting was to: (1) relay the instructions of the Party Central Committee, the State Council, and the Military Affairs Commission on transferring military technology to civilian use; (2) plan and arrange for the military's research and production of civilian goods; and (3) mobilize the defense research and industrial facilities to serve national economic modernization objectives. A decision also was made to incorporate defense production of civilian goods into the State plan for the remainder of the Sixth Five-Year Plan (1981-85) and in the Seventh Five-Year Plan (1986-90).

Emphasis on Weapons Research

Because research and development of conventional weaponry had been largely ignored in the past by both the NDIO and the defense industries, China is now attempting to upgrade its capabilities in this area by renovating existing conventional weapons systems and stepping up development of an indigenous R&D program. A similar problem has been avoided in the strategic weapons sector because the NDSTIC controlled both the research and production of nuclear weapons and ballistic missiles.

China is attempting to apply more sophisticated methods to its conventional weapons renovation and development programs by introducing systems engineering, integration, and design concepts into the overall process. It is making efforts to implement a "three-generations" weapons development policy—improving of one-generation, developing another generation, and preparing for the development of a follow-on generation. For example, Beijing is currently upgrading a number of indigenously developed weapon systems including antitank missiles, air-to-air missiles, and radar, while looking to Western suppliers for the "second-generation" technology. Beijing is aware that much of weapons technology it may acquire from abroad will not be state of the art. Thus, its indigenous research capability must be upgraded in order to improve on this imported technology and to develop a Chinese style "third-generation" weapon system. According to one Chinese official, this three-generation process of importing and absorbing foreign technology is China's definition of self-reliance. 25X1

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New Methods of Management. China's use of systems engineering techniques has been strongly encouraged by Deng Xiaoping and other Chinese leaders and is being widely applied to the management of military R&D activity. China has introduced a technical command system into the defense industrial system that appears to be patterned after the chief designer systems used in the USSR and the United States. The Chinese system makes a specific individual officially responsible for a particular weapons development project at each level of the technological hierarchy. This individual can come from industry, an institute, or from within the military. 25X1 25X1 25X1

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China also has established a contingent of factory-based military representatives from each of the armed services who will be responsible for ensuring that the quality of weaponry produced meets the expectations of the respective military organization. 25X1

In addition, Beijing is responding to the problem of having too many research institutes engaged in overlapping activities by limiting the research within these facilities to specifically assigned tasks such as antiair, antitank, and electronic countermeasure systems research. To make more judicious use of its R&D resources Beijing also is attempting to bring about closer cooperation between military and civilian researchers and technicians and to increase military participation in the development of nonmilitary equipment. China also is stepping up efforts to promote

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closer cooperation between research and production in its key manufacturing enterprises by installing new or additional research units within these facilities.

The Research and Production Combine

Beijing's decision to formalize cooperation between military and civilian research and production presages significant structural changes in China's military-industrial organization, particularly below the ministerial level. Until now, China's defense plants have been supervised by an unwieldly, though identifiable, system that subordinated them to the provincial bureaus of their parent ministry and the provincial bureaus of the National Defense Industries Office (NDIO). As now planned, many defense research and production facilities will be merged into joint research and production combines.

As the various defense industrial ministries merge their subordinate facilities with nonmilitary enterprises, the identity and function of the individual defense industrial facility will become obscured. These economic entities will be headed by boards of directors. Within each economic region or key municipality, such as Shanghai or Tianjin, there is a supervisory body for research and production and a science commission whose functions are to administer the various corporations within the area jointly with assistance from local authorities and to report these activities to the State Council.

A number of the specialized research and production corporations that have been only recently formed seem to be at least administratively responsible to a military control element. The Tianjin Machine Tool works, for example, is a regional corporation comprising machine tool, heavy machinery, and off-highway equipment plants and several research facilities. The director of this conglomerate is an active duty PLA general who was assigned to the unit in 1983 as part of a nationwide program to improve efficiency in key Chinese industries. senior PLA officers are now being placed in charge of many other large regional groupings of key industries.

Each civilian element within a military-controlled research and production corporation appears to remain subordinate to its civilian parent unit in all aspects except research, design, and technology transfer, which are activities administered by military control elements within the corporation. The manufacturing process reportedly is a combined activity up to the final assembly or packaging stage. And where the military and civilian product are the same, coordinated production continues through final manufacture. Where the military production process is highly specialized, for example, nuclear weapons, there would be little or no civilian involvement. 25X1

The research and production corporations that have been observed so far appear to be organized along the same regional boundaries as the country's new economic regions or priority investment zones. These economic regions are planned by China to be focal points for 90 percent of all foreign investment and an increasing share of domestic investment. At least eight priority investment zones have been established thus far, including the Northeast Zone, the Beijing-Tianjin Zone, the Shanghai Zone, the Min River Zone, the Pearl River Delta Zone, the Wuhan Zone, the Central China Zone, and the North China Zone. 25X1

A number of joint military and civilian regional industrial companies have been formed over the past year in Chongqing (Central China Zone) as part of a State Council economic experiment. The Ministry of Ordnance Industry (MOI) as well as the China State Shipbuilding Corporation (CSSC) reportedly cooperated with Chongqing authorities in working out plans for the joint production of military and civilian goods. The CSSC also has regional shipbuilding industry companies in Shanghai (Shanghai Zone), Guangzhou (Pearl River Delta Zone), Tianjin (Beijing-Tianjin Zone), and Wuhan (Wuhan Zone). 25X1

Contract research and the establishment of consultancies also are becoming additionally significant forms of cooperation between the research community and industrial enterprises. Funding from these types of 25X1

technical exchange are key sources of revenue for both military and civilian universities and institutes. For example, the Ministry of Petroleum Industry has signed agreements with several universities to initiate long-term research in several of its priority areas. Jointly managed research centers also are being established on some university campuses to intensify cooperation between research and production.

The defense industry has only recently started to introduce new and extensive forms of technology cooperation with the civilian sector. Among these exchanges is a long-term technical cooperation agreement that was signed between the NDSTIC and the city of Tianjin. The agreement enables 38 of China's military research institutes to cooperate with 80 civilian industrial facilities in manufacturing military and civilian products. A similar agreement also is being arranged by the NDSTIC with Sichuan Province.

Another first in defense science and technology exchange is the recent establishment of a consultancy corporation under the auspices of the Ministry of Astronautic Industry (MOAI)—the defense industrial ministry responsible for China's ballistic missile and space development. The corporation offers the services of the MOAI's 60,000 technicians to provide expertise in introducing and appraising foreign technology that is being imported by civilian industrial enterprises. Other military research organizations are beginning to augment their research budgets with revenues received from supplying technical expertise to civilian firms on a contractual basis.

Linking the R&D Community

Combining the research and production unit is only one of several methods China is using to forge closer ties between its military and civilian industrial enterprises and the R&D community (see figure 2). This form of cooperation is limited in that it can only bring together universities and industrial facilities located within the same general area.

China's research and development system comprises about 4,300 facilities and employs more than 425,000 researchers; there are more than 6 million scientific and technical personnel throughout China. The principal elements of the research system are the Chinese Academy of Sciences (CAS) and its affiliated institutes, the institutes under the direction of the Ministry of Education (MOE), those under various industrial ministries, the local research sector, and the national defense research units. 25X1

Based on recent Chinese claims, in 1983 there were 119 research institutes affiliated with the CAS and more than 900 civilian research institutions under the jurisdiction of ministries and commissions of the State Council. 25X1 there are 200 or more research facilities within the defense industrial system that are not included in China's published statistics. These are the most advanced research facilities in China and are staffed by some of the country's most accomplished researchers and technicians. Many Chinese students now studying in the United States come from these institutes. 25X1

Engineering education ranks as China's highest academic priority. Approximately one-third of the million or more college-level students in China are studying engineering. About 100,000 of engineers graduate from Chinese universities each year—a figure surpassed only by the Soviet Union. In addition, China reportedly has some 20,000 students studying abroad who are engaged in science and technology and related management curriculums. As shown in appendix A, the majority of China's college-level students are engaged in a standard four- to five-year curriculum. In an effort to expand its body of engineer-technicians, China is developing a shortened engineering curriculum that would provide the senior technicians needed to fill intermediate positions between the university-level engineer and the technician produced by specialized secondary schools (see table 1). 25X1 25X1

In addition to its research organizations China has over 106 science and engineering associations and societies affiliated with the China Association for Science and Technology (CAST). CAST is a multidisciplinary science and technology organization that is 25X1

directly subordinate to the Chinese Communist Party. Its objectives are to enhance public understanding of science and technology and make significant contributions to the rapid advance of China's expertise in this area. As part of this function, CAST's responsibilities involve: organizing both domestic and international academic exchanges and symposiums; providing in-service training; publishing periodicals and other material for the scientific community and the general public; providing advice and expertise to various sectors in military and civilian industry; and serving as a mechanism to relay its constituents' comments and appeals to the party and relevant government departments.

In early 1983 CAST played a major role in the formation of the China Science and Technology Consultive Service Center in Beijing. The center, composed of more than 500 separate consulting organizations, serves as a vehicle for bringing together multidisciplinary teams of experts to advise on economic and technical matters. Where appropriate, advice reportedly will be rendered on a fee basis. The center is located within the SSTC and operates closely with the Commission's Institute of Science and Technical Information, which has widespread access to Western technical data bases.

The Search for Foreign Expertise

China has significantly increased efforts to enlist foreign scientists in its scientific and technological development as teachers, advisers, and researchers. In October 1982 a China Science and Technology Exchange Center (CSTEC) was established under the auspices of the State Science and Technology Commission (SSTC). A major function of the CSTEC is to organize and promote exchanges and cooperation between Chinese scientific and technological circles and corresponding nongovernmental scientific and technological communities and people in foreign countries. Because of the reluctance of some foreign firms, institutes, and technical personnel to deal directly with Chinese Government organizations such as the SSTC, the center will, on behalf of the commission, maintain contact with these foreign entities and people on a nongovernmental basis. The CSTEC, for example, sponsored the much publicized Beijing Science and Technology Policy Forum held in June 1983 and attended by more than 20 overseas Chinese scientists and technicians from the United States and Canada. Deng Xiaoping underlined Beijing's interest by meeting separately with these individuals during the conference.

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Figure 2
China's Research and Development Community

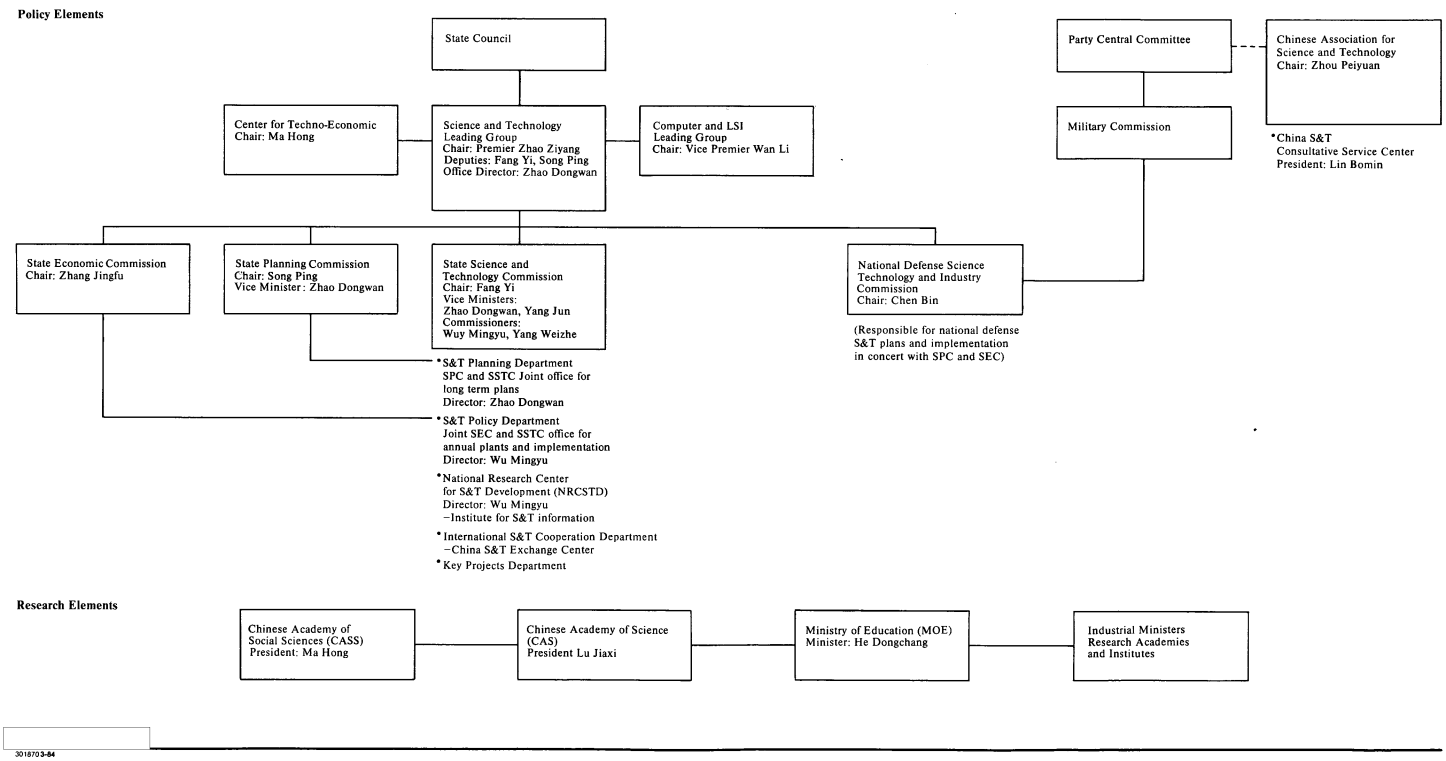

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Table 1
China: Developments in Engineering Education [a]

	1965	1978	1981	1982
Enrollment in normal courses	65,598	114,689	81,432	91,329
Enrollment in short-cycle courses	1,846	17,436	9,829	11,496

[a] Based on Chinese claims.

Unified Procurement of Foreign Technology

China reportedly is attempting to define its foreign industrial technology and equipment needs more systematically through a process of unified planning that will encompass most basic military and civilian needs. Each industrial ministry is to formulate its technology and equipment requirements according to domestic and foreign availability. These requirements are further refined in terms of regional, central city, and key installation needs. When submitted to the State Council the requirements are examined to determine those technologies and equipment available domestically, those that can be expected to become available domestically, and those that must be imported. The state planning commission reviews the requirements further, in the context of broad military and civilian industrial objectives. A decision is then made as to what foreign technology and equipment would best meet these comprehensive research and industrial requirements.

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Key Targets in Development: Electronics and the Machine-Building Industries

Development of China's machinery and electronics industries is crucial to technological progress in all sectors of the economy. Because of this, the State Council decided in 1981 that development of these industries should receive priority attention. To facilitate this objective, the State Council indicated its intention in December 1982 to import 3,000 advanced technology packages during the last three years of the Sixth Five-Year Plan. More than 1,000 of these projects will be used to refurbish 490 factories and nearly 60 research institutes within the machine-building and electronic industries. The plan also provides that an additional 3,800 items would be manufactured or developed indigenously to upgrade many other facilities, most of which will be machinery and electronic plants. In addition, local governments and specialized trade corporations are making similar investment to modernize the machinery and electronic factories they control.

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The priority on machinery and electronics was reflected in Beijing's effort to attract foreign investors and suppliers to the China International Mechanical and Electronic Technology Conference held in Beijing in

December 1983. The conference was used as a forum to work out technical and commercial details for 107 machinery and electronic projects, most of which represent technologies of the late 1970s and early 1980s, that China hopes to assimilate and eventually replicate for use in other machinery and electronic facilities throughout China

China has set strict guidelines on which plants within the machinery and electronics industry will use foreign technology and equipment. The State Council in early 1983 stressed, in its "Tentative Rules for the Technical Transformation of the Engineering and Electronics Industries," that factories selected to use advanced foreign technology and equipment must have a solid foundation and strong administration and management so that the imported technologies can be rapidly studied and assimilated. The guidelines further suggest that importing facilities must pay close attention to purchasing "know-how" as well as the equipment, so that the technology can be closely integrated with the factory's own research and development.

China's objective for technological progress in the machinery and electronics industries is to develop and produce a variety of quality products that have both significant export potential and are urgently needed in China's modernization effort. To further these objectives the machinery and electronics industries have been assigned specific product improvement targets that must be attained in the course of China's present and future five-year plans.

According to SEC Vice Minister Lu Dong, who also serves as a member of the State Computer and Integrated Circuit Leadership Group, the research and design contingent within China's machinery and electronics industries will be expanded until it constitutes one-third of the total technical personnel employed in these sectors. Technological development also will require greater coordination between the research units and the production facilities and between the machinery and electronic industries and the raw material suppliers. Increased attention also is being directed to improving the quality and training of scientists, technicians, and managers; establishing a strict system of individual responsibility; promoting the application of modern management techniques in both research and manufacturing; and raising quality control and product standards to international levels by yearend 1985.

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Electronics Development and Military Needs. Beijing's highest technological priority in modernizing its industries is to establish a modern electronics industry capable of satisfying both its military and economic needs. Particular attention has been focused on building a modern semiconductor industry that can support Chinese plans for expanding computer development and manufacturing. Beijing is thus engaged in a massive effort to replace its obsolete electronic component production lines and processes with technology and equipment of a more current vintage. In addition to importing all types of electronic component and integrated circuit manufacturing equipment, China is stressing the acquisition of relevant "software"—design technology, training, management techniques, production, and quality control methods—in order to assimilate, replicate, and diffuse this advanced technology and equipment to other parts of industry.

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This technology acquisition process is consistent with China's goals:

- To achieve within a decade an integrated circuit and computer manufacturing capability equal to that existing in the United States.
- To provide an infrastructure to support China's strategic, military, and commercial electronic needs.
- To minimize China's dependence on foreign supplies of electronics and equipment.
- To establish a competitive foothold in the international market for electronic materials and equipment.

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Beijing's progress toward these objectives is reflected in its development of a near state-of-the-art supercomputer with an operational speed of 100 million operations a second,

What the Military Receives . . . More and more, we have seen the Beijing leadership addressing the importance of electronic advancement to China's military weapons development. A special leading group was established within the State Council to monitor Chinese civilian and military progress in development and manufacture of computers and large-scale integrated circuits (LSIs). Defense Minister Zhang Aiping has called for rapid development of the electronic industry, describing it as crucial to all Chinese military research and development goals. China's Minister of the Electronics Industry also has recently stated that military electronics occupies a top priority in the industry's development.

The strategic importance Beijing attaches to its electronics industry at this juncture is consistent with China's policy for using new and emerging technologies for military use before they are transferred to economic and social applications. A leading official of the Chinese Academy of Sciences stated in October 1983 that China's strategy for technology dissemination is to transfer achievements from the laboratory to production, from production to the military, and from the military to both military and civilian application. China's Defense Minister also has frequently stated over the past year that new technologies will be used in military R&D before they are transferred to civilian economic use.

China's interest in applying new technologies first to military experiment goes beyond microelectronics and computers. Technologies in such fields as nuclear, space, laser, bioengineering, and the material sciences are also targets. In the material sciences, for example, China has shown strong interest in acquiring an advanced composite materials production capability. Advanced composite materials are used in the fabrication of rocket motor cases and weapons reentry vehicles. 25X1 25X1

. . . And What It Delivers. As increased cooperation between military and civilian research and production progresses, the defense industrial sector is expected to play an increasingly more positive role in China's economic development. The value of civilian products turned out by military factories has grown considerably since 1978. According to Chinese claims, nonmilitary production by the defense industries for 1982 represented more than 20 percent of their total industrial output value, or roughly 2.3 billion yuan. 25X1 25X1

In addition to production for the civilian sectors, military-industrial facilities continue to produce arms for export. Shipments of A-5 aircraft to Pakistan and Type-69 tanks to Iraq, for example, provide foreign exchange earnings. Nevertheless, industrial capacity within the defense industry continues to be underutilized. as much as one-third of China's total military industrial capacity remains idle. 25X1 25X1 25X1

Military-industrial cooperation in civilian manufacture is, nevertheless, leading to problems of competition between military and civilian producers. The North China Industries Corporation (NORINCO), the export-import arm of the Ministry of Ordnance Industry, is actively involved in a number of foreign transactions relating to the manufacture of nonmilitary products (see table 2). In 1982 it was engaged in a dispute with the Ministry of Light Industry (MLI) concerning the conversion of 22 MOI facilities to the production of bicycles and mopeds. Because MLI wanted the domestic market to itself, it successfully sought State Council intercession in order to force NORINCO to limit its production scheme to the export market. 25X1 25X1

Table 2
China: Defense Industry Affiliated Trade Organizations

Trade Organization	Parent Organization
China Yanshan Science and Technology Corporation [a]	**National Defense Science, Technology and Industry Commission (NDSTIC)**
China Xinshidai Corporation [a]	**NDSTIC**
China Nuclear Energy Corporation (CNEIC)	Ministry of Nuclear Industry (NMI)
China National Aero-Technology Import-Export Corporation (CATIC)	Ministry of Aeronautic Industry (MAI)
China Air Materials Company	MAI
China Electronics Import-Export Corporation (CEIEC)	Ministry of Electronics Industry (MEI)
China North Industries Corporation (NORINCO)	Ministry of Ordnance Industry (MOI)
China State Shipbuilding Corporation (CSSC)	China State Shipbuilding Corporation
China Great Wall Industry Corporation (GWIC)	Ministry of Astronautic Industry (MOAI)
China National Precision Machinery Import-Export Corporation (CMPC)	MOAI
China Hua Feng Industrial Corporation	MOAI
Oriental Scientific Instruments Import-Export Corporation (OSI)	Chinese Academy of Sciences
China Scientific Instruments and Materials Corporation (CSIMC)	Ministry of Machine Industry
China Electronic Systems Engineering Corporation	PLA General Logistic Department

[a] The Yanshan Science and Technology Corporaton and the Xinshidai Corporation are NDSTIC elements that are responsible for coordinating the military weapons and technology procurement activities of the various trade organizations affiliated with the defense industry. Yanshan Corporation reportedly deals primarily with weapon systems and technologies that are more advanced, while Xinshidai Corporation concentrates on procurement of weapon systems of a lower technology level or where little technology transfer would be required.

Prospects

The reorientation of China's R&D and military industrial systems is only beginning. The relationships between the many new organizations—committees, commissions, institutes, combines, corporations, and professional societies—that are to be the mechanisms for implementing the new policies are still evolving. Nevertheless, China appears to have dismantled its Soviet-style R&D and military-industrial production systems and is beginning to integrate them with civilian economic activity (see figure 3).

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Beijing will benefit from this merger in several ways. In general, China should be able to take better advantage of the increasingly rapid worldwide diffusion of technology.[7] We believe these new policies will lead to a more systematic ordering of priorities as to which technologies will be developed and which will be imported. Although military needs will remain paramount, civilian industry will also profit from the increased opportunity to draw on technologies developed or acquired for military purposes. Both military and civilian industry will gain as increased centralization of R&D programs eliminates some of the wasteful duplication that has accompanied Chinese efforts to acquire technology and equipment abroad. Increased production of civilian goods by military industry should also be a plus—for the military in terms of greater use of idle capacity and increased revenues and for the civilian economy in terms of larger quantities of badly needed producer and consumer goods.

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The concentration of resources on key industrial and S&T projects implied by these policy changes may already be bearing fruit. In electronics, for example, the new state-of-the-art "Galaxy" computer was developed by using the combined talents of the military and civilian research establishments to incorporate both domestically produced and imported components. Although this computer is expected to help China's nuclear weapon program by allowing studies of more complex weapons models, it also may be applied in such areas as oil and geological exploration, long-term weather forecasting, and satellite imagery processing.

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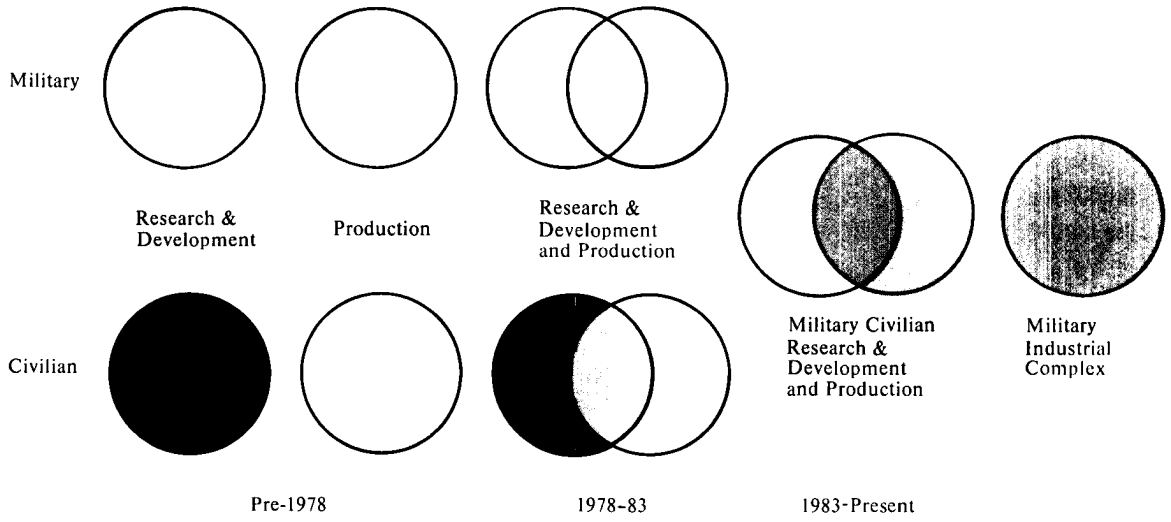
Figure 3
China: Evolution of the Military-Industrial/Scientific Complex



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The increasing Chinese emphasis on scientific and engineering education is a fundamental part of the new policies. The number of engineers now graduating from China's universities is second highest in the world, a figure that is being boosted each year by thousands of foreign-trained scientists and technicians. Moreover, China is attempting to attract scientists and engineers living abroad to China for extended stays. In large measure, China's ability to replicate, and eventually to improve upon advanced technology to produce achievements such as the Galaxy computer will depend upon the abundance of the resources made available to these personnel and the working conditions provided for them. In this last respect, the leadership has repeatedly stressed that China's scientists and technicians are not the targets of the current campaign against "spiritual pollution." Nonetheless, ambivalent leadership policies toward intellectuals seem unlikely to encourage innovative thinking.

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In any event, we believe there are significant obstacles to the full integration of military and civilian research and production elements. In January 1984 Minister of Defense Zhang Aiping indicated that military research and production elements continue to be unenthusiastic in supporting the merger effort. Personnel within these facilities believe that their primary function should be military research and production and

not non-military-related activity. There is also evidence of a developing rivalry between the State Economic Commission, which is tasked with the overall acquisition of foreign technology and equipment, and the various national-level foreign trading organizations—including those associated with the military establishment—over the extent of SEC control over individual transactions. Similarly, although individual plants are being encouraged to compete with each other for specific foreign technologies, this has strengthened the longstanding tendency of enterprises to refuse to share newly acquired technologies with other enterprises.

For the United States, the merger of military and civilian institutes and factories into specialized research and production combines probably will further obscure Chinese strategic or special mission activity.

The new Chinese policies will also create additional problems in the export control area. As the delineation between military and civilian research and production becomes less clear, determining the status of end users will become far more difficult. Problems with other members of COCOM are also likely to multiply. Until recently, COCOM members have agreed to a relaxation of export controls for China because it has meant additional business for everyone. However, as China continues to concentrate on acquiring technology, rather than hardware, and, if it follows through on its stated preference for US technology, the market for other COCOM members will contract. The other members of COCOM are already sensitive on this score and they may become less willing to approve further liberalization of export restrictions. The new Chinese policies also increase the likelihood of closer military linkages to joint ventures and similar technology transfer mechanisms. Thus, these types of transactions may become a more sensitive and more complex issue in COCOM deliberations than the export of particular pieces of equipment or machinery.

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Appendix A

Table A-1
China: Breakdown of Undergraduate Students, by Academic Specialities

Percent

	1949	1952	1965	1977	1978	1982
Total	**100**	**100**	**100**	**100**	**100**	**100**
Engineering	26.0	34.8	43.8	33.4	33.6	34.5
Agriculture	8.4	6.9	7.9	8.6	6.3	5.6
Forestry	0.5	1.1	1.5	1.1	0.9	1.0
Medicine and pharmacy	13.1	13.0	12.3	15.0	13.2	14.2
Pedagogy	10.3	16.5	14.0	26.4	29.2	25.1
Humanities	10.2	7.1	6.8	5.6	5.4	5.1
Natural sciences	6.0	5.1	9.2	6.7	7.5	7.0
Finance and economics	16.6	11.5	2.7	1.3	2.1	4.8
Politics and law	6.3	2.0	0.6	0.1	0.2	1.3
Physical culture and sports	0.2	0.2	0.6	0.1	0.2	0.8
Arts	2.4	1.9	0.6	0.8	0.6	0.5

Table A-2
China: 1982 Graduates, New Entrants, and Enrollment, by Academic Specialities

	Percent		Enrollment	
	Graduates	New Entrants	Four- to Five-Year Programs	Two- to Three-Year Programs
Total	**100**	**100**	**928,929**	**225,053**
Engineering	37.7	32.6	362,763	35,451
Agriculture	7.1	5.8	54,764	9,563
Forestry	1.2	1.0	11,020	452
Medicine and pharmacy	5.7	9.4	144,267	19,771
Pedagogy	28.3	30.9	149,532	139,916
Humanities	6.0	5.1	55,649	4,014
Natural sciences	8.9	6.5	79,140	1,992
Finance and economics	2.9	5.8	45,341	10,639
Politics and law	0.3	1.6	12,562	2,073
Physical culture and sports	1.2	0.8	8,875	630
Arts	0.7	0.5	5,988	552

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