Buying Hens Not Eggs: The Acquisition of Communications and Information Technology by the Peoples' Republic of China

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Program on Information Resources Policy

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Executive Summary

- Foreign trade and investment from the United States has become increasingly important to the Chinese economy. Although trade in communications and information (C&I) technologies makes up only a small percentage of overall Sino-American trade, the market for those technologies in China is potentially vast.

- China's capabilities to produce electronic components, telecommunications equipments, and computers are limited but growing. The range of electronic technologies produced by the Chinese is characteristic of an industry in transition.

- Large production increases have not been matched by increases in quality, however. In 1985 the Chinese semiconductor industry resembled the American and Japanese industries of the mid-1960s. Moreover, fundamental infrastructure problems still hamper development.

- The government is nonetheless determined to modernize the electronics industry and transform it into a leading component of the economy. Acquiring advanced Western technology and adopting modernized management methods are critical elements of the Chinese strategy. They will make every effort to understand and absorb imported technology with a goal of achieving self-production and increasing their capacity for self-reliance.

- The environment for business in China is shaped not only by socialist ideology but also by timeless Chinese cultural values. Although the government has a hand in all dealings, increasing decentralization means that the Western business person will not deal with a monolithic trade ministry but with a bewildering plethora of agencies in a nation that has spent millennia perfecting bureaucracy.

- While the Chinese have passed numerous laws since 1979 intended to provide a favorable climate for foreign investment and business operations, the ambiguity of many of these laws has left Western business people cautious. The Chinese believe that rule by virtuous men is a better method of regulating conduct than rule by law; invoking the law to settle commercial disputes is a last resort.

- The Chinese prefer joint venture agreements for the acquisition of foreign technology rather than simple purchase or sales agreements. However, the Chinese are also tough bargainers, making joint ventures the least popular form of contract for Western investors. Further, as the frustrations of doing business in China accumulate, the rate of all foreign investment has declined.

- On the other hand, Western companies have too often left their business sense behind. Enticed by the seeming promise of the vast Chinese market, they have agreed to terms and practices that can't be sustained. With misperceptions on both sides, the situation can be summed up by a phrase the Chinese sometimes use of old married couples: *tong chuang yi meng* -- same bed, different dreams.

- The Chinese are capable of very advanced work in the computer sciences, at least on a narrow front where they are willing to concentrate resources. However, they may not be using their installed computer base to best advantage.

- The Chinese concentration on hardware development and acquisition, to the detriment of software development, may have been a critical impediment to the adaptation of computers for information, as opposed to numerical, data processing. China's effort to modernize her sparse telecommunications infrastructure will be critical to her development of advanced computer networking.

- The language itself is another major stumbling block. Although numerous Chinese character input methods exist and are being developed, the absence of a standard methodology for inputting, storing, accessing, or generating Chinese characters continues to impede the development of applications software for business.

- The lack of competent, mid-level managers who can understand computer applications for productivity derives in part from the persecution of intellectuals during the Cultural Revolution. The increasing replacement of political cadres with experts may help China apply C&I technologies to administrative and management problems. Recent political events have again raised the specter of repression, however, and with it the fundamental question of whether China can enter the Information Age without also reforming her political system.

- Whether to continue control of dual-use C&I technologies exported to China is a chief policy issue confronting U.S. government officials, the Congress, and business executives. Despite considerable liberalization of export control regulations, some critics charge that the U.S. export licensing process remains a mire of undecipherable bureaucratic red tape that attempts to control too many products and technologies.

- U.S. policy supports China's economic development and considers her a friendly, non-allied country whose prosperity will help stabilize East Asia. The likelihood that China would divert militarily significant Western technology to the USSR seems remote. However, Chinese applications of advanced technologies to military weapon systems raise national security questions for the U.S.

INTRODUCTION

Through the end of the century, United States policymakers will face questions, problems, and issues generated by the demand for high-technology transfers to the People's Republic of China (PRC). One key issue concerns the kind and quality of dual-use communications and information (C&I) technology that the United States will allow to be exported to the PRC. The U.S. policy trend in the mid-1980s has been to liberalize restrictions on C&I technology transfers to China. Generally, American business people have welcomed this trend, but it has generated some controversy within the government. Liberalizing U.S. export policies toward the People's Republic has both benefits and disadvantages. Thus economic and national security implications of C&I technology transfers to China will be explored in this report.

Government officials recognize that technology transfers to China can have profound effects on both our foreign policy and on defense relations with that no-longer-sleeping dragon. Business people have found that there are both opportunities and pitfalls associated with China's opening to the West. This report is written both for the general public interested in the key issues affecting relations between the PRC and the United States and for officials in the U.S. military, government, and industry who engage in or set policy affecting one of those key issues, namely the transfer of dual-use C&I technologies to China.

On her part, China is struggling to reform and modernize her economy -- and her leaders firmly believe that developing a viable telecommunications infrastructure and adapting the power of C&I

technologies to her needs must be a major part of that process. They are determined to acquire the technology to do so.

Accordingly, this report aims to:

- Provide a brief survey of the current technological level of the Chinese electronics industry, which is the foundation of C&I technologies.

- Provide a basic understanding of the environment the Chinese have created for foreign investment and for the transfer of advanced C&I technologies into their economy.

- Examine the ability of Chinese society and the Chinese economy to absorb these technologies.

- Discuss the transfer of C&I technologies to China within the context of U.S. export control policies.

- Examine some of the implications of the trend toward liberalization in U.S. export control policies toward China.

Background

With the death of Chairman Mao Zedong in September 1976 and the arrest of the Gang of Four (Mao's wife Jiang Qing and three of her cohorts in the Central Cultural Revolution Group) in October of that year, the Great Proletarian Cultural Revolution sputtered to an end. A decade of upheaval and chaos came to a close, and the new Chinese leadership (by late 1978 consolidated under Deng Xiaoping) turned from class struggle to economic reform. The late Premier Zhou Enlai's call for Four Modernizations (first proposed in 1965, then renewed the year before his death in January 1976) became the banner under which the whole country would march toward a goal of quadrupling the gross value of China's industrial and agricultural output by the year 2000.

As with all other mass movements in China, the Four Modernizations (modernization of agriculture, of industry, of science and technology, and of the military) are a slogan under which a myriad of concrete policies are subsumed. The Chinese face major problems in attempting to reform and modernize their economy. Feeding, clothing, and sheltering more than 1 billion people at something above a subsistence level is a problem that could easily absorb most of the productive capability of the country. As a result, the reform and development of agriculture receives the first priority in the Four Modernizations. To modernize successfully, however, the Chinese must also develop an advanced infrastructure to support the agricultural, industrial, and service sectors of their economy. As a key part of the modernization of industry, the energy, transportation, and telecommunications sectors of the industrial economy receive the second highest priority in Chinese development efforts. The third priority, scientific and technological development, supports the entire modernization effort. Modernization of the People's Liberation Army ranks only fourth in the current Chinese blueprint.

One of the chief policy thrusts of the Four Modernizations has been a startling reversal of China's previously self-imposed isolation from the world economy. Although self-reliance remains a key principle of Chinese economic and foreign policy, the Chinese now believe they must obtain Western technology and adopt some Western management methods to achieve their economic goals and to attain self-reliance. As a result, they have adopted an open-door policy, inviting the West to invest in and trade with China on an unprecedented scale. Technology transfer from the West has become a major objective of the open-door policy --

particularly the transfer of advanced C&I technologies. The Chinese believe that C&I technologies -- computers, telecommunications, and electronics -- are vital to their attempt to develop an advanced infrastructure that will support the entire modernization effort. However, to integrate C&I technologies successfully into their development efforts, the Chinese must face, and successfully resolve, a number of problems, some typical of any developing economy, others uniquely Chinese.

Overview of Major Problems, Issues, and Questions

Problems

The problems associated with the transfer of C&I technology to China can be categorized according to their relevance either to the Chinese themselves, to Western business people, or to Western governments. For the Chinese, the problems include structural difficulties bound up with their attempts to reform a planned economy while simultaneously trying to attract Western investment. They also include problems the Chinese are experiencing in absorbing the high technology they have acquired and plan to acquire. For Western business executives, the chief problem is how to assess the risks and weigh the possible gains of entering the Chinese market for high technology. For Western governments, and most notably the United States, the primary problem is how to strengthen and expand trade and commercial relations with China, particularly in areas of high technology, without giving away technologies that provide a qualitative advantage to Western military weapons systems or a competitive advantage to Western high-technology companies.

Within each of these categories there are subsets of problems. In attempting to reform what has been a rigidly planned economy, the Chinese must deal with problems ranging from the misallocation of resources resulting from an irrational pricing system to determining a proper balance between centralized and decentralized planning in the development of various industries. Some problems are structural. In attempting to attract Western investment, the Chinese have passed a host of laws dealing with taxation, joint ventures, patents and trademarks, and other areas of commerce. Many of these laws contain incentives designed to create a favorable environment for Western capitalists. Despite an acute awareness that their legal system needs strengthening, however, the Chinese have a cultural bias against regulating the affairs of men by laws alone. The results include not only inconsistent administration of the laws but also ambiguities and gaps in the laws themselves. For instance, the Chinese failure to pass a copyright law that would protect Western software products has become a grave impediment to C&I technology transfer. This gap in their legal system reflects the Chinese failure to acknowledge the concept that intellectual property rights should exist and be protected, a failure due more to a Chinese than a communist world view. This bias against legalism creates a great deal of uncertainty in the minds of Westerners, whose own tradition is to rely on law (and particularly the precedents of case law) to regulate their business affairs.

In weighing the risks and benefits to be gained from entering the Chinese market for high technology, Western business people face the fundamental problem of obtaining accurate, relevant information about a very alien environment. Faced with a non-alphabetic language that is unreadable without extensive study, an ethnocentric (and sometimes xenophobic) culture that has not been fundamentally changed by a mere four decades of communism, and a government that sometimes considers economic statistics as state secrets, the Western business person must stake a great deal on trust. Once committed to any venture more complex than a straight contract to buy or sell, the Westerner will find him- or herself working, on a daily basis, with a bureaucracy created by the civilization that invented bureaucracies. Misunderstandings, frustrations, and realizations short of expectations are an almost inevitable result.

A major national security objective of the United States is to prevent the Soviet Union and its allies from acquiring advanced, militarily sensitive technology that gives the United States and its allies a qualitative edge over Soviet weapons systems. The administration of the U.S. Export Administration Act, which was passed into law to achieve this objective, has led to continuing problems for those seeking to promote high technology trade and technology transfer to the Chinese. Most C&I technology is dual-use technology; that is, it can be adapted to both military and civilian uses. The problem of determining what technologies to allow the Chinese (considered by Administration policy to be a friendly but non-allied country under the terms of the act) to acquire, and what technologies to deny to them, can have no easy, much less long-term, solution. While there is little fear that the Chinese would pass technology furnished to them along to the Soviets, there is much to fear from the possibility that Chinese-made weapons incorporating U.S. technology might be sold to other nations unfriendly, or even hostile, to the United States.

Furthermore, until some history of coincidental Sino-U.S. interests is achieved in regions such as the Korean peninsula and the island of Taiwan which lack a natural equilibrium, providing the Chinese technologies that may allow them to develop weapons systems comparable to our own is not in the best interests of the United States. The Chinese insist on their right to pursue an independent foreign policy. That is a right which the United States respects, but which allows for the development of serious differences between the U.S. and China.

Issues

These problems give rise to issues in which the various players -- the Chinese, Western business people, and Western governments -- have competing stakes. There are also factions within each of these groups of players, with issues arising between players in the same group, as well as between the groups. The issues discussed and analyzed in this paper are:

- Issues among the Chinese

While the top Chinese leadership is publicly committed to reforming the economic system and to opening China to the West, millions of mid- and lower-level bureaucrats appointed to office during the Cultural Revolution remain in power. They often oppose the change and innovation that will be required to reform the system. Many are conservative precisely because they lack the technical and managerial skills that will be needed to succeed under the reforms. At stake for them are their livelihood and the power they obtained by being "red" rather than "expert." At stake for the top leadership is the success of the Four Modernizations, and the commitment the leadership has made to the Chinese people to quadruple output by the turn of the century.

As the Chinese have expanded the number of locations within the country where foreign investment will be allowed, and have simultaneously delegated more decision-making power to provincial and municipal governments, regional rivalry and competition for government development funds and for foreign trade and joint ventures has been stimulated, particularly in high technology areas such as electronics. While this can be healthy, the absence of an effective pricing system to regulate competition can also make the rivalries dysfunctional. Investment decisions made for political rather than economic purposes have led to misallocations of resources (particularly foreign exchange and energy). While the Chinese have begun to reform the pricing system, they risk underdeveloping some regions and overdeveloping others as they seek to strike a balance between the demands of their socialist ideology and the requirements of an efficient economic system.

- Issues between the Chinese and Western business firms

Technology transfer itself has generated a number of issues between the Chinese and Western businesses. Few Western firms initially approached the Chinese with a view toward anything other trade. To the Western business person, China is attractive as a potential market of 1 billion-plus people. The Chinese wanted, and want, much more than trade, however. Unwilling either to deplete their foreign exchange reserves, or to borrow extensively (even at concessionary rates of interest), the Chinese want to establish joint production ventures with Western firms whenever possible. Furthermore, rather than opening their domestic market to the products of such joint ventures, they want most production to be exported, so the country can earn more foreign exchange to finance those imports which they have no capability to produce themselves. In high technology joint ventures (particularly electronics), they also want technology transfer, so they can learn and assimilate modern production processes.

This Chinese desire for joint production ventures oriented toward the export market requires a much greater commitment, and carries much greater risk for the Western firm, than do simple trading ventures. Technology transfer also carries the risk that the Western firm may lose control of proprietary knowledge and techniques and create a competitor who can produce the same product for less because of lower labor costs. The Chinese did not promulgate a patent law to protect Western proprietary knowledge until 1985, and they still have no copyright law that protects technical data or software. The Western firm that agrees to transfer advanced technology to China must be willing to stake its current competitive advantage on the hope that in the long term it can establish such a mutually beneficial relationship with the Chinese that they will not seek to become competitors, but will instead continue the relationship for mutual profit.

- Issues of dual-use technology transfer

Of all the issues discussed in this paper, those raised by the transfer of dual-use technologies to China are the most complex and troublesome. The transfer of a single technology, such as fiber optics, can cause conflict and disagreement between the different executive departments of the United States government (primarily State, Commerce, and Defense), between U.S. firms desiring to transfer the technology and the U.S. government, between the U.S. and the Chinese governments, and between the U.S. government and its allies. The stakes in even a single case such as this can be enormous, involving judgments about the national security interests of the United States and its allies on the one hand, and potential market shares worth billions of dollars on the other.

Questions

Western firms seeking to invest in China and U.S. government officials concerned with technology transfer to that country may see critical questions in the preceding problems and issues.

For Western firms:

- What is the current Chinese capability to produce its own C&I technology?
- Do the Chinese have a strategy for acquiring Western C&I technology?
- Can the Chinese make joint ventures attractive enough to Western technology producers to obtain the technological capabilities they seek through such ventures?
- Will the traditional Chinese emphasis on self-reliance (autarky) limit the importation of C&I technology from the West?
- What mix of Western imports, technology transfers, and self-production will the Chinese seek to build a new C&I infrastructure?

For Western firms and government policymakers:

- What is China's capability to absorb advanced C&I technologies into its economy?
- What problems have the Chinese experienced while trying to adapt Western technology to their needs?

- Has U.S. government implementation of the Export Administration Act helped or hindered the private sector's capability to sell or transfer C&I technologies to the Chinese?

- Have the provisions of the Export Administration Act regarding China protected technology critical to U.S. national defense without unduly restricting or impeding the sale or transfer of other technology?

- What significant foreign competition can the U.S. private sector expect in selling to the Chinese market?

- What U.S. government actions could help or hinder the U.S. private sector's ability to compete with foreign suppliers of C&I technologies in the Chinese market?

General Approach

This research report is descriptive rather than prescriptive, and the information it contains is current through June 1987.* In discussing the numerous questions, problems, and issues which the Chinese acquisition of C&I technologies has raised for both Chinese and American policymakers, the report offers no recommendations for changes in the numerous policies it discusses, but limits itself to pointing out where some policies have been dysfunctional to their purposes. Some of the problems and issues discussed will be familiar, others will not. Hopefully, the perspective in which they are presented will be fresh, and therefore useful.

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* A 1988 addendum updates this text to include relevant personnel changes that occurred coincident with the October 1987 13th Congress of the Chinese Communist Party, as well as other germane developments.

A broad description of the Chinese electronics industry, which encompasses the technologies essential to the development of advanced communications and information processing capabilities, is presented in Chapter 1. The development of this industry ranks among the highest priorities in the modernization of the Chinese economy. After several false starts, the Chinese have devised a coherent strategy for its development, a strategy that hinges on the ability to create an environment that Western firms will find attractive for investment.

Chapter 2 discusses the Chinese environment for the transfer of C&I technology, particularly the role of the government and bureaucracy in foreign trade, the Chinese legal environment, foreign exchange constraints, the desire for joint ventures, and the Chinese orientation toward importing technology that can produce for export. While the Chinese have tried to create an attractive environment for Western investment, their history, culture, and political ideology, as well as Western ingenuousness, have all conspired to diminish the results of their efforts.

Chapter 3 explores the capacity of the Chinese society and economy to absorb the new electronics and C&I technologies. The decade-long Cultural Revolution had a devastating effect on the general level of education in China, an effect that raises questions about the capability of the Chinese to use productively much of the C&I technology they seek to import. As a result of this and other factors (among which is the difficulty of devising a standard, simple methodology for the input-output of the written language), there is not a demand for C&I technologies within China comparable to that within advanced Western economies. Most of the impetus for C&I technology development has been directed by the government. An inadequate telecommunications infrastructure, as well as a Chinese penchant for hardware rather than software development, has also affected the Chinese capability to absorb and apply new C&I technologies.

The final chapter addresses, from the U.S. government's perspective, the policy implications of the trade and transfer of C&I technologies to China. The U.S. government must balance its important commercial and foreign policy objectives of contributing to the modernization of China's economy and encouraging China's opening to the West with its equally vital national security objectives. The United States believes that a prosperous China that remains open to Western ideas will be more likely to contribute to peace and stability in the world than will a China that reverts to the revolutionary fervor of the Cultural Revolution. Nevertheless, significant foreign policy differences remain between the two countries (most notably over Taiwan), and there are no guarantees that relations will remain non-antagonistic.

Moreover, China's increasingly evident desire to become a major arms exporter to Third World nations may affect the U.S. government's willingness to allow the export and transfer of advanced C&I technologies to her. By their inherent nature, C&I technologies can be used for either military or civilian purposes. The control of such dual-use technologies by the U.S. Export Administration Act has been a major issue in the evolution of U.S. trade policy toward China. The final chapter discusses this issue in some detail, since it is, and will remain well into the 21st century, one of the most perplexing issues to confront U.S. policymakers.

China's capability to influence events in East Asia, the Pacific, and South Asia, as well as her relations with the Soviet Union, make the question of her technological capabilities and economic viability of vital interest to the United States. Productive and enduring relations among great nations are strengthened more by the satisfaction of mutual interests than by a common world view. The continued development of friendly Sino-American relations is much more dependent on the belief of both nations that their mutual interests are being satisfied than on ideological differences that will undoubtedly persist and continue to influence specific policies of both governments.

THE CHINESE ELECTRONICS INDUSTRY

Since the normalization of Sino-American relations in 1979, foreign trade and investment from the United States has become increasingly important to the Chinese economy. From slow beginnings, the volume of trade between China and the United States has expanded from $1.2 billion* in 1978 to $7.2 billion in 1985.[1] Even more important to the Chinese, American commitments for direct investment in China reached a cumulative total of $2.1 billion by 1985.[2] Having surpassed the Japanese in 1986, the United States is currently the second largest Western investor in the People's Republic, with approximately 13% of total foreign investment commitments in China.[3]

To date, communications and information (C&I) technologies imported from the United States make up only a small percentage of overall Sino-American trade. In 1985, the "computer and office machinery" category of trade with China equalled only $188 million.[4] Yet the market for these technologies (electronics, telecommunications, and computers) in China is potentially vast.

In their Seventh Five-Year Plan (1986-1990), the Chinese have set ambitious goals to construct and install a completely modernized telecommunications infrastructure within the country by the year 2000. With an installed base of 5 to 6 million phones, and one of the lowest phone densities in the world (0.4 per 100 persons),[5] the Chinese plan to spend $30 billion to double the number of phones installed by 1990 and to have 33 million installed by the turn of the century.[6] The

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* Unless otherwise noted, all monetary figures are cited in then-year dollars.

Chinese also have ambitious plans to transform and modernize their electronics industry, which had an estimated output value of $9.9 billion in 1985.[7] Most importantly, the Chinese market for consumer electronic products could become the largest in the world. In the 1850s, Englishmen mused "that the mills of Lancashire could be kept busy for a generation if only each 'Chinaman' would add one inch to his shirt-tail."[8] Today, Americans speculate about the 2 billion Chinese ears that could be covered with headphones plugged into small radios (and hope they're not sold exclusively by the SONY Corporation).

China's current capabilities to produce electronic components, telecommunications equipments, and computers are limited but growing. The following brief survey of Chinese electronics production capabilities establishes the baseline from which the Chinese plan to modernize and expand the industry.

The Chinese Electronics Industry

An electronics industry, as such, was virtually non-existent in pre-1949 China. With Soviet aid, the Chinese established a small-scale industry during the 1950s.[9] Beginning with the production of electron tubes, by 1960 five key factories had been built capable of producing radios, electronic computers, telephone exchanges, and television transmitters. More than 160 brands of radios were produced, including some semiconductor sets.[10] The Institute of Computation Technology of the Chinese Academy of Sciences designed and trial-manufactured China's first electronic computer in 1958. A factory in Tientsin also reportedly produced an analog computer in 1959.[11] From the beginning, the Chinese emphasized the development of a strong electronic components manufacturing capability.[12] This would give them a capability to do independent design work, and lessen China's dependence on foreign sources of supply.

Despite the turmoil in China during the Cultural Revolution (1966 - 1976) the Chinese electronics industry continued to grow, both in the output value and variety of its products and in its technological level. As China undertook the Four Modernizations and opened to the West after 1978, ambitious goals were set for electronics development. By 1986, the industry had grown to 2630 establishments -- more than 2200 industrial enterprises, 134 research institutes, and 56 schools (including six universities). Employing approximately 1.4 million people, the industry now produces more than 1300 systems in 20 major classes. Most components are of Chinese design and development.[13]

A 1986 report published in English and Chinese by the PRC's Ministry of Electronics Industry (MEI) includes a chart of electronic goods produced during the Sixth Five-Year Plan (1981 - 1985).[14] The chart is reproduced as Figure 1-1. Some interesting facts emerge from an examination of this chart. First, the range of technologies being produced is characteristic of an industry in transition. Production of electron tubes fell from a high of 31.4 million in 1981 to 18.9 million (-40%) in 1985, while the fabrication of semiconductors rose from a low of 633 million in 1983 to 1.3 billion in 1985 (+205%). Production of integrated circuits was up 314% (from 16.8 million in 1981 to 53 million in 1985), and other electronic components were up 220% (from 4.7 billion in 1981 to 10.4 billion in 1985).

Items	Unit	1980	1981	1982	1983	1984	1985	Five Year Plan Totals
Computers Large, Medium, Small	1	293	187	241	360	381	286	1748
Microcomputers	1	59	378	1561	5436	27089	35715	70238
Peripherals	1	5553	3672	3550	14206	69933	68228	165202
Communications and Navigation Equipment	10^3	791.7	782.7	845.5	1332.7	1204.7	2694.5	7651.8
Broadcast and Television Equipment	1	4933	4217	8342	6839	20322	62790	107443
Television Sets	10^3	2479	5174	5701	6423	9370	14597	43744
Black/White TV	10^3	2447	5024	5414	5895	8085	10812	37677
Color TV	10^3	32	150	287	528	1285	3785	6067
Radio Sets	10^3	27405	36338	15556	18434	20079	13873	131695
Cassette Recorders	10^3	824	1524	3285	4376	6742	11023	27774
Electronic Instruments	10^3	236	210	170	269	404	320	1609
Special Equipment	10^3	14.3	20.6	25.6	33.2	44.4	41.9	180
Electronic Components	10^3	4745220	6459840	4800030	5653090	8414450	10415820	40488450
Electron Tubes	10^3	27370	31370	21420	16090	15990	18850	131090
Semiconductor discrete Devices	10^3	677060	927750	633570	734210	1053650	1303760	5330000
Integrated Circuits	10^3	16840	12790	13520	23610	39280	52950	158990

Source: Ministry of Electronics Industry, 1986

Figure 1-1

Output of Main Electronic Products
1980 - 1985

The higher technology portions of the industry began to accelerate in 1983, and took off in 1984. This acceleration is most apparent in the microcomputer and computer peripherals production figures. The Chinese produced 1561 microcomputers in 1982 -- in 1983 they tripled production to 5436, but in 1984 they quintupled that number to 27,089. Assembly of computer peripherals followed an even steeper curve, from 3550 produced in 1982 to 14,206 in 1983 (+400%) to 69,933 in 1984 (+492%). Total output value of the electronics sector in 1984 was 21.4 billion RMB[15] (*ren min bi* - People's dollars, the basic Chinese currency unit), approximately U.S. $7.4 billion.* This was an increase of 40% over 1983 output and some 6% of total light industry output value.[16]

The Chinese attribute this sharp increase in production to internal management and planning measures taken under the policy of "readjusting, restructuring, consolidation, and improvement."[17] Increased coordination among producers and marketers of electronic goods at the state planning level,[18] the conduct of actual marketing surveys,[19] and reorganization and consolidation at the ministerial, provincial, municipal, and autonomous region levels are cited as areas where strong progress contributed to increased production.[20] Management shakeups (called "readjustment of the leading bodies") injected fresh ideas and younger blood into enterprises under the Ministry of Electronics:

> Of the 173 enterprises under the Ministry of Electronics, 165 had readjusted their leading bodies by the end of the year

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* 1984 output of the U.S. electronics industry, which equalled nearly 40% of the world's total output of electronic products, exceeded $200 billion.

> [1983]. . . . The average age of the leading personnel dropped to around 47 years from more than 50. Those who had received senior middle school education or higher increased to 85.9% from 60.5% whereas those with technical titles rose to 70.4% from 44.1%. The young and middle-aged leading cadres accounted for 37.36%. The readjusted leading bodies could decide things quickly and were proficient in directing production. Some opened up a new situation in their enterprises within a short period.[21]

While these measures helped to rationalize and invigorate the industry, China's opening to the West and subsequent acquisition of Western technology after 1979 was probably the factor critical to the large increases in production which began in 1983. In November 1985, Liu Jianfeng, Vice Minister of the Electronics Industry, stated that "during the past few years" China had imported 1135 items of advanced technology and equipment with a value of U.S. $1.37 billion.[22] Approximately one-third of China's key electronics enterprises were "completely or partially transformed" with the imported technology and equipment.[23] Also, a significant percentage of the increase actually came from assembly operations rather than from wholly indigenous production. For instance, of the 3.785 million color televisions output in 1985 (Figure 1-1), 3.5 million were actually produced with only limited Chinese components under assembly agreements with Japanese companies.[24]

In addition to these substantial increases in output, the Chinese also claim increases in the quality of the electronic components being produced. The mean-time-between-failures (MTBF) rate for black and white television sets has increased from 200 to more than 5000 hours, with some models exceeding the world standard of 10,000 hours. MTBF for color televisions was 15,000 hours.[25] The MEI points out Chinese successes in developing electronics for intercontinental ballistic missiles, communications satellites, 32-bit super-mini computers, and digital microwave and optical fiber communications technologies as examples of high performance/high reliability electronics production. MEI claims successful laboratory production of 3-micron integrated circuit (IC) technology and manufacture of 5-micron ICs on 3-inch wafers: "Not a few products have reached the international level of the late 1970s, while a batch of new products has reached the world standard at the beginning of the 1980s."[26]

Western observers do not rate Chinese capabilities so highly, however. Both press reports and comments made by U.S. electronics industry executives (after personal tours of Chinese factories) indicate that the Chinese have not grasped or implemented the process technologies and environments required for advanced electronics production. After touring several electronics production facilities in China, one American electronics executive characterized the Chinese semiconductor industry as very much resembling the American and Japanese industries in the mid-1960s.[27] Moreover, fundamental infrastructure problems still hamper development. Poor factory conditions (substandard environmental controls),[28] unreliable supplies of electricity and raw materials,[29] and a lack of technical expertise prevent yields much higher than 10% for wafers and 40% for transistors.[30] As a result, costs to produce 3- and 4-inch chips run 20 times what they would in the United States or Japan.[31] Most components are manufactured with a high proportion of hand labor.[32] While an abundance of labor would seemingly give the Chinese a comparative advantage, electronics component production is so exacting that automation is desirable to improve the quality of the product -- a fact that the Chinese themselves recognize.[33]

Of nine factories toured (and then reported upon) by a U.S. electronics industry executives group in March 1985 (see Chapter 2 below), only one (the Shanghai Radio Component Factory #14) was actually engaged in much electronic component production. This factory began to manufacture metallic oxide semiconductor (MOS) integrated circuits (ICs) and field effect transistors (FETs) in the mid-1960s, and complementary metallic oxide semiconductor (CMOS) devices in the mid-1970s. In 1985 it produced 52% of the CMOS devices for the Chinese market (about 4 million units). Yet in the opinion of the executives who toured the factory, prevailing environmental conditions and controls were so poor that production of 5-micron devices in commercial yields would just barely be possible at this facility.[34] At the Shanghai #5 Component Factory, which hoped to broaden its product line into erasable, programmable read-only-memory chips (EPROMs) and input/output devices (converters and interface circuits) all in high-speed CMOS, the "prevailing fabrication environment . . . would prevent commercial production of virtually all integrated circuits in common use today. The clean rooms visited by the delegation could not have sustained operations in the 5-micron range."[35] (By comparison, IBM is currently manufacturing state-of-the-art chips with features only 1 micron wide, while its newly announced 4-Megabit memory chip contains some features only .7 of a micron wide.)[36]

Other, more modern facilities in Shanghai, Shaoxing, and Guangzhou drew comments from the touring delegation about underutilization (or overcapacity) due to low observed activity levels, incomplete installation of imported equipment, and labor-intensive operations.[37]

Several of the factories were still under construction, but in most cases their potential to produce advanced electronics products was rated as only modest.

Regardless of this more sobering view of current Chinese electronics production capabilities, the government of the People's Republic is determined to modernize the industry and transform it into a leading component of the economy. Goals set in the Seventh Five-Year Plan call for a 16.5% annual growth rate, with output value to reach 60 billion RMB by 1990 (U.S. $19.4 billion).[38] Advanced technologies which the Chinese plan to acquire or develop include production capabilities for computer-aided design (CAD), computer-aided manufacture (CAM), and computer-aided testing (CAT); microprocessor production technology for very large scale integrated circuits (VLSI); and production capabilities for digital communications and switching technology as well as industrial electronics (process control and robotics) technology.[39] By 1990, the Chinese hope to have achieved a 1980s level of technology on a broad front.[40] These are ambitious goals; although the Chinese have a strategy for achieving them, their attainment is far from certain.

The Chinese Strategy for Developing the Electronics Industry

As the Chinese entered the final year of the Sixth Five-Year Plan, two top officials issued important policy statements outlining China's strategy for modernizing the electronics industry. Writing in *Hong Qi* (Red Flag), Jiang Zemin, former Minister of Electronics and currently Deputy Secretary of the Shanghai Party Committee, called for a rational approach to the development of the industry. To avoid "rushing headlong into mass action and developing in a blind manner . . . . it [would be] necessary to treat the whole country as one chessboard."[41] According to Jiang, just as the pieces on a chessboard require mutual support and coordinated moves to be effective, Chinese electronics development will require support from scientific research institutes and some reorganization and consolidation of enterprises to break down artificial barriers which can impede progress. In this effort, business must be separated from politics, and decentralized decision making must be allowed where appropriate.[42] In accordance with the principle of "limiting the objectives but giving prominence to major projects" China will concentrate on developing the microelectronics and microcomputer portions of the industry during the Seventh Five-Year Plan. The goal: "to speed up the development of the major electronic products for military equipment, electronic computers, communications equipment, and other means of production . . . and bring about the comprehensive and coordinated development of the electronics industry on a new technological foundation."[43]

To accomplish this, Jiang called for further opening to the West to acquire advanced technology and modernized management methods, developing the industry by stages but attempting to leap over certain stages to speed up modernization. In some areas, China would adopt a policy that is the opposite of development: Where society urgently needs products that the domestic industry cannot supply, China will import key components or even full sets of equipment to meet the demand. Even so, Jiang points out that the goal must always include a conscious effort to understand, absorb, and digest the imported technology so that China can eventually achieve self-production and increase her capacity for self-reliance.[44] Finally, Jiang called for a "restricted but adequate protectionist policy covering electronic products manufactured by our own country."[45]

Reinforcing Jiang's article, then Vice Premier Li Peng (now Premier), Chairman of the Leading Group for Electronics Development under the State Council (*Guowuyuan Dianzi Zhenxing Lingdao Xiao Zu*), penned an article in *Renmin Ribao* (People's Daily) in January 1985. He also declared that the "main task" of the electronics industry was to lay a solid foundation "so that it will be possible to achieve relatively great advances during the second decade [1990s]."[46] Criticizing "leftist policies" that kept the People's Republic from interacting with much of the West during her first three decades of existence, he urged his countrymen to take advantage of the recent open-door policy to take the road of "importing, digesting, developing, and pioneering" to modernize the electronics industry.[47] Joint ventures, based on equality and mutual benefit, as well as direct importation of advanced technology, would speed up China's own development and increase her capacity for self-reliance.

Premier Li outlined several specific policies that China will implement to speed her modernization. First, and most importantly, will be to place greater emphasis on the development and popularization of electronics applications for economic production. It is no longer enough to produce computers just for "number-crunching," an approach that the Chinese have followed in the past.[48] Software for specific applications must also be developed, particularly if computers are to be applied to management functions. In addition to direct effects on efficiency and productivity, applications software will stimulate demand for computers themselves, supporting the development of the electronics industry.

However, China's written language presents unique problems which have slowed the adoption of computers for business management. Although more than 400 systems to input-output Chinese characters have been developed,[49] a standard has not been agreed upon (see Chapter 3). Premier Li recognized this problem when he called for further research to "mature and perfect" information-processing technologies for Chinese characters.[50] Until a simple, easy-to-use method for entering and displaying Chinese characters on computer monitors is developed, it will be difficult to "popularize" computers for functions such as word processing, non-numerical database management, and other business applications.

Popularizing computers and computer applications is only a small part of the strategy to advance the electronics industry, however. The Chinese recognize that more emphasis must be placed on production to satisfy the market demand for consumer goods, even if such an approach seems antithetical to socialist mores. Li states that televisions and radio-cassette recorders should be mainstays of the industry, but China should gradually seek to develop new products as well, such as video recorders.[51] While Li rates current capability to assemble television sets as "great," he acknowledges that Chinese capability to produce picture tubes and other key components is not adequate and that emphasis should be given to developing an electronic component capability to match current Chinese assembly capabilities.[52]

Like Jiang, Li believes that some decentralization of planning and decision making will be necessary for progress. "We do not have to be overly worried about the current phenomena of 'disorderliness, disorganization, and miscellaneousness [sic]' in the production of television sets, radio-cassette recorders, and microcomputers," he writes. "Nor should we be afraid of production overlaps at low technological levels."[53] Rather, lower-level organizations should concentrate on improving the quality and lowering costs in the serial production of a variety of electronic products. Market forces, such as competition, will transform or eliminate inferior or expensive products. Mere administrative measures that direct the type and quantity of products an enterprise can produce are counterproductive, and only dampen the enthusiasm of the people for managing the electronics industry, according to Li.[54]

However, products requiring considerable investment, long development times, or advanced technology, "such as production lines for large-scale integrated circuits, large and medium-sized computers, program-controlled switchboards, and color-picture tubes, must be produced under unified state planning. . . ."[55] This is necessary to avoid waste and duplication of effort.

Finally, Li states flatly that the electronics and information industries* complement each other and must be developed in parallel. Modern communications require advanced electronics equipment. Large and medium-sized mainframes must often be networked to be useful. China wants to build "a national economic information management

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* Although Li states that any definition of the information industry must be multifaceted, in this context he is speaking primarily of "the methods used to transmit information and the instruments of communication."

system, a national scientific and technological information index system, automatic command systems, banking management systems, railroad operation and management systems, weather forecast information systems, and electric power grid monitoring and control systems."[56] To do so, the existing telecommunications system must be expanded and modernized so that many computers can be linked together to provide the desired data processing and management capabilities. "Therefore, the electronics and information industries must pay attention to close coordination, supporting and complementing each other, seeking mutual development."[57]

Several common themes, which outline a reasonably achievable strategy for developing the Chinese electronics industry, run throughout both these important policy statements. The first theme is that China must continue its opening to the West to acquire the technology she needs to modernize the industry. Even though some products or components will have to be imported for a time, until the Chinese can develop an indigenous capability to produce them, they must emphasize the acquisition of technology in all import transactions. Their preferred method of acquiring technology is to form joint ventures with Western firms either to assemble the product required (with as many Chinese components as possible), or to acquire the necessary processing technology to produce the item in its entirety. The second theme is that market forces should be relied upon (to a degree almost unprecedented in planned economies) to rationalize the industry. This policy approach assumes that decision making must be decentralized wherever possible, and that factory managers will have to pay attention to consumer demand, quality, and cost to be successful.

Scientific research must be linked to production, and vertically channeled information flows (the tendency for enterprises and institutes to furnish information only to hierarchical superiors) must be broken down so that newly gained knowledge can be shared and exchanged. Managers must emphasize the application of electronics (particularly computers) to production and management.

The Chinese are convinced that the world has entered a new age characterized by a scientific and technological revolution that began in the 1950s. With a typical Marxist penchant for "scientific" analysis of historical forces, the director of the Research Institute of Marxism-Leninism-Mao Zedong Thought of the Chinese Academy of Social Sciences states that, no matter what this new age is labeled (the "fourth industrial revolution" or the "third wave"),

> . . . the qualitative change of productive social forces has begun and science and technology will, in the foreseeable future, make a great breakthrough which can also be called a revolution. With the dazzling applications of microelectronics taking the lead, it will enrich and supplement people's physical strength and mental ability, and even enable them to reach unprecedented levels never before dreamed of.[58]

With this ideological blessing, the Chinese have taken the position (which they hold almost as an article of faith) that a modernized electronics industry is essential to economic development. Jiang Zemin states that it should have the "same importance and strategic position in economic construction as do energy and communications."[59] Premier Li Peng predicts that the electronics industry will "eventually become a mainstay of China's national economy,"[60] and that the "development and promotion" of both information and electronics "will play an inestimably large role in accelerating the pace of the four modernizations and in revitalizing our national economy."[61] With such convictions, it is small wonder that the Chinese government is willing to invest a significant portion of the national modernization effort into developing the electronics industry.

NOTES FOR CHAPTER 1

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2. U.S. Government, Department of Commerce. People's Republic of China, CY85. Unpublished fact sheet furnished during interview with Mr. George T. DeBakey, Deputy Assistant Secretary, Science and Electronics, International Trade Administration, U.S. Department of Commerce, January 16, 1987. Mr. DeBakey was extremely helpful, furnishing me several published and unpublished documents and reports relevant to this study.

3. "Foreign Investment in China: China's Sweeter," The Economist, October 25, 1986, pp. 70-71. Total foreign investment commitments to China totalled $16.2 billion by mid-1986. The $2.1 billion investment commitment by the United States is approximately 13% of all foreign commitments. The United States share of foreign investment in China is exceeded only by Hong Kong-Macao, by far the world's leading investors in China (70%). Actual capital inflows to China since 1979 have equalled only $4.6 billion, however.

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5. Quistorff, N. CMP Industry Sector Analysis: China - Telecommunications. Beijing: U.S. Department of Commerce, June 1986, p. 72. (Unpublished)

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16. Delfs, Robert. "Economic Monitor - China: The Turning Point," Far Eastern Economic Review, January 24, 1985, p. 72.

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20. Ibid., p. 275.

21. Ibid., p. 274.

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23. Ibid.

24. Quistorff, N. CMP Industry Sector Analysis: China - Electronics and Computers. Beijing: U.S. Department of Commerce, April 1986, p. 31. (Unpublished)

25. Ibid. See also "Electronics Now China's Fastest-Growing Industry" (note 22), and "Progress in the Electronics Industry" (note 17), pp. 273-74.

26. China's Electronics Industry, (see note 7), p. 1. Translated from the Chinese text.

27. U.S. Department of Commerce, Trip Report: U.S. Executives Electronics Mission to the People's Republic of China, March 1985, Transcript of Concluding Press Conference (Hong Kong, April 3, 1985, p. 8. (Unpublished) Furnished to me by Mr. George T. DeBakey and cited hereafter as Trip Report.

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29. Erlich, P.C. "China Turns to U.S., Japan for Know-how," Electronic News, Vol. 31, No. 1540, March 11, 1985, pp. 11SM, 20-21. [LEXIS Abstract]

30. Erlich, P.C. "China Chips Face Hurdles Ahead," MIS Week, January, 1985, p. 14. [LEXIS Abstract]

31. Ibid.

32. Quistorff, Electronics and Computers (see note 24), p. 31.

33. See Jiang, Zemin. "Invigorate the Electronics Industry, Promote the Four Modernizations Program," Hong Qi 18 (1984), in Thomas Fingar, Modernizing China's Electronics Industry: Prospects for U.S. Business. Stanford University: 1985, p.27. Jiang (a former Minister of the Electronics Industry) comments that "In our country, the principal purpose of automation is not the replacement of manual labor. Rather, it is to improve the quality of the products and to improve production efficiency and economic results . . . ."

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SAME BED, DIFFERENT DREAMS: THE CHINESE ENVIRONMENT FOR COMMUNICATIONS AND INFORMATION TECHNOLOGY TRANSFER

Shaped and colored by pervasive and seemingly timeless Chinese practices, attitudes, and mores, doing business in China is a unique experience for the Westerner. Despite the trappings of Socialism and recurrent slogans about the New China, the Chinese are no more able to completely throw off their ancient culture than the English or the French would be able to throw off theirs. Nor do they want to. The Western business person who would succeed in China must appreciate certain aspects of doing business in the Middle Kingdom* which can both frustrate and perplex the uninformed. Moreover, not understanding the Chinese environment can lead to real losses of business opportunities and profits.

The Role of Government in the Marketplace

Doing business in China above all means negotiating with the government. Foreign trade is a state monopoly in China, and any business person attempting to negotiate a contract or joint venture will inevitably have to secure approval from some governmental organ before negotiations can be concluded or a contract can go into effect. However, unlike the case in some centrally planned economies, the Westerner will not deal with a single, monolithic ministry in the course of contract negotiations. While most foreign trade is still carried out by Foreign Trade Corporations (FTCs), the Chinese have begun to implement the policies outlined by Premier Li and increasingly

* *Zhong Guo* -- the Middle Kingdom -- is what the Chinese have called their country since ancient times.

are decentralizing the process of buying from abroad, allowing provincial and lower-level governmental units to determine their requirements for Western technologies and to negotiate imports or joint ventures directly with Western firms. Decentralization has also meant that more state-owned factories and factory managers are directly involved in negotiating foreign contracts or business ventures.[1] Authority to approve a contract or joint venture is not always clear, however, and the Westerner is well-advised to determine, at the beginning of the negotiating process, the exact authorities the Chinese negotiating team can exercise.

Initial proposals can be made to an FTC. Seven of these state-owned corporations have an interest in electronics. Along with their supervising ministries, they are:[2]

Foreign Trade Corporation	Supervising Ministry
China Great Wall Industrial Corporation (GWIC)	Ministry of Space Industry
China National Aero-Technology Import and Export Corporation (CATIC)	Ministry of Aviation Industry
China Nuclear Energy Industry Corporation (CNEIC)	Ministry of Nuclear Industry
China National Electronics Import and Export Corporation (CEIEC)	Ministry of Electronics Industry
Oriental Scientific Instruments Import and Export Corporation	Chinese Academy of Sciences
Xinshidai Company of China	State Council
China National Machinery and Equipment Import and Export Corporation (EQUIMPEX)	Ministry of Machine Building Industry

Although the China National Electronics Import and Export Corporation (CEIEC) is the primary FTC that deals with electronics, each of the other FTCs listed, and their respective ministries, has a substantial interest in foreign electronics technology. In addition, since 1985 more than 100 independent and ministry trading houses, including scores of provincial trading houses, have emerged to trade in telecommunications and electronic equipment.

For American business people new to China, the plethora of government ministries, factories, and trading houses with an interest in foreign trade at both the national and local levels can be bewildering. During the March 1985 executives' electronics mission to China briefly discussed in Chapter 1, which was sponsored by the U.S. Department of Commerce (DOC), American business executives and DOC officials met with or visited the following governmental units and Chinese electronics firms:[3]

Beijing:

Government Units: Ministry of Electronics Industry (MEI), Ministry of Foreign Economic Relations and Trade (MOFERT), the State Council Leading Group for Invigoration of the Electronics Industry, Ministry of Posts and Telecommunications, Ministries of Metallurgy and Aviation.

Firms and Factories: China Electronics Import and Export Corporation (CEIEC), Beijing Semiconductor Factory #3, Beijing Wire Communications Factory.

Shanghai:

Government Units: Vice-mayor and Shanghai Electronics Industry Bureaus.

Firms and Factories: Shanghai Radio Component Factory #5, Shanghai Radio Factory #14, Shanghai Computer Factory (Nanjing Rd).

Hangzhou:

Government Units: MEI, Electronics Bureau Hangzhou, Hangzhou City and Regional officials.

Factories and Firms: Hangzhou Magnetic Recorder Factory, Shaoxing #871 Electronic Devices Factory.

Guangdong Province:

Government Units: Electronics officials from South China headed by Guangdong Province leaders, Shenzhen City and Special Economic Zone officials.

Factories and Firms: CEIEC-Guangdong, Electronics Industry Corporation, Hua Nan Computer Factory, Ai Hua Electronics Corporation, Huayun Semiconductor Factory.

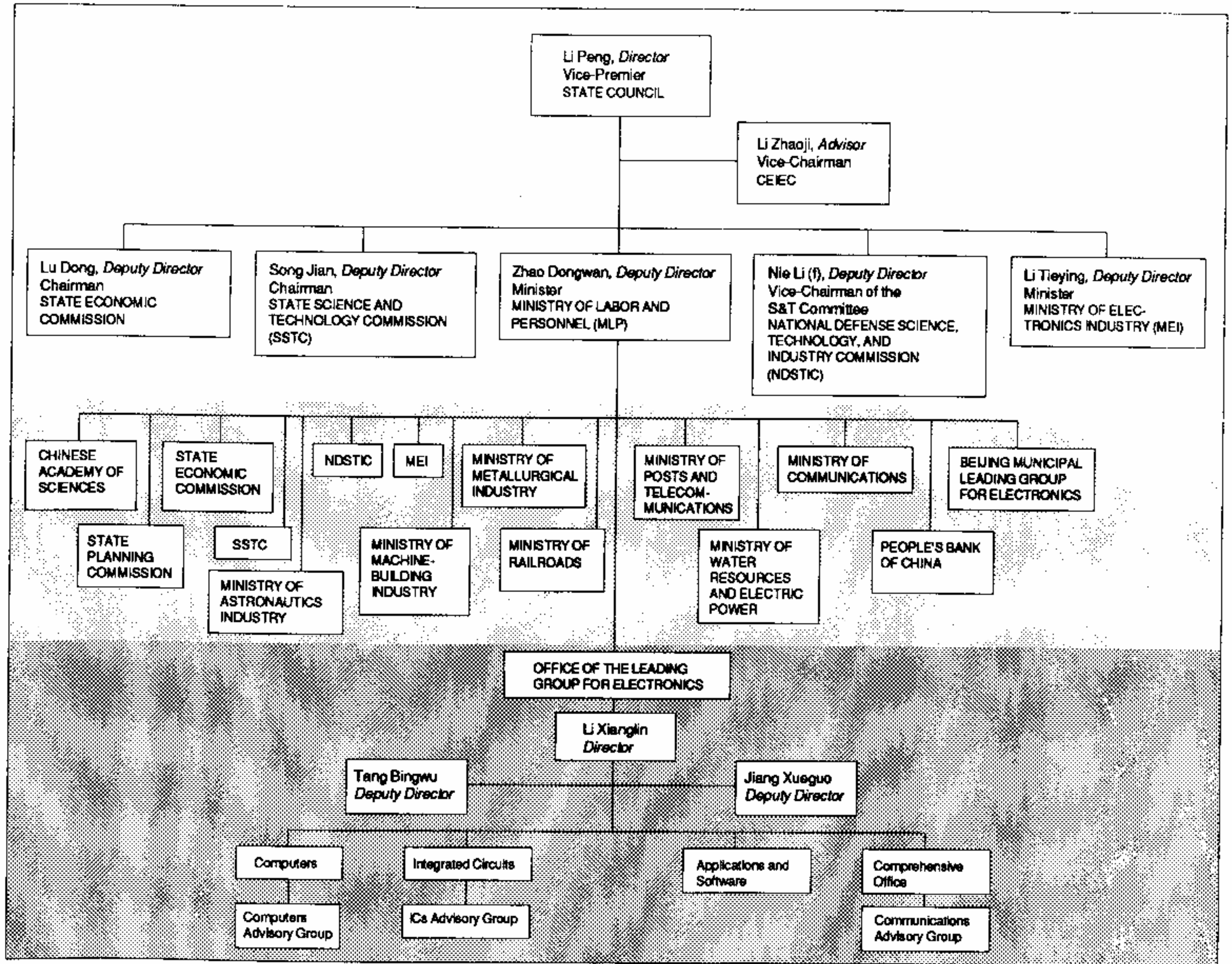
After the trip, several participants indicated to the DOC sponsors that this two weeks in China provided them with contacts that might have taken one to two years to establish on their own.[4]

The Chinese have had over three millennia to refine and perfect the bureaucratic form of government, and the People's Republic has not abandoned the tradition. Professor Denis Fred Simon of Tufts University has analyzed the bureaucracy associated with the Chinese electronics industry and, in what he calls the "Shanghai Example," he describes a five-level decision-making process for import approval, from the factory up through the central government.[5] The number of steps required for approval apparently depends on the projected cost of the imported project. While Shanghai is unique in wielding more authority over local enterprises than do other Chinese municipalities, the "Shanghai Example" is a useful paradigm of the Chinese bureaucratic process.

For example, a factory (level 1) may propose -- and even enter into negotiations with a foreign firm -- to import a component production line. Such a proposal would be initiated within the general boundaries of the investment strategy set by central planners in Beijing. The factory is usually part of a corporation (level 2) and will need corporate approval to conclude the purchase and sign a contract. Corporations generally can approve projects valued up to $2 million. If the project exceeds that amount, however, the corporation must seek approval from the next level up, which in the case of Shanghai is the Shanghai Electronics and Instrumentation Bureau (level 3). That bureau can approve projects with a value up to $5 million. Above that amount, the decision will be kicked up to the Shanghai Municipal Government (level 4), which theoretically can approve projects up to $10 million in value. In practice, however, the municipal government will usually consult with the central government (level 5) in Beijing before approving projects costing between $5 and $10 million.[6]

In Beijing, the Ministry of Electronics will usually have the "action" to approve the project, but the Leading Group for Electronics Development under the State Council, formerly headed by Vice Premier Li Peng, and the State Planning Commission may also get involved. Set up in 1984, the Leading Group can cut across ministerial boundaries in determining and carrying out broad policies to coordinate the development of China's fragmented electronic industry. The Leading Group operates on three levels (see Figure 2-1). The top tier includes the director of the Leading Group and five other minister/vice-minister-level heads of key commissions or ministries. The middle tier is composed of 15 or so organizations heavily involved in research, development, and production of electronics and computers. The bottom tier, which actually does the substantive day-to-day work of developing and implementing an overall electronics and computer development strategy, is the "Office of the Leading Group." Composed of four functional subgroups, the Office gathers expert advice from advisory bodies under each subgroup and furnishes that advice and policy recommendations to the middle tier of the Leading Group. The Leading Group then works closely with the State Planning Commission and other groups to ensure that funds are made available for priority projects and technology imports that will further its broad development policy.[7]

In most cases in which a significant amount of hard currency must be expended, the Ministry of Foreign Economic Relations and Trade (MOFERT) and the State Economic Commission will also coordinate on project approvals. Under regulations issued for the administration of technology import contracts (see below), MOFERT, or an agency designated by MOFERT, must approve the form of any technology import contracts that involve technology transfers. Other ministries that are members of the Leading Group, such as the Ministry of Posts and Telecommunications or the Ministry of Communications, may also need to coordinate.[8]



Source: Reprinted from The China Business Review, March - April 1986, with permission from the National Council for U.S. - China Trade.

Figure 2-1

Leading Group for the Invigoration of the Electronic Industry

While this process may seem linear and straightforward (except at the central government level), in practice, decision making is often complicated by other factors. Other ministries outside the Leading Group (such as those listed with their respective FTCs above) have an interest in electronics and seek to build up their own supporting infrastructure. Regionalism, a traditional bane of the central government, can lead to intense competition for government funding and scarce foreign exchange (e.g., Simon discusses the rivalry between Shanghai's Caohejing district and the city of Wuxi, in Jiangsu Province, for the establishment of a second government-sponsored electronics research-production center, loosely modeled after California's Silicon Valley or Boston's Route 128 corridor.)[9]

While it is not unique to China or even to Asia, there is also the infamous "rice-bowl" syndrome, the personal interest of bureaucrats (usually in keeping their jobs secure) expressed as an insistence that only one exquisitely refined procedure, which may only be accomplished by one person or office, must be followed to accomplish any official action. While going "out of channels" or over an official's head may succeed on rare occasions, it is not a wise practice to follow if the official must ever be dealt with again. He may not only "lose face" by being bypassed, but the possible meaninglessness of his approval may be revealed, a definite threat to his livelihood. The foreigner trying to buck the system will be doubly resented, and can expect severe difficulty and delay the next time around.

The Chinese Legal Environment

To facilitate foreign trade, the Chinese have passed numerous laws and regulations since 1979 which are intended to provide a favorable climate for foreign investment and business operations. However, the ambiguity of many of these laws and uncertainty over their interpretation and implementation (which in practice can vary widely by region) have left Western business people cautious. Civil law has never played the role in Chinese society that it has in the West. In this respect, the Confucian mold of the past has carried over into the new communist state.

Stanford Law Professor Victor H. Li's monograph on Chinese law, Law Without Lawyers, provides unique insights into the role of law in traditional Chinese society and in the new communist state, a role vastly different from the role of law in the West. While the rule of law "is one of the philosophic and political cornerstones of Western society . . . in China this term was used in a critical or derisive way, at least until the end of the 19th century."[10] The traditional Chinese ruler governed not by the application of law but by *ren*, which is usually translated as "perfect virtue". The Chinese character for this word is the ideograph for "man" and for the numeral two -- the combination conveys the concept of the benevolence that must link each man with his neighbor.[11] The ideal ruler was a man of *ren*, who not only governed his own conduct by this principle, but by his example inspired the people to do likewise. When all men internalized *ren*, law was not needed to ensure a tranquil society. When law had to be resorted to, it was a sign that society was breaking down.

Therefore, avoidance of the law was the norm for Chinese society. Disputes, and particularly commercial disputes, were to be settled without resort to the law if at all possible.

This deep-seated attitude toward law was carried over into the New China by Mao Zedong and the legally untrained communist cadres who governed the People's Republic. Although laws were promulgated and courts set up, the people were governed more by intensive persuasion and education (carried out by millions of new communist cadres) than by the formal legal system.

> The new cadres contended that better than the *rule of law* is a kind of *rule of man* wherein enlightened and conscientious officials would rule under the supervision of vigilant and concerned masses. So long as all people are knowledgeable about what is happening, make every effort to carry out their work properly, and are willing to speak up whenever any impropriety is seen regardless of who is the perpetrator or the victim, then society will operate smoothly and individuals will be well protected.[12]

Without a large body of lawyers to interpret the laws and assist people to use the law to settle disputes, many functions handled by the courts in the West are handled by non-legal organs in China.[13] To ensure that the laws promulgated can be taught to and understood by the masses, most laws are kept simple. By Western standards, that means they are ambiguous as well.

Since 1979, the PRC has promulgated many new laws and regulations with the objective of encouraging foreign trade and investment in China's economy. The <u>Law on Joint Ventures</u> (1979), <u>Tax Laws for Joint Ventures</u> (1980 and 1983), <u>Rules for Foreign Exchange Controls</u> (1983), <u>Rules for Double Taxation</u> (1984), and <u>Patent Law</u> (1985) have all been issued. A copyright law (particularly important to software companies) is under consideration but has not yet been promulgated. Many of the laws have been updated or otherwise modified as both the Chinese and foreign firms have gained experience in dealing with each other. Yet the updates and modifications have not been uniformly encouraging to the expansion of trade, joint ventures, and technology transfers. While the Chinese profess a sincere desire to encourage trade, they often appear to have incorporated provisions in updated laws and regulations that they were otherwise unable to obtain through negotiations. Certain provisions of the Regulations of the People's Republic of China for the Administration of Technology Import Contracts, issued in May 1985 by the State Council, illustrate this.

Article 6 of the Regulations requires the supplier of any transferred technology to "guarantee that the technology being provided is complete, free of error, effective, and can achieve the objectives stipulated in the contract."[14] Moreover, before a contract can be approved, the approving agency must determine "whether the contract has reasonable provisions on the technical standards the transferred technology should attain, *including a guarantee of the quality of the products produced using the technology*.*"[15] Chinese negotiators had long sought such quality guarantees. Western firms would be very reluctant to grant them unless the "objectives" of the contract were very clearly defined and other contractual stipulations could assure that the technology recipient would apply the technology properly.[16] The new Regulations require the guarantees for contract approval.

Furthermore, restrictive contract clauses that would require the recipient of the technology to "accept supplemental conditions . . . including the purchase of *unnecessary* technology, technical services, raw materials, equipment or products," are prohibited by Article 9 of the Regulations.[17] Although special approval of such conditions can be

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* Emphasis added.

obtained, arbitrary interpretations of what is or is not "necessary" leave Western firms open to the risk of having to guarantee the quality of products produced by their technology with no control over the raw materials, equipment, or technical services the Chinese partner can use.

The approval process for technology import contracts set forth in the Regulations also contains a provision which, while seemingly helpful, actually puts the Western firm further at risk. The Regulations provide that after the contract is signed, the Ministry of Foreign Economic Relations and Trade (MOFERT), or the agency designated by MOFERT to be the approving authority, must grant approval within 60 days. If the approving agency fails to make a decision within this period of time, the contract is deemed approved and automatically goes into effect. While a seemingly effective means to goad the notoriously slow Chinese bureaucracy into acting expeditiously on agreements submitted for review and approval, the provision is a double-edged sword. Approved contracts are issued a certificate which is required to carry out other necessary transactions, such as securing bank letters of credit and guarantees, payments, foreign exchange settlements, customs clearances, and tax payments.[18] It may be impossible to carry out the contract, even though it is deemed effective, without the necessary certificate. Furthermore, if the contract contains any restrictive provisions that require special approval under Article 9 of the Regulations, automatic effectiveness of the contract after 60 days does not apparently include the special approval needed to make the restrictive provisions legal. A Western firm with such an "automatically effective" contract on its hands may be holding a legal document of very uncertain value.[19] The uncertainty generated by this provision of the Regulations will only be resolved by actual practice -- years could pass before it becomes clear how all the provisions of the regulation will be applied (if the regulation itself is not changed in the meanwhile).

All contracts contain provisions for the settlement of disputes, and very often the Chinese will agree to third-country arbitration. The China National Technical Import Corporation (Techimport), which has in the past negotiated the bulk of all contracts involving technology transfers, has a standard clause that refers disputes to arbitration in Stockholm under rules set forth by the Stockholm Chamber of Commerce.[20] Recourse to Chinese courts is also possible, though not advised. The foreigner who has a commercial dispute with a Chinese partner is much more likely to gain satisfaction through conciliation and compromise than through legal remedies.[21] This reflects the traditional Chinese preference to regulate affairs between people on the basis of correct relationships and on internalized values accepted by society, rather than on the basis of law. In commercial relations, the pervasive Chinese assumption is that both parties have entered into a long-term relationship where each has a duty to make the relationship work toward its intended ends.[22] Evidently, this mind-set has prevailed in Chinese commercial relations with normally litigious Westerners. In the thousands of newspaper and magazine articles reviewed during research on this paper, the author has found no mention of litigation between Chinese and Western firms. Furthermore, as of late-1985, and despite the probability that thousands of contracts contain the Stockholm arbitration clause, very few disputes involving the PRC have been referred to that forum for settlement.[23]

As the preceding discussion of the technology import regulations illustrates, despite the promulgation since 1979 of numerous laws intended to facilitate foreign trade, the importation of technology, and ultimately the modernization of Chinese industry, U.S. businesses will find a legal climate in China very different from the one they take for granted in this country. The Chinese rely much less on law and legalisms to regulate business and interpersonal relations than Americans do. Ambiguity in the laws, and rule by men who will not necessarily be bound by precedent, are the norm. Negotiation, conciliation, and compromise are the preferred methods for settling disputes. Lawsuits will be avoided if avoidable. In this respect, the new socialist man in his Mao jacket differs but little in the process he uses to regulate the affairs of society from his ancestor in a long Confucian gown.

The Chinese Preference for Joint Ventures

The Chinese have reasons to prefer joint venture agreements for the acquisition of foreign technology rather than simple purchase or sales agreements. They have burned themselves badly in the past when they purchased, and then attempted to operate on their own, turn-key plants or production lines without fully understanding the technology involved or the management practices required to achieve successful production. Acquiring a partner who furnishes the technology desired and who will help set up and operate either an entire new plant or a newly modernized production line in an existing factory for a number of years in a joint venture is one of the surest ways available to acquire the "know-how" the Chinese desire above all else. Technology, after all, is not a machine, or a production line, or even the product made by a production line. Technology is a process. As Fred J. Bucy put it, it is "the design and manufacturing know-how required to produce goods. It is the hundreds of detailed steps necessary to manufacture products to meet specific needs."[24] The Chinese have realized this, and are determined to acquire the process, not just the machinery.

Chinese officials almost invariably mention joint ventures when they speak of the importation of Western technology which they need to modernize their electronics industry. Premier Li Peng has written, "Based on the principle of equality and mutual benefit, we should develop joint ventures with foreign investors and cooperate with them in the production of electronic products and the development of technology. . . . When we import foreign electronic equipment we should also import technology."[25] For high technology joint ventures, the Chinese offer incentives ranging from non-specific promises of commercial preferences to favorable tax treatment. In May 1984 Zhang Jingfu, a former head of the State Economic Commission, promised increased access to the Chinese market for firms willing to transfer advanced technology, particularly if it was not currently available in China. He was most interested in electronics technology.[26] Another Chinese official said, "while some countries may export equipment a little more cheaply to China and withhold advanced technological know-how, others may meanwhile sell equipment at a somewhat higher price but include advanced technology also. To be frank, we would prefer the latter [though] of course cheaper equipment plus transfer of technology would be more welcome."[27] Joint ventures contracted for more than 10 years qualify for exemption from income tax for two years after first making a profit and pay reduced rates during years three through five. The Chinese contracting party can also reduce the 20% withholding tax to 10% by contract, while the Ministry of Finance can waive the remaining 10% withholding tax if the technology being transferred is considered of "high importance" to China.[28]

While attractive on the surface, the tax rate incentives do not provide as strong an incentive as the Chinese probably think they do. Differentiation of rates based on the length of the contract compels a long-term commitment to qualify for a favorable rate, and it is left to the Chinese to determine whether the technology transferred is "advanced" or of "high importance." As a result, Chinese negotiators have a wide margin within which to maneuver. As Y. Y. Kueh and Christopher Howe have noted in the China Quarterly, "This individualized approach is characteristic of Chinese trade practices, and has long been a source of confusion and complaint."[29]

The Chinese Environment for Joint Venture Investments

The Chinese also persist in acting with two minds when it comes to negotiating joint ventures. Access to the domestic market, which is probably the greatest incentive the Chinese could offer to a Western business firm, remains among the most difficult concessions to gain. Most joint ventures negotiated with China to date call for at least some of the production to be exported. This arrangement not only offsets the foreign exchange expenditure needed to acquire the technology or obtain components which the Chinese still can't produce domestically, but it also limits Western market penetration. Furthermore, in the long run it provides the Chinese the capability to become a competitor. Kueh and Howe state flatly that "it is an approach in sharp contrast with the practice of most industrializing nations in Asia, where foreign investment is part of a policy of import substitution."[30] Despite their talk of "equality and mutual benefit," the Chinese always attempt to gain as many concessions and give as few benefits as possible in any joint venture. One U.S. commercial consul described the Chinese mind-set this way:

> Basically, what China means by a joint venture is "You come to us. You bring us the capital. You bring us your most up-to-date, state-of-the-art technology. You even bring us the market that we can sell into. Then you teach us everything you know. And, after 15 or 20 years, after we've mastered your technology, we say goodbye. You leave and go back to where you came from. And then we take your product, which you taught us to make, and which we can now manufacture in our country cheaper than you can manufacture it in your own, and we compete with you in the international market."[31]

It has taken several years for the difficulty of doing business in China to become apparent. When the Chinese flung the door open in 1979 and invited foreign investors into the country to reinvigorate its economy, the response was enthusiastic. In fact, 2645 equity joint ventures, 4075 contractual joint ventures, and 130 wholly owned foreign subsidiaries were formed in China during the period 1979 to mid-1986.[32] However, only a small percentage of this investment was in the "foreign-exchange-earning, export-oriented high technology" the Chinese most desire.[33]

Until the mid-1980s, wholly owned foreign subsidiaries were restricted to the Special Economic Zones *(Shenzhen, Zhuhai, Shantou, and Xiamen)* which the Chinese first set up in 1979. Of the types of joint ventures commonly formed in China, the equity joint venture, which requires the greatest commitment and the highest risk by the

Western investor, has been the least popular.* As of April 1985, the China Business Review could list only 55 U.S. manufacturing equity joint ventures established in China since 1979, with a value of approximately $1.029 billion. Thirty-nine (71%) of these were capitalized at $5 million or less. One very large $600 million coal-mining venture, between Occidental Petroleum Corporation and the China National Coal Development Company/Bank of China Trust and Consultancy Corporation, accounted for over 60% of total U.S. investment. Fifteen of the joint ventures involve the production of electronic and telecommunications equipment. The largest of these is the $50 million China-Wang Computer Joint Venture, Ltd., a three-year venture to produce low-end VS (virtual storage) computer products, including software.[34] Furthermore, the rate of all foreign investment has been declining. New commitments of foreign capital to China declined to only $1.24 billion in the first half of 1986, down 20% from the first half of 1985.[35] Promises do not always lead to actual investments either, for only one-fourth to one-third of the amounts pledged have actually been invested. Since 1979, of the $16.2 billion promised by foreign investors, only $4.6 billion has been invested.[36]

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*Equity joint ventures are characterized by the formation of a limited liability corporation by Chinese and foreign partners to include joint investment and operation, with mutual sharing of risk, profits, and loss by the partners in proportion to their individual equity. Contractual joint ventures may or may not involve the setting up of a separate corporation. The foreign partner generally contributes technology and sometimes material not otherwise available in China, while the Chinese partner contributes land, real property, labor, and other material. Profits are shared according to the terms of the contract, with the foreign partner generally receiving a relatively rapid payback of his investment. See Jennifer Little, Betsy Saik, and Beth Keck, "U.S. Manufacturing Equity Joint Ventures in China (As of April 1985)," The China Business Review, May-June 1985, p. 33.

Although many U.S. companies are currently profiting from their investments, some of the problems that have discouraged a greater rate of investment in China were detailed in a July 1986 front-page article in the Wall Street Journal. Excerpts from that article provide a good summary of the complaints most commonly expressed by Westerners:

> China's investment climate . . . has gone from bad to worse, from promising to "promises, promises." [There are complaints] of soaring costs, arbitrary tax and tariff levies, inadequate labor and numerous other annoyances. . . .
>
> China isn't competitive. . . . [U.S. Embassy messages] speak of "an investment environment which no one, except the Chinese, has yet characterized as attractive. . . . For those U.S. companies that have made the decision to invest, the initial costs have been very high and the risks very real, and the payoff is still years away. . . ."
>
> U.S. Ambassador Winston Lord said in a May 28 speech that "many business people are frustrated by high costs, price gouging, tight foreign exchange controls, limited access to the Chinese market, bureaucratic foot-dragging, lack of qualified local personnel, and unpredictability. . . ."
>
> Chinese bureaucrats . . . often cripple ventures with endless quibbling and delays, infighting between competing ministries and departments, and corruption. . . .
>
> Chinese labor is neither cheap nor productive. . . . It costs Nike more to make shoes in China than in Maine. . . .
>
> Chinese bureaucracy has created [a labor shortage] for foreign companies . . . an outfit called the Foreign Enterprises Service Corp. (FESCO) monopolizes Chinese workers and assigns them to foreign companies. The workers are politically screened and trained to keep an eye on their foreign bosses. FESCO can't meet the demand for workers, so there are long waiting lists. Foreign firms must make do with whoever is assigned, Army-style. . . .
>
> Wages . . . are higher than those in most other Asian economies. Yet the worker doesn't draw this wage; he must kick back as much as 85% of his pay to FESCO.
>
> A French oil company reportedly paid $9,000 a month for a highly trained technician. The technician's monthly take-home pay: $54. . . .

> The estimated cost of maintaining a single expatriate staffer in Peking for a year now is $150,000 to $200,000. That doesn't include office rent, which ranges from $50,000 a year at the seedy Peking Hotel to $125,000 at the Great Wall Hotel.[37]

Specific complaints about tax and custom laws illustrate the uncertainty Western companies face when trying to gauge the risk of doing business in China:

> Although tax laws are published, each company's corporate and withholding tax must be negotiated around what Chinese officials deem to be "fair." Most foreign representative banks in China claim they are losing money . . . Chinese officials, not understanding why a bank would be in China if it was losing money here, simply don't believe their books, so local officials are formulating policies that will allow them to tax "deemed income. . . ."
>
> Import tariffs average 40%, compared with 5% to 6% in the U.S. A year ago [1985] the Chinese government tacked on a steep "adjustment tax," so that taxes and duties on an imported corporate car now run up to 230%. . . . To bring in a $2,000 personal computer for office use costs $1,800 in duties and adjustment taxes -- in theory. In practice . . . duties depend on the mood of the customs officer on duty.[38]

This environment, which has seriously affected the potential for communication and information technology transfers to China, is not totally the fault of the Chinese, however. Never integrated into the world economy, and with only a thin veneer of Westernization (most notably in Shanghai and Canton), the Chinese closed in upon themselves, seeking after their late-1950s split with the Soviet Union to become essentially self-reliant. Experimenting on a vast scale with radical economic and social models, they paid little attention to the paths of development followed successfully by Asian nations such as Japan, Taiwan, South Korea, and Singapore. With a tradition that emphasizes the rule of virtuous men (the new Socialist Man) rather than regulation by law, and with a natural self-interest to avoid exploitation and obtain the best possible terms for China, the Chinese have had difficulty learning how to attract the investment and technology they so ardently seek. After they opened the door and sought to attract foreign investment after 1979, they were, as James Sterba noted in the Wall Street Journal, "spoiled by a parade of business suitors willing to indulge any local whim to romance local hosts who offer only the vague promise of future intimacies."[39] In pursuit of the vast potential of the Chinese market, "many foreign companies have waltzed into China giddy about the prospects and ignorant of realities."[40] The resulting misperceptions are summed up by the Chinese phrase *tong chuang yi meng* -- same bed, different dreams.[41]

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CHINA'S CAPABILITY TO ABSORB COMMUNICATIONS AND INFORMATION TECHNOLOGIES

By the end of 1985 China had an estimated installed computer base of 165,000 microcomputers and 5500 minicomputers. Ninety thousand of the micros (55%) were 8- and 16-bit machines produced by the Chinese. Some 4200 of the minis (76%) were also produced in China.[1] Between 1977, when the DJS* series of microcomputers first went into production, and the mid-1980s, the Chinese prototyped (or produced in fairly small runs) nearly 50 different models of 8- and 16-bit micros.[2] In 1984, however, this almost experimental production history entered a new phase -- reportedly, the Chinese decided to concentrate indigenous production on the Great Wall (*Changcheng*) micro, a family of IBM-compatible 16-bit machines based on the 8088 CPU (central processing unit). An early version of the Great Wall reportedly has a 40K ROM (read only memory), 256K to 512K RAM (random access memory), two 5.25-inch floppy disk drives, a high-resolution display, and a parallel printer adapter.[3] It can run the MS-DOS, UCSD p-system, and CP/M-86 operating systems. It also runs Chinese character DOS (CCDOS), and has Chinese word-processing software containing 7000 characters.[4] Great Wall applications software for agriculture, medicine, construction, and national defense is being developed by the Chinese, who are also converting (often without authorization) American applications software packages to run in Chinese on the machine.[5]

Although the Chinese have declared that they will concentrate on developing the microelectronics and microcomputer portion of their

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* DJS stands for *Dianzi Jisuanji* - electronic calculating machine.

information industry during the current Five-Year Plan (see Chapter 2), they have not neglected the spectacular. In December 1983 the Chinese announced that they had produced their own supercomputer, the Galaxy (*Yinhe*) capable of executing 100 million instructions per second (MIPS) or approximately 20 million floating point operations per second (megaflops). The Galaxy was very near the state of the art in 1983, comparable in speed to the Cray-1 and Cyber 205 supercomputers (though the amount of memory the Galaxy supported was not announced). The machine was developed over a six-year period (beginning in 1978) through the cooperative efforts of more than 20 institutions led by the National Defense Sciences and Technology College.[6] A November 1985 article in the Beijing Review alluded to the fact that the Galaxy was a hand-crafted, one-of-kind machine.[7] It may also have been built largely from imported rather than indigenously produced components.[8] Nevertheless, its construction was an impressive achievement, demonstrating that the Chinese are capable of very advanced work in the computer sciences, at least on a narrow front where they are willing to concentrate resources. With only 165 or so supercomputers in the world, and nearly all of them in the United States, Western Europe, or Japan,[9] China has entered a club almost as exclusive as the nuclear weapons fraternity.*

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* Although comparable to the state of the art in 1983, the Galaxy has been far outstripped since then. By 1986, the Cray XM-P/48 computer, with up to 16 million 64-bit words of central memory, 4 processors, and peak calculation speeds of 1.2 billion floating point operations per second (megaflops) was available. ETA Systems was designing a machine, the ETA-10, with 8 processors capable of 10 billion megaflops and 64 million 64-bit words of memory. (See Roger A. Pielke, "Earth Sciences," in Yearbook of Science and the Future. Chicago: Encyclopaedia Britannica, Inc., 1987, p. 349.)

By November 1985 the Chinese reported that the Galaxy had provided more than 25,000 hours of "terminal service" in national defense and scientific research areas.[10] It had supported projects for more than 60 research teams sponsored by such entities as the Ministry of Nuclear Industry, the Ministry of Petroleum Industry, the State Meteorological Bureau, the National Seismological Bureau and Beijing University. It had been used to investigate the causes of earth tremors in China's seismic zones and to analyze intricate problems in high energy particle physics.[11] It is also highly probable that the Galaxy has been used for nuclear weapons research, cryptographic applications, and design problems in the Chinese aerospace industry, areas where the West has found the powerful capabilities of supercomputers particularly helpful.

Although China's installed computer base is small (only 2 to 4% of the world's total installed base of microcomputers), the gains the Chinese have made in computer production during the 1980s, their achievements (such as the Galaxy) in advanced computer sciences, and the proclaimed intention of Chinese leaders to put information technologies in the forefront of their drive toward modernization, have convinced many Western observers that the computerization of China is as inevitable as it has seemed to be in the West. The Japanese seem particularly convinced, as the following quotation from a Japanese report on computers in China demonstrates:

> The huge expansion in both domestic production and imports indicates a faster-than-expected diffusion of computers in Chinese society. . . . modernization and economic development must increase the volume of information by an enormous margin, and computers will inevitably be called on to process it.[12]

However, disquieting signs surface from time to time which indicate that the Chinese may not be using their installed computer base as well, or as effectively, as they could be using it. These signs range from Chinese admissions that "the speed of application development and extension is too slow to accommodate the development of the national economy"[13] to outright assertions that "approximately 80% of the computers in China are sitting in warehouses; they are not being used."[14] While a figure of 80% may be exaggerated, and idle computers are probably sitting in many more different places than warehouses, there is good evidence that the Chinese do not operate computers as we do. More than one source has pointed out that large, mainframe computer centers in China do not operate 24 hours per day (as most do in the West), but often close down for the night.[15] Furthermore, there is a wealth of anecdotal evidence indicating that many mid- and senior-level cadres simply do not understand how to put computers to good management use.

Joseph Y. Battat, who in 1978-79 served as the first "Technical Foreign Expert" in China since the departure of the Soviets in 1960,[16] relates a story that illustrates some of the problems that can be experienced when the Chinese try to apply computers to management projects (rather than to scientific research and development). Battat was hired as a consultant by a large industrial ministry, and worked at one of the ministry's universities during most of his 15 months of employment. His primary task at the university was to develop, and then teach, a Systems Engineering Teacher Training course. While Battat judged the first course he taught to be a failure (due to numerous infrastructure and attitudinal problems), he taught a second course in data processing to a small, select group of students who had finished the first course. As part of the course, the students undertook a project to design an automated payroll system for the university. Seven months after beginning the course, the students successfully tested the payroll system for three months in parallel with the university's manual system.

According to Battat, this student-developed application was probably the most advanced payroll system (in its design) in China at the time. He estimated that it reduced human computation and data manipulation requirements by up to 1000-fold and manpower by a factor of 12. Furthermore, it incorporated a university-wide faculty and staff identification code system and a database designed to form the basis for other computerized systems which could be developed by the university. Yet, despite the successful test and the advanced features of this application, the university decided not to adopt it.[17]

Battat cites several factors that may account for this decision (including low labor costs and the problem of relocating displaced personnel), but concludes that the primary reason the system was not adopted was that the "university leadership did not truly appreciate the significance and level of the technology embodied in the payroll system."[18]

This anecdote is but one example of many indicating that, outside of the military and scientific research and development areas, China is having some difficulty effectively utilizing the computers it has produced and imported. Critics charge that managers of financial and industrial enterprises have not rushed to acquire computers and to apply them to management problems, or if they have bought and installed computers, they haven't used them seriously and effectively to increase productivity. In many ways, however, these charges, and the anecdotes related about China, are reminiscent of charges leveled and anecdotes told about American managers who sought to cope with computer technology for the first time within the past decade.

The key question to answer in trying to determine how well China is adapting to the computer revolution is not whether China is experiencing any difficulties in absorbing information technologies. Rather, the question is, or should be, is there anything peculiar to China (culturally, socially, or politically) that will make it difficult for the Chinese to take full advantage of the computing capabilities they are determined to acquire? What do the Chinese lack that will impede or delay their entry into the Information Age? What peculiarities, if any, does China have that might do the same?

To answer this question, several specific areas must be examined. The first is the software side of the Chinese information industry. This essential component of the industry has lagged far behind hardware development, considerably hampering China's progress toward computerization. A second area for examination is the current state of China's telecommunications capabilities. Increasingly, advanced computer applications in the West are coming to rely on networking to link individual micro- and mini-computers together for efficiency and to provide new services. However, as was briefly mentioned in Chapter 1, China's telecommunications infrastructure is so sparse that it will not be able to support large scale networking, either local or long distance, for some time. The third area is the Chinese language, which is probably the most difficult of the world's major languages to adapt to computer usage. Fourth is the capacity of China's human resources (in education, in government, and in industry) to adopt advanced managerial techniques that lend themselves to computerization. Because of the continuing effects of the Cultural Revolution, that capacity is still questionable. Finally, current political attitudes and problems within China could completely halt progress on China's Four Modernizations, and thus could halt progress in its information industry.

China's Information Industry

There is considerable evidence that the Chinese concentration on hardware development and acquisition, to the detriment of software development, has been a critical impediment to the adaptation of computers for information, versus numerical, data processing. Complaints were still surfacing in technical and business publications in mid-1985 that "applications software [for Apple IIs and IBM PCs] is almost nonexistent"[19] and that "Chinese PC users are starved for applications."[20] In 1984, China had only 30 software development centers and approximately 10,000 software people in the entire industry.[21] This contrasts with the 1.4 million people and 2600 enterprises in the electronics industry as a whole.[22] Prior to 1984, software development was uncoordinated, leading to unnecessary duplication of effort, while it was more common than not for computer buyers to have to write their own applications software for the machines they purchased.[23] There were very weak links between hardware producers and software developers, leading to very little synergism between the two.

Moreover, technical service centers for after-sale service and support to computer buyers were almost non-existent. So also were any sales networks for either Chinese-made software products or for foreign software. Without technical support and marketing, computer purchasers were pretty much on their own to learn how to use their machines and to develop their own applications. Nevertheless, many managers rushed to buy or to import computers when government and party leaders proclaimed that computers would be an essential part of China's modernization.

This rush to acquire hardware, without much thought given to how the hardware could be employed, accounts for much of the reported underutilization of computers in China. Even where sound applications for computers were developed, the peculiarities of China's government and economy inhibited the spread of such applications to other enterprises. With many managers appointed for their political reliability rather than their managerial or technical expertise, with no profit incentive, with very little advertising allowed, with no marketing or sales networks, with institutional barriers to lateral information flows between similar enterprises, with no patent law in place until 1985 and no copyright law to protect computer software developers, there were few, if any, incentives built into the Chinese system to promote the spread of good ideas. Instead, there were slogans and the "mass line"* of the Four Modernizations. These could promote the acquisition of computers, but were totally inadequate to promote their effective utilization.

In 1984 this situation began to change. The "Leading Group for the Computer and LSI Industry under the State Council," which had been established in October 1982 to guide computer and LSI (large-scale integrated circuit) R&D, production, and acquisition, was replaced by the "Leading Group for Electronics Development under the State Council" under the leadership of then Vice Premier Li Peng. This new "Leading Group" began to steer the industry away from its previous emphasis on the hardware development side, and attempted to "transform the electronics and information industry into a new industry which will permeate the entire economy and society."[24] The "Leading Group's" mandate is to build, by 1990, an infrastructure within China for digital electronics. It functions as a policy forum to set strategic priorities for the expansion and development of China's information industry (see Chapter 1).[25] The former Minister of the Electronics

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* Developed by Mao Zedong in the late 1920s, the "mass line" is the technique that bases the implementation of Marxist doctrine on the "mentality, needs, and interests of the common people." (See Fairbank, John King. The Great Chinese Revolution 1800 - 1985. New York: Harper & Row, 1986, pp. 238, 247, 257.) Filtered by Marxist ideology, the common people's ideas of what China needed could be widely propagandized, often by setting up an individual (almost always a poor peasant or soldier) or a collective as an example of right conduct. One of the most famous examples of the mass line during the Cultural Revolution was the slogan "In Agriculture, learn from Dazhai." Dazhai was a small agricultural brigade in Shanxi to which millions of Chinese peasants trooped to learn the virtues of hard work, self-reliance and cooperative living. The discovery after Mao's death that Dazhai had accepted millions in government subsidies, and that its ever-increasing production statistics were fraudulent, contributed to the downfall of Mao's immediate successor, Hua Guofeng, and the rise of Deng Xiaoping. See Butterfield, Fox. China: Alive in the Bitter Sea. New York: Times Books, Inc., 1982, pp. 403 - 404.

Industry, Jiang Zemin, specified some of the ways that computers could be used to "greatly increase production, raise work efficiency, and lower consumption of raw materials and energy, thus achieving big economic results."[26] He claimed that if computers had been used in 1980 to control automatically and regulate the 230 billion kilowatt-hours of electricity generated by Chinese thermal power plants, coal consumption could have been lowered by 23 million tons.[27] Foreign experience showed that, applied to railroad transportation, computer-assisted operations and management could increase efficiency 25 to 30%; if China achieved only a 10% increase in efficiency, 200 million more tons of material resources could be transported each year, earning the railroad system an additional 100 million RMB.[28]

Jiang called for a "large increase in the number of people engaged in the making of software, processing of information, and rendering of technical services."[29] Using his chessboard analogy (see Chapter 1), he stated:

> The electronics industry is a complex industry of high-level techniques that demands coordinated development, linking the parts with the whole, the fundamentals with the completed equipment, hardware with software, production of a single unit with production of a whole series of units, and production with technical services. It demands close union between scientific research and production and adaptability of production scale to market needs.[30]

China intends to increase the number of software development centers to several hundred by the mid-1990s, and to increase the number of personnel in the software industry to more than 100,000 in the same period.[31] The China Computer Technical Service Corporation (CCTSC), founded in 1980, expanded to 33 branches by the end of 1985, for the first time attempting to provide computer purchasers with "high quality technical services" on a nationwide scale.[32] Showing a good understanding of what is needed, the general manager of CCTSC, Ouyang Zhineng, was quoted in the Beijing Review as saying that "Marketing, popularization, technical service, and installation and maintenance are the four major tasks in computer service."[33]

China's universities are also becoming heavily involved in software development, and are beginning to concentrate on the types of general purpose, business, and management software that China most needs. Beijing University is researching data acquisition and database management techniques, as well as laser photocomposition for Chinese characters. Nanjing University is working on Chinese word-processing software. The People's University of China (Beijing) is developing applications for national economic and statistical databases, as well as other Chinese information processing systems. Qinghua University has taken a leading role in the development of applications software packages for mini- and microcomputers.[34] Other universities and technical institutes are producing a wide variety of software, to include financial analysis systems, production management systems, economic information management systems, process control and monitoring systems, and engineering project systems for industrial and transportation enterprises.[35]

The Chinese are also becoming increasingly interested in establishing standards for software engineering. The China Software Technology Corporation (CSTC), established in February 1984, in tandem with CCTSC (its sister company) works under the aegis of the National Computer Industry Bureau. Both corporations, The China Business Review has reported, are involved with the bureau in "national planning work associated with the development of new software, and the creation of various standards and disciplines in software engineering."[36]

The Chinese have realized that their past concentration on hardware production and acquisition, to the neglect of software and applications development, has been a stumbling block on the road to harnessing the power of computers to assist in the modernization of their economy and society. Their more balanced and integrated approach since 1984 promises to speed their progress toward more effective utilization of the computer resources they have acquired and increasingly are producing.

Computer Networking and the Chinese Telecommunications Infrastructure

As computer technology became established in the developed nations of the West as an indispensable tool for business management, the benefits of linking micro- and minicomputers in networks also became apparent. Even with their tremendous capability to perform a wide variety of functions in a stand-alone mode, micros and minis nevertheless acquire a whole new set of capabilities when they are linked together. The most apparent added capability is communications, and electronic mail was one of the first applications developed for networking. The ability to send reports, memoranda, and data (both graphic and alphanumeric) to other computers in a network, within the same department, across departmental lines, or to branch or regional offices of a business, has increased the crossflow of information tremendously, because of both the ease and the speed of electronic mail. Data sent computer-to-computer is also in a form that lends itself to further manipulation and analysis by the recipient of the data. This is generally not true of data sent by other media such as paper. With appropriate privileges, microcomputer users can also use the network to access a wide range of databases maintained on a mini or mainframe file-server. Centrally located databases can be updated and kept current by one department and yet be accessible simultaneously to all who need the information they contain. For certain applications, such as computer-aided design, local work stations can perform preliminary design functions autonomously, then send design data to a more powerful machine in the network for further processing. This capability leads to more efficient use of the more powerful machines, which aren't tied up with a lot of input-output functions. Financial institutions in particular have developed so many new applications dependent on networking that it has become indispensable to their operations.

In many Western nations, except within single buildings or building complexes that have had special cabling installed for local area networks (LANs), most networks are supported by the local, long-distance, and international telecommunications infrastructures of their societies. Whether a computer must communicate with another across a room or across the country, the installed telecommunications infrastructure supports the communication. In the West, these infrastructures have been developed, installed, and improved over the entire course of the 20th century. They represent capital investments by private enterprises or public ministries of hundreds of billions of dollars. The telephone network is so dense in the United States that 92.3% of all households have telephones.[37] No business in this country, no matter how remotely located, can operate without one.

The development of inexpensive modems for microcomputers, based on the RS-232C serial transmission standard, has allowed the telecommunications network in the United States easily to support point-to-point computer communications at transmission rates of 300 to 2400 baud with acceptable error rates. Without this in-place telecommunications infrastructure, computer networking could not have developed as it has in the United States and other Western countries.

In contrast to the West, the Chinese telecommunications infrastructure is extremely sparse, and in its current state of development cannot reasonably support computer networking. As mentioned in Chapter 1, nationwide telephone density is among the lowest in the world (0.4 per 100 persons). In 1985, there were somewhere between 5 and 6 million telephones installed in China, with approximately 1 million of these installed in urban areas and connected to public networks. In the entire country, the total number of phones connected to networks is lower than the number of phones installed in Hong Kong. Beijing, the capital, has only 250,000 phones to serve all of government and its population of 9 million.[38] In 1986, the Asian Wall Street Journal Weekly reported that there were only 1862 international telephone and telex lines serving the country.[39] IBM China has had to be satisfied with only one poor-quality, low-baud-rate data-communications line between its offices in Beijing and its mainframes in Hong Kong.[40]

Even if China achieves its goal of having 33 million telephones installed by the turn of the century, population growth may keep telephone density to 2.0 phones per 100 persons.[41] This will remain far below the world average, which in 1984 was 12 phones per 100 persons.[42]

Installed telephone technology in China also remains backward by Western standards. Rural areas are still served by manual switchboards and open wires. Urban telecommunications are supported by a mix of technology which includes manual switching (35%), step-by-step (32%), crossbar (24%), semi-electronic (6%), and rotation switching (3%). Calls are completed successfully only about 50% of the time.[43] A Beijing-to-Shanghai call takes an average of four hours to complete.[44] Faced with a telecommunications infrastructure that one U.S. executive in China called "diabolical," many foreign companies have not even tried to establish connections between their home offices and their offices in Beijing or elsewhere in China. Instead, to interface their computers at home with their computers in China, they mail floppy disks back and forth.[45]

The Chinese are well aware of the deficiencies of their telecommunications infrastructure and of the potential effect these deficiencies could have on the growth of information technology in China. They have made modernization and expansion of the telecommunications infrastructure a top priority in the Seventh Five-Year Plan. Modernization will be selective, with the coastal cities that have become trading centers and the industrialized northeast receiving the bulk of the most modern equipment. The Ministry of Posts and Telecommunications (MPT) has stated that its priorities for modernization are stored program control (SPC) digital switches, digital transmission media (microwave and satellite), data transmission, fiber optics, and automated maintenance and supervision of the network. Refurbished crossbar systems will be installed to service rural areas.[46]

Pyramid Research, Inc., a Cambridge, Massachusetts, consultant in public telecommunications policy, estimates the Chinese will need to install 19 million main lines and replace 5 million lines to reach their goal of 33 million installed telephones by the year 2000. The company also estimates that long distance lines will increase nearly tenfold by the end of the century (see Figure 3-1). "Direct dialing for all local subscribers is planned by the year 2000, and top priority is being given to non-voice services."[47]

(000 units)	1985	1990	2000
Telephones	5900	10000	33000
Main Lines	5800	8800	25000
% Digital	2%	15%	84%
Trunk Circuits	36	96	300
% Digital	2%	79%	97%

Source: Pyramid Research, Inc. Telecommunications Development Report, December 1986. Reprinted by permission.

Figure 3-1

China: Public Network Expansion, 1985-2000

As with computers and other electronics, China is seeking technology transfer as well as direct imports to supply the hardware and know-how required to modernize her telecommunications infrastructure. The Chinese are particularly interested in advanced switching technology and fiber optics production technology. Although they have been developing fiber technology since the 1970s, quality remains poor (4 or 5 dB loss per km)* and production capacity is limited (5000 to 20,000 km per year).**[48] Until early 1986, however, U.S. opposition to transferring fiber optics technology to China prevented anything but direct sales.

In an extensive article on the prospects for Northern Telecom sales in China, Lawrence Surtees has written in the Toronto Globe & Mail that the Chinese are planning extensive use of fiber optics to build new networks "in and between China's large industrial cities and the five foreign investment zones along the southern coast."[49] The MPT is planning to build a 2400-kilometer line, to be completed by 1990, from Nanjing to Chongqing via Wuhan along the route of the Yangtze River. After a change in the rules of the Coordinating Committee on Multilateral Export Controls (COCOM) in late 1985 (see Chapter 4), the Chinese signed more than 24 agreements and contracts for fiber optic joint ventures and equipment with European countries and Japan. One agreement with Furukawa Electric Co., Ltd., of Japan will provide the Chinese a factory in Xian capable of producing 20,000 km of fiber a year.[50] With the signal quality, capacity, and security fiber optics can provide, it is the technology of choice for Chinese long-distance lines and even for some intra-city applications.

The Chinese also have been able to obtain significant technology transfers in the area of digital switching. Shanghai Bell Telephone Equipment Manufacturing Co., Ltd., the 1983 joint venture between ITT's

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*Such poor quality fiber would require signal amplifiers (repeaters) every 5 to 10 kilometers to maintain an acceptable signal strength. By contrast, the best Western fiber optic technology in production as of 1986 requires repeaters only every 200 kilometers.

**Demand for fiber optic cable in the United States was projected at nearly 100,000 kilometers for 1987.

Belgian subsidiary BTM, the Belgian government, and the MPT's China Posts and Telecommunications Industrial Co., Ltd., which was formed to transfer ITT's 1240 digital switching system technology to China, cut over its first locally produced model 1240 switch in December 1986.[51] China is reportedly seeking a second major switching supplier to form a joint venture with the Ministry of Electronics Industry.[52] Efforts since 1985 led by the U.S. Department of Commerce to liberalize export controls further (see Chapter 4) may also make more of the technology available which China needs to modernize her telecommunications infrastructure. The success of China's efforts to modernize her telecommunications infrastructure will be critical to her development of advanced computer networking applications.

The Chinese Language

There is another major stumbling block to the development of Chinese applications for computers. That is the Chinese language itself, which has not been easy to adapt to computers and keyboard input methods. Many Westerners, because they observe a superficial similarity between written Chinese and Japanese (the Japanese began to adopt Chinese ideographs for their own writing system after the fifth century), assume that the two languages are similar. Knowing that the Japanese have made considerable progress in overcoming the difficulties of adapting their language to computers, they assume that the Japanese solutions should work equally well in China. This is most definitely not the case, however. In fact, the two languages are unrelated, and it may be an accident of history that the Japanese did not develop an alphabet before they borrowed Chinese characters for writing.

Unlike most languages in the world, Chinese is a tonal, not a phonemic language. It is largely monosyllabic. Chinese words are made up of morphemes, individual units of sound with meaning, such as *ma*, or *wang*, or *yin*. However, each of these morphemes can have several meanings, depending upon the tone (steady, rising, falling/rising, falling) with which it is spoken and the other morphemes with which it is associated. Thus *ji* (steady tone) can mean a chicken, while *ji* (falling tone) can mean a carp. *Ji* (steady tone) at the end of a string of other morphemes means machine, as in *dian hua ji* (electric speaking machine -- telephone). These brief examples suggest some of the problems involved in attempting to input Chinese into a computer with a keyboard: Because of the great number of homophones (words with identical sounds but different meanings) the language is just not very amenable to romanization, or to the use of an alphabet to represent words. Its tonality will also complicate any efforts to develop an oral input system, a type of user interface in embryonic experimentation/development for some Western languages. In fact, its tonal basis led the Chinese to invent ideographs to write the language -- the only adequate method which has yet been found to immediately represent meaning to a reader.

In contrast to tonal Chinese, Japanese is an agglutinative language characterized not by monosyllabic, but by polysyllabic words which are toneless but highly inflected (modified by a great number of particles which alter the meaning of root words.) Edwin O. Reischauer, the noted scholar of Japanese history and a former ambassador to that country states:

> . . . there is no greater linguistic contrast in the world than that between the Sinitic and the agglutinative languages. . . . [the Korean and Japanese] languages today remain fundamentally and irreconcilably different from Chinese, contrasting with it far more sharply than does English with ancient Greek, or Russian with Hindi and the other North Indian languages.[53]

The essential difference between the two languages in terms of their adaptability to computers is that Japanese is phonemic, and can be represented with 17 of the letters of the Roman alphabet plus two diacritical marks (an alphabet called *Romanji* by the Japanese).[54] Japanese words can be typed into a computer according to their sound because the written language is phonemic, rather than ideographic like Chinese.[55]

As briefly mentioned in Chapter 2, there may be as many as 400 different Chinese character input systems under development in the PRC. Most of these depend on two basic technologies. The first stores the Chinese characters on either floppy or hard disks; the second generates the characters by the use of a specialized microprocessor, a Chinese character "generator." If not built-in, these character generators can usually be plugged into the back of most microcomputers.[56] The multitude of input methods being developed all seek either to access the stored characters on disk, or to command the character generator, in different ways. Some of the more promising systems include *Cang Jie*, the Three-Corner system, and the Large-Keyboard system.

Cang Jie (which was actually invented by a linguist from Taiwan) uses a standard English keyboard. Each character is entered by pressing one to five letters, which are codes for standard character "strokes."* The codes are then used either to access the character on disk or to generate it with the specialized microprocessor. A competent typist using the *Cang Jie* system can average 50 to 60 characters per minute.[57]

The Three-Corner method, which comes in several variants, reduces all Chinese characters to approximately 100 components. Using a standard keyboard, the codes for these components are typed in for the component appearing at the top left, top right, and bottom right corners of the character. This method conveys enough information for the program to access or generate the unique character desired. Typists using the Three-Corner method can average about 35 characters per minute.[58]

The Large-Keyboard system uses a varying number of keys for the components needed to compose each of the several thousand characters commonly used in business correspondence. IBM developed a version of this method on an 18" x 30" keyboard with more than 300 keys, which commonly ran on the IBM 4331. Impractical for effective usage, this system is nevertheless the easiest for a beginner to learn, since the character components can be printed on the key covers.[59]

All of these methods are slower than alphabetic systems, and require considerable training to be effectively used. Moreover, common word processor and database functions such as sorting, merging, and

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* Chinese is commonly written with a brush, rather than a pen. Hence, each character is formed by a series of brush strokes laid down in a standard sequence. Chinese characters are actually looked up in most Chinese-English dictionaries by their "radical" (one of 214 ideographs which form a part of every Chinese character and which can be used to group characters together) and by the number of brush strokes required to complete the character after its radical has been written.

searching are difficult to implement for non-alphabetic languages such as Chinese. This is particularly true in the absence of a standard methodology for inputting, storing, accessing (in memory or on disk) or generating Chinese characters. Although considerable progress has been made in adapting written Chinese to computers, until a widely accepted standard is developed, the Chinese language itself will continue to impede the development of applications software for business and management.

China's Human Resources

Because of their connections with the People's Liberation Army (PLA), the computer-related sectors of the electronics industry were largely spared from the ravages of the Cultural Revolution.[60] Protected by the PLA, competent scientists and engineers continued to work on the development of computer technology even during the worst rampages of the Red Guards. After the opening to the West in 1979, China began to send thousands of students abroad, a great many to the United States.* Most went (and still go) to do advanced work in scientific and technical fields, including the computer sciences. China is now graduating as many as 10,000 computer researchers and engineers per year.[61] It is also highly probable that the Chinese inform themselves of advances in computer hardware and software research and development in the West as soon as research results become part of the public domain. China's development of the Galaxy supercomputer is just one example of the scientific and technical

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* Han Xu, China's ambassador to the United States, said there were 17,000 Chinese students in the United States in 1986. (Notes taken during remarks of Ambassador Han Xu to the Cambridge Forum on November 6, 1986).

competence in certain sectors (particularly military-related sectors) of her economy.

China's problem today in applying information technologies to economic and social modernization lies not with any great lack of competent, or even brilliant and innovative, computer scientists and engineers. Rather, it lies much more in her lack of mid-level cadres in administrative positions in government and industry who can understand and appreciate, or have the background to understand and appreciate, how computers can be applied to administrative and managerial problems to increase productivity. This lack of competent, mid-level managers is a direct result of the persecution of intellectuals during the Cultural Revolution.

China's intellectuals,* those people in the society who could be expected to most readily apply the power of communications and information (C&I) technologies to the task of modernizing China's economy and society, have been severely persecuted from time to time during the continuing Chinese revolution. As heirs to the former ruling class of scholar-gentry officials, their class origins have always been suspect to the Chinese communists. From the Hundred Flowers campaign which preceded 1958's Great Leap Forward to the Great Proletarian Cultural Revolution, they have come under attack again and again, usually accused of "rightism" and other anti-party activities. As a class, they were particularly oppressed during the 10-year period of the Cultural Revolution. Mao labeled intellectuals and experts the "stinking ninth category" of bad elements, traitors to the revolution.

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* In China, anyone who is a graduate of a middle school or above can be considered an intellectual.

Millions were purged from jobs in schools, industry, government, and Party and sent down to the countryside, to labor alongside China's poorest peasants. Hundreds of thousands were humiliated, beaten, and tortured -- perhaps as many as a million were killed or committed suicide during the worst excesses committed by the fanatical Red Guards.

The closing of China's universities in 1966, and the "reform" of the entire educational system (which in most instances meant the purging of competent teachers), resulted in a generation of uneducated, or greatly undereducated, youth.* Nevertheless, a great many of these youths found their way into cadre positions, in the government, Party, and industry. Ideological purity and a good class origin (inherited from their parents) were much more important than technical competency in securing administrative positions. By the 1980s, many of them had reached mid-level management positions.

It was exactly these cadres, who had achieved their positions by being more "red" than "expert," who were called upon to apply C&I technologies to the work of modernizing China. Many were unable to do so. Fearful of losing their positions, they opposed change and innovation, which they didn't understand and thus couldn't control. While it is impossible to quantify the degree to which China's "reds" have impeded progress in the past, their increasing replacement by younger, more technically qualified personnel is a phenomenon of the

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* By some estimates, at the end of the Cultural Revolution China might have had as many as 140 million illiterates, 120 million of them under the age of 45. (Butterfield, Fox. China: Alive in the Bitter Sea. New York: Times Books, 1982, p. 196.)

mid-1980s which cannot help but increase the rate at which China begins to apply C&I technologies to administrative and management problems.

The Chinese have begun to build up the infrastructure that will be required to support the application of C&I technologies to economic modernization. Although many rehabilitated intellectuals remain wary, remembering all too well how past expressions of China's need for their talents have been followed only too quickly by savage repression, the younger generation is convinced that the path to advancement in life is through education, particularly education in science. Seventy percent of the 92,200 students who took the college entrance examinations in Beijing in 1982 listed science as their preferred major.[62] Scientific and technologically competent people are increasingly being promoted to administrative and managerial posts, and scientists are being consulted in policy formulation. Intellectuals have been redefined as "mental workers," and made a part of the working class by political leaders.[63] Yet, despite the winds of change that have swept through China since the death of Mao and the overthrow of the Gang of Four, the permanence of China's commitment to modernization is still suspect. Recent political events in China have again raised the specter of repression, and have brought up the fundamental question of whether China can truly modernize and enter the Information Age without reforming her political system as well.

Politics and C&I Technologies

It is apparent that the Chinese, given enough time, could master the technology to support an information-based society. It is not so apparent that they either want (or are able) to alter their society in some of the fundamental ways that may be necessary to achieve the synergistic effects usually associated with the new Information Age.

While the Chinese have opened up to Western scientific ideas, the Chinese Communist Party continues to reject vehemently those ideas that it believes might threaten its continued dominance of the Chinese polity. "We firmly resist the corrosion of any decadent ideology, and absolutely do not allow our socialist society to be reduced to a pathological one," says Party theoretician Su Shao-zhi.[64] Yet, by the very process of opening up to the West, educating many of China's brightest students in Western universities, adopting Western management methods and technologies to facilitate modernization, decentralizing economic decision-making authority, and even allowing some market forces to determine the viability of enterprises, the Chinese have fostered a pluralism that could threaten to undermine the Four Basic Principles that they say must accompany the Four Modernizations: socialism, proletarian dictatorship, leadership by the Communist Party and Marxism-Leninism-Mao Zedong thought.[65]

At least, that is what many fascinated observers of China's cautious experimentation with Western techniques thought until they watched the vigorous response by the Party to a series of student demonstrations that began in December 1986. Actually, the demonstrations (which called for a real democratic choice in the election of local Party leaders) may just have been used as an excuse for a crackdown on "bourgeois liberalism," a code name for Western democratic ideas. Hu Yaobang, Party General Secretary, was accused of being a leading advocate of this deviation and was forced to resign as Party Chief on January 16, 1987.[66]

Hu had been a proponent of allowing more freedom of discussion in academia of economic, cultural, and political issues. His aim, according to one analyst, "was to try to encourage more of the intellectual ferment, innovation and creativity that is required to keep the economic reform movement going."[67] Hu reportedly advocated greater intellectual freedom in a speech he made in Shanghai during summer 1986 that greatly offended some Party veterans. He may also have been unpopular with some leading military officers, despite the fact that he is a veteran of the Long March,[68] the Chinese Communist equivalent of the biblical Exodus from Egypt. Conservatives, fearing that freer discussion could undermine the Four Basic Principles, used the student demonstrations to test their power within the Party. Despite the fact that Hu was a protege of Deng Xiaoping, Deng was forced to consent to his ouster to protect his economic reform program.

It is also just as possible that Deng, who was preparing to retire from his Party positions in Fall 1987, allowed Hu to call for the voices of dissent to speak out so that "troublemakers" could once more be identified and neutralized before they could actually cause trouble. Deng has been accused of using this tactic successfully with the Democracy Wall movement, that previous period of "practicing democracy" when Big Character Posters were written and posted in Peking in the winter of 1979.[69] Having revealed themselves to the omnipresent secret police, the poster writers were arrested when the movement began to question the legitimacy of Communist Party rule. The ouster of General Secretary Hu during January 1987 demonstrated once again where the limits to allowable dissent lie, and reassured the conservatives that economic reform would not be allowed to threaten Party rule.

For the rest of the spring of 1987, Deng made it clear that while he might be a pragmatist when it came to economic reform, he would not condone political dissension which could threaten the Party. In late February he praised Poland's leaders for their handling of opposition from the Solidarity labor union and the Roman Catholic Church. "They adopted martial law and controlled the situation. That shows clearly that if we don't use dictatorial methods, it won't do. We must not only talk about dictatorial methods but also practice them."[70]

When U.S. Secretary of State George Shultz visited China in early March, Chinese leaders were quick to reassure him that China had not reversed her open door policy, and was not turning back toward isolationism. Foreign Minister Wu Xueqian said, "Our present policy of reinvigorating the domestic economy and opening to the outside world has proved effective . . . and enjoyed immense popular support."[71] The following day, then Vice Premier Li Peng reportedly told Secretary Shultz: "We will continue to introduce our students to advanced sciences, technologies, managerial experiences and culture of foreign countries."[72] The Chinese vice minister of culture, Ying Ruo-cheng, made it clear that while Western "cultural" influences were welcome, Western political influences were not. Such influences were incompatible with China's Communist system.[73]

While the leadership was publicly proclaiming that the economic reforms necessary for China to enter the Information Age will continue, there is little doubt that the recent political upheavals were over the pace and the scope of the reforms. Should Deng Xiaoping completely retire in 1987 or become disabled or die before the end of the decade (he was 82 in 1987), there is no guarantee that the reforms will continue. Already, they have begun to slow. For example, a proposed law that would have prohibited Party officials from interfering with factory managers failed to be introduced into the Spring 1987 session of the National Peoples Congress, China's parliament.[74]

More important, however, than the pace of the reforms is the question of whether economic modernization, and particularly China's attempt to enter the Information Age, is compatible with her present form of government and the monolithic ordering of her society. It is apparent that information flows and freedom of discussion have limits that begin whenever the Party believes that they threaten its rule. Whether the Party will ever be able gradually to relinquish its all-pervasive control of economic decision making (probably the most useful thing it could do to assist the economy) without feeling threatened is a question that only time can answer. Similarly, whether China can take full advantage of the power of communications and information technologies without the freedom commonly found in the West to exchange information and make economic decisions without direct government direction must also await future answers. China, having embraced the idea of modernization, and having declared that modern communications and information technologies will be essential to that process, will be a unique laboratory to test whether freedom of information is essential to the Information Age.

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IMPLICATIONS FOR POLICY

China's turn away from the chaos of permanent revolution and Maoist self-reliance toward the reform and modernization of her economy and society may have begun at last to fulfill the promise of the 1911 Revolution which overthrew the last imperial dynasty. Although there seems little chance of any real move toward democracy in China, and the Communist Party promises to remain in power for the foreseeable future, China's willingness to experiment with decentralized economic planning, to allow some market forces to operate in economic decision making, and to open up and begin to adopt some Western management techniques as well as Western technology has led to genuine economic gains. Provided the Chinese continue on the path of modernization they have begun to follow, by one projection her gross domestic product (GDP) could overtake West Germany's by 2003.[1] This would still not make the individual Chinese a rich person. By the same projection, GDP in China would be $875 per person* in the year 2000, while in West Germany it would have risen to $20,700 (in 1980 dollars).[2] Nevertheless, if China achieves this projected gain, the implication would be that she had chosen a successful development path and that short of catastrophic war or internal upheaval her modernization was probably self-sustaining and irreversible.

It is United States policy to support China's economic development and modernization. The United States considers China to be a friendly,

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* Per capita gross national product (a higher figure than GDP) in China was $310 in 1984. See "Britannica World Data: China," in <u>1987 Britannica Book of the Year</u>. Chicago: Encyclopaedia Britannica, Inc., 1987, p. 622.

non-allied country, and believes that Chinese prosperity will help stabilize East Asia.[3] The United States has gone so far as to provide arms assistance to China, signing (among other agreements) a contract in October 1986 to provide 50 avionics kits (and five spares) to upgrade the defensive avionics of the Chinese-built F-8-2 air defense fighter. Worth a reported $501 million, the kits include new radars, inertial navigation equipment, heads-up displays, air data computers, and a data bus.[4] In presenting the fiscal year 1988 Security Assistance Program to the Congress, the Reagan administration made the following statement about arms sales to China:

> FMS [Foreign Military Sales] cash and commercial sales programs with the People's Republic of China are proceeding at a measured pace. They complement other U.S. initiatives in the diplomatic and economic spheres, encourage China to broaden its contacts with the West and facilitate its general movement toward modernization.[5]

United States government policy goals in making such sales to China were listed as being to:

- Strengthen China's self-defense capabilities
- Expand parallel interests in mutual opposition to Soviet expansionism in Asia
- Support an independent foreign policy which is non-threatening to our friends and allies in the region
- Support China's economic modernization program[6]

Nevertheless, the Chinese continue to view U.S. export controls as administered on a day-to-day basis as a significant impediment to trade and technology transfer. In late 1986, the Chinese were still urging the United States to remove all export control restrictions on technology sales and transfers to China.[7] During Secretary of Defense

Weinberger's visit to China in October 1986, Chinese Defense Minister Zhang Aiping urged the United States in formal banquet toasts to step up its transfer of military technology to China. He expressed the hope that Weinberger's visit would "accelerate military technology exchanges between our two armed forces."[8] In November 1986, Chinese Ambassador to the United States Han Xu, in answering questions from a luncheon audience at the Harvard Club in Boston, said that "U.S. slowness in granting export licenses for high-technology products to China means there are 'many obstacles' to continued expansion of trade relations."[9]

The continued application of export controls to dual-use communications and information (C&I) technologies destined for China is one of the chief policy issues that will continue to confront U.S. government officials, the Congress, and U.S. business persons for the remainder of the century. While the United States greatly desires to aid and assist in China's modernization, and recognizes the key role China's leaders have assigned to the acquisition of C&I technology, the current administration remains torn between powerful advocates of increased liberalization on the one hand, and equally powerful groups who oppose any further easing of restrictions on the other. That the direction of U.S. policy has been toward liberalization can be readily seen from a brief recapitulation of policy shifts in the rules concerning trade with China over the past several years.

Export Controls and Trade with China

U.S. export control policies toward China were first relaxed in 1980 when China was also granted most-favored-nation status.[10] In June 1983 the United States moved China from the Group P to the Group V export category, which meant that thereafter China would be treated as a friendly, non-allied nation.[11] This did not, however, result in treatment of the PRC identical to that of other friendly non-allied countries. For example, the PRC is the only country in that category subject to COCOM controls. (COCOM is the Coordinating Committee on Multilateral Export Controls. It is a Paris-based organization formed by the NATO allies, less Iceland but including Japan, to police militarily sensitive commercial exports to the Soviet bloc.) Second, the move to Group V concerns only the Commerce Department regulations on dual-use exports. The purchase of military items is an entirely separate issue.

More specifically, in November 1983, the Commerce Department published, in the Federal Register, new guidelines for the licensing of dual-use technology exports to China.[12] The liberalized regulations led to dramatic increases in the shipment of high-technology, dual-use items to China the following year. Trade in office machines and automatic data processing equipment more than doubled to $10.2 million; shipment of scientific instruments rose 24% to $178.2 million; and sales of computers more than tripled to $32.5 million in 1984.[13] However, liberalization of the export control regulations created other problems. COCOM approval was still required for most of the products newly eligible for export licenses, and a tremendous backlog in the licensing process occurred. By mid-1985, the State Department estimated that 64% of the COCOM caseload was made up of licenses for China, and that 90% of the cases submitted by the United States for COCOM review were for China.[14] Former Assistant Secretary of State Richard C. Holbrook wrote in a February 1985 Wall Street Journal article that cases submitted to COCOM could average 283 days to be processed; this was in addition to the average 29 days it took the Commerce department to process a routine request. If the case was complicated, other required reviews by U.S. agencies could take up to 117 days before the case could even be submitted to COCOM.[15]

To solve this problem, the United States reached agreements later in 1985 with other member nations to exempt approximately 75% of all licensed exports to China from COCOM oversight.[16] The Department of Defense says that these agreements "placed China on an extremely favorable footing, compared with the Warsaw Pact countries, for receiving high-technology exports from the West and Japan."[17] Three product zones were created for licensing exports to the PRC: green, yellow, and red. COCOM-exempted items fell into the green zone. License approval for green zone products was routine, with no Department of Defense approval required. This category included commonly traded oscilloscopes and other measuring instruments, most medium-sized general purpose computers, and most commercially available microcomputers and magnetic tape recorders.[18] In all, certain items in 27 categories of high-technology products were "made available to China on roughly the same basis as exports to other non-allied countries."[19]

License cases that fall into the yellow zone require review by the Defense Department. Approval is usually granted, unless the product to be exported is categorized as a threat to U.S. security interests. Red zone products are prohibited exports. Included in this category are such obvious items as nuclear weapons, intelligence sensors, electronic warfare and anti-submarine warfare equipments.[20]

These progressive liberalizations of the export rules governing trade with China led to dramatic increases in the number and value of licenses issued. In 1982, 2020 licenses were issued for the export of high-technology goods worth $580 million.[21] By the end of fiscal year 1985 preliminary figures indicated that license approvals had more than quadrupled to 8593 approvals with a value of $5.7 billion. More than half the licenses (4421) approved that year were for electronic computing equipment with a total value over $3.8 billion.[22]

Despite the increase in license approvals in part due to the establishment of the China Team Center within the Department of Commerce, some critics charge that the export licensing system remains a mire of inconsistent and impossible-to-understand bureaucratic red tape. A primary criticism of the system is that it attempts to control too many products and technologies.[23] A January 1987 National Academy of Sciences (NAS) report titled Balancing National Interests: U.S. National Security Export Controls and Global Economic Competition found that over 40% of nonmilitary manufactured exports (worth $62 billion) required a license before they could be shipped. Moreover, 90% of all licenses sought were for the shipment of goods to Western countries.[24] Former Secretary of Commerce Malcolm Baldrige said flatly that the current Commodity Control List (CCL), administered by his department's Office of Export Controls, is out of date and "too large to be policed."[25] As a result, "the costs imposed on U.S. industries have become excessive and the burden too much to overcome in many cases."[26]

Even though it contains some 40,000 items subject to export controls,[27] the CCL is not the only list with which U.S. manufacturers who want to export high technology must contend. In addition to the CCL, the Pentagon maintains a Militarily Critical Technologies List (MCTL), the State Department maintains a Munitions List, and COCOM maintains three separates list of controlled items. In all, nine separate federal agencies have a hand in administering what one commentator called a "baffling web of export regulations."[28]

Although the Pentagon points with pride to the considerable efforts it has made to rationalize the MCTL and to merge it with the CCL and the Munitions List,[29] it admits that "most of the changes [in the lists] which can be contemplated are not going to either reduce the export license burden in any massive way or improve the enforceability of the embargo in a demonstrable manner."[30]

The National Academy of Science report estimated that the burden export controls place on the U.S. economy could be as much as a $17.1 billion loss per year to the gross national product. Direct, short-term losses were estimated at $9.3 billion and 188,000 jobs in 1985.[31] These included lost export sales to Western countries of $5.9 billion and lost West/East export sales of $1.4 billion.*[32] These figures are probably conservative. In the case of China alone, Commerce department figures show that in fiscal year 1985, 2830 license applications for export to the PRC worth $2.5 billion were returned, without action, to the applicants.[33] While not all of this business was lost -- the "returned without action" category includes those applications returned because no export license is required -- the sheer number of

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* These losses come at a time when the United States can ill-afford them. The U.S. foreign trade deficit was $132.1 billion in 1985, and grew to $147.7 billion in 1986 -- lost sales due to export controls equalled 5.5% of the 1985 trade deficit. (For 1985 trade deficit figures see "Britannica World Data: United States," in <u>1987 Britannica Book of the Year</u>. Chicago: Encyclopaedia Britannica, Inc., 1987, p. 774. For the 1986 trade deficit see "Trade Gap Was $147.7b," <u>The Boston Globe</u>, March 12, 1987, p. 39.

applications not acted upon indicates the difficulty business has in complying with the law.

Complaints abound from business executives about business lost to delays caused by the export licensing process. Herbert M. Dwight, Jr., of Spectra-Physics, Inc., a business member of the panel that produced the NAS report "cited cases in which his company had lost sales to rivals located in allied nations because of the 'cumbersome' year-long process in the United States of getting a license for products that are readily available from other countries."[34] Vico E. Henriques, President of the Computer and Business Equipment Manufacturers Association, said, "For a number of years, our companies have realized that many export controls are costing us billions of dollars without really increasing U.S. national security. We force customers in western countries -- our military allies -- to go through so much red tape to buy computers and business equipment from us that they are turning to vendors in other countries."[35]

A recent case, involving the sale of fiber optics equipment to China, illustrates the dysfunctional impact the administration of the Export Administration Act can have on U.S. companies' attempts to compete for business in China. In late December 1986, the Baltimore Sun reported in a page one story that the White House had yielded to a British request to allow the sale of fiber optics equipment to China even though American firms were still barred from doing so on national security grounds. Testifying before the Joint Economic Committee of the Congress, Roger W. Sullivan, president of the National Council for United States-China Trade, revealed that "the British government prevailed on the White House to override" the Defense Department, which continues to oppose the sale of fiber optics because the technology "has the potential for military use in war."[36] Mr. Sullivan reportedly warned the committee that U.S. competitiveness in the China market would be seriously harmed if the Pentagon continued to oppose the sale of advanced telecommunications technology to China.

> Telecommunications is becoming a very high priority in China, but so far American companies have not done well. We have companies like ITT and GTE that want to sell, but they have trouble because of controls on exports and long delays in processing [license applications], and the situation is going to get worse . . .
>
> Even though the American telecommunications industry is the most advanced in the world . . . it captured only 2.5 percent of the Chinese market last year while Japan won 60 percent.[37]

As former Secretary Baldrige argued, "The overall security of this country is comprised of both economic and military security."[38] Cases such as this, which deny U.S. companies the chance to compete for the multi-billion dollar Chinese market for fiber optics while allowing Japan and Western European companies free rein, make it difficult to argue that the administration of the Export Administration Act is fully serving the national interests of the United States.

Export Controls and Military Security in the Case of China

In the Executive Summary of the previously cited report to the Congress on The Technology Security Program, the overall goal of the program is stated to be the "protection of our national security by limiting Soviet acquisition of militarily significant technology."[39] In actuality, however, the Department of Defense does not limit its concern only to Soviet acquisition of advanced, militarily useful technology. If Defense officials were solely concerned with the

Soviets, there would probably be fewer controls placed on trade with China than with Japan and Western European countries. Defense officials would probably agree with former Secretary Baldrige's assessment that "the risk of diversion of sensitive technology to the Soviet bloc from the PRC was less than with many European partners, who view trade with the Soviet bloc as important."[40] While a Sino-Soviet rapprochement is rumored from time to time, the likelihood that China would divert militarily significant Western technology to the country that continues to maintain an army of 50+ divisions along their common border is remote.

The possible Chinese application of advanced technologies to military weapons systems may not always serve the best interests of the United States. China is one of the world's five acknowledged nuclear powers, and is known to possess a small Intercontinental Ballistic Missile capability. Moreover, while China's foreign policy does not directly threaten United States interests at the moment, there is certainly no guarantee that will always be the case. The Chinese have repeatedly said that they intend to follow an independent, non-allied foreign policy. There are substantive differences between the United States and China on a number of important policy issues. Ambassador Han Xu enumerated some of the differences when he told the Cambridge Forum that "China opposes the militarization of space, favors sanctions against South Africa, opposes foreign intervention in Nicaragua and has long supported 'the just claims of Arab peoples' in the Mideast."[41] China supports North Korea's plans for the peaceful reunification of the peninsula and favors tripartite talks between herself, the North Koreans, and the United States,[42] a position opposed by the United

States. China, along with the Soviet Union, recently signed the South Pacific Nuclear Free Zone Treaty, a pact the United States has refused to sign, saying it would compromise its "global security interests and responsibilities."[43] The Chinese reacted to Washington's refusal to sign the treaty by saying that the refusal has "aroused great dissatisfaction among countries in the Pacific . . . and has provided a good chance for the Soviet Union to make headway in this part of the world."[44]

While the United States has distanced itself from the Taiwan sovereignty issue, stating officially that the differences between the PRC and the government on Taiwan are an internal matter for the Chinese to resolve between themselves, Taiwan remains the outstanding foreign policy difference between the two countries. The Chinese have refused to renounce the use of force to reunify the island with the mainland,[45] and the United States continues to sell defensive arms to Taiwan. As long as the issue remains unresolved, the potential will exist for a serious clash with the PRC. It is not inconceivable that a determined move by the PRC to reunify the island by force of arms could lead to a military confrontation between United States and Chinese forces.

Although neither country harbors a desire for a clash of arms over Taiwan or over any other divisive issue, the May 1987 attack on the *USS Stark* by an Iraqi Air Force pilot flying a French-built F-1 *Mirage* fighter is a painful reminder of the lethality of modern, high-technology weapons and their all-too-potent capability to inflict tragedy in an uncertain and confused situation. Although the Iraqis claimed that their pilot's attack (with what were apparently *Exocet* sea skimmer missiles) was accidental, the United States lost 37 sailors when the *Stark* failed to detect the missiles in time to counter them.

The Chinese, of course, had nothing to do with the Iraqi attack on the *Stark*, and no attempt is being made to say that a similar incident would happen again should the United States provide the People's Republic technology that would allow them to build an air-to-surface missile as capable as the *Exocet*. However, it is ironic that in the wake of the Iraqi attack the United States chose to warn Iraq's enemy in the Gulf war that its apparent preparations to deploy Chinese-built anti-ship missiles called *Silkworms* was a matter of grave concern. In numerous television interviews, high administration officials refused to deny that Iranian deployment of the *Silkworms* could lead to a preemptive strike against them. Tensions escalated as Iran threatened to strike any Arab military bases the United States might use in its effort to protect Persian Gulf shipping,[46] and hinted at terrorist attacks against nuclear reactors on U.S. soil if the United States attacked the *Silkworm* bases.[47]

Although China has repeatedly denied selling arms to Iran, Western experts have believed for some time that the Chinese have in fact been doing so. The Institute for International Strategic Studies in London claims that Iran and China struck a $1.6 billion arms deal in 1985.[48] In addition to the *Silkworm*, China reportedly sold 440 tanks to Iran, enabling it to mount its *Kerbala 5 and 6* offensives against Iraq in late 1985 and early 1986.[49] Although the Iran-Contra scandal revealed that the United States has violated its own policy toward the sale of arms to Tehran, the United States reaffirmed its policy against Iranian arms sales after the scandal broke. Secretary of State Shultz reportedly urged the Chinese to cease selling arms to Iran during his visit to China in March 1987.[50]

Although the *Silkworm* missile is representative of late-1950s technology (the Chinese copied its design from the Soviet SS-N-2 *Styx*, which was first deployed in 1959 or 1960), its range of 50 miles and its 1000-pound warhead pose a definite threat to oil tankers transiting the Straits of Hormuz. The Chinese have probably followed the Soviet practice of upgrading and improving this weapons system since they first copied it. Chinese versions may include an infrared heat-seeking guidance system in addition to radar guidance.[51] As the attack on the *Stark* shows, even the sophisticated electronics and defensive systems of modern warships, which should be able to deal easily with missiles such as the *Silkworm*, are of little use if a situation occurs in which the crew is not alert to possible danger. Although not intended, the Chinese sale of *Silkworm* missiles to Iran has contributed to an escalation of tensions in the Gulf and has placed American sailors in harm's way.

The Chinese sale of arms to Tehran and the foreign policy differences between the United States and China discussed above can be cited to support a strong argument that the United States should not supply China with dual-use technology that could be used to upgrade the capabilities of Chinese-built weapons systems. Although the possibility of a military clash in the near future between China and the U.S. is remote given the present state of Sino-American relations and China's current foreign policy, there is a considerable possibility that increasing Chinese sales of arms to Third World countries may conflict with United States interests in other parts of the world.

Chinese Arms Sales to the Third World

There is every indication that during the past several years China has set out to establish herself as a major arms supplier to the Third World. The Chinese first participated in a European arms exhibit in 1984, and in November 1986 sponsored one of their own in Beijing.[52] According to the Washington Post, China "paid the way to the exhibition for 80 persons from 21 nations. Representatives of a number of Middle Eastern and South Asian nations, including Algeria, Libya, Pakistan and Tunisia, were seen at the exhibition."[53] In addition to the *Silkworm* missiles sold to Iran, the Chinese have begun to offer increasingly sophisticated weapons systems for sale on the open market. They claim to have exported the F7M fighter (a Chinese-built variant of the Soviet MIG-21 interceptor) and the A5 attack aircraft (an indigenously designed weapons system) to a "dozen countries."[54] At the Beijing exhibit, the Chinese also offered to sell air-to-air and naval missiles, pilotless aircraft, ocean patrol planes and helicopters.[55] The A5, the F7M, and the D4 RD drone were later scheduled for exhibit at the 1987 Paris Air Show.[56]

In January 1987 the Chinese unveiled the B6-D bomber, an updated version of the Xian H-6 strategic bomber, which itself is based on the 30-year old Soviet Tupolev TU-16. A "foreign military expert" called announcement of the new aircraft by the Xinhua News Agency "part of Peking's push to become a major arms seller." The B6-D reportedly carries air-to-ship guided missiles, which were characterized as "late-1960s or early-1970s technology."[57] The Chinese were also offering their most advanced supersonic fighter, the F-8-2, for sale, the same aircraft that the United States is equipping with advanced defensive avionics.[58]

In the realm of military electronics, the Chinese have offered several "modest" electronic warfare systems for the export market. An airborne radar warning and electronic support measures system for combat aircraft, an airborne chaff dispenser, a shipborne radar warning unit, and a mobile, truck-mounted radar reconnaissance system have all been announced.[59]

In Spring 1987 the Brazilian newspaper O Globo reported that China was interested in joint Sino-Brazilian development, construction, and marketing of an advanced jet fighter plane.[60] A few days later, the Christian Science Monitor reported that the Chinese had "clinched a deal" with Brazil to supply it with "several dozen" F-7 fighters.[61]

Chinese motives for increased arms exports are probably similar to those of other countries, such as Israel, which have also begun to export increasingly sophisticated arms in larger quantities. Arms sales earn scarce foreign exchange, support the domestic industry by allowing economies of scale in weapons production, and are an important foreign policy tool. The United States government must weigh Chinese ambitions to become a major arms exporter in any decisions it makes about the level of dual-use technologies it will allow China to acquire from the West.

Concluding Thoughts

Differing but not necessarily antagonistic foreign policy objectives and China's demonstrated interest in exporting arms are considerations that must be weighed against the desire to assist China in her economic modernization. Military security, foreign policy, and a sound economic and trade policy are not easily reconciled goals in developing a rational export control policy. Even while generally supportive of the national security goals that make export controls necessary, business persons lured by the potential size of the Chinese market will continue to lobby for the relaxation of those controls and the rationalization of a system that has cost the country billions of dollars in exports at a time of record trade deficits. Foreign competitors will not wait for the United States to relax these controls but will continue to press whatever advantage they can obtain from the built-in delays of the cumbersome American export licensing and control list processes.

Although not totally united in their point of view, the Chinese are committed to economic modernization as a goal and to their opening to the West to attain that goal. An essential part of China's efforts to modernize is her attempt to enter the Information Age through the acquisition of Western communications and information technologies. "Buying Hens, Not Eggs" -- that is, acquiring technological processes, and not just products -- is the essence of her strategy of borrowing from the West. Yet, jealous of her sovereignty and self-interest and mindful of centuries of Western exploitation, the Chinese have yet to create an environment congenial to mutually beneficial partnerships with Western enterprises. While the United States seems willing, and even committed, to assisting China to achieve her goals, it does so with significant reservations based on national security considerations.

Honest, intelligent policymakers with the best interests of the United States at heart will continue to differ over what technologies can be transferred or exported without harm to the national security. This is not a problem that is soluble in any ordinary sense of the word. As technology changes, the set of technologies at issue will also change. What is too sensitive for export or transfer today could be allowable in some not-to-distant tomorrow. In addition, the political dimensions of the problem can and do have as much effect on some export control decisions as the arguments of experts. However, even if the problem can never be solved, it can probably be managed, and managed more effectively, than it is today. In the case of exports or transfers of C&I technology to China, declared policy is that the preponderant interest of the United States is to continue to support and assist China's legitimate aspirations for economic and social modernization. By contributing to China's modernization and economic prosperity, the United States will strengthen the peace and stability of East Asia and bolster its own national security.

NOTES FOR CHAPTER 4

1. "Giants Hold No Fears." The Economist, December 21, 1985, p. 69. [LEXIS]

2. Ibid.

3. Interview with M.W. Searls, Jr., Deputy Assistant Secretary for East Asia and the Pacific, U.S. Department of Commerce, on January 16, 1987. Mr. Searls, who served as Commercial Officer in Beijing for four years in the early 1980s, provided me extensive background information on the evolution of United States export control policies toward China under the Carter and Reagan administrations.

4. "Chinese F-8-2 Fighter Configured for All-Weather, Day/Night Missions." Aviation Week & Space Technology, January 19, 1987, p. 42.

5. U.S. Government, Congressional Presentation for Security Assistance Programs, Fiscal Year 1988. Undated, p. 23.

6. Ibid., p. 273.

7. "Weinberger Due in Peking for Talks." Washington Times, October 6, 1986, p. 8.

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ADDENDUM

On October 25, 1987, the Chinese Communist Party (CCP) convened its 13th Party Congress in the Great Hall of the People in Beijing. The Congress was a watershed in the history of the People's Republic, marking the passing of the torch to a new and younger generation that had not experienced the rigors of the Long March or the revolutionary communism of Yenan. At the urging of Deng Xiaoping, most of the septuagenarian and octogenarian leaders of the CCP resigned their party positions, making way for a younger and smaller group of leaders. Even Deng resigned from the Politburo, although he did keep one official position -- chairman of the party Military Commission. Most importantly for the modernization of China, several newly promoted leaders come from the ranks of the technocrats who have been in the forefront of the movement to modernize the economy. At least three members of the new 17-member Politburo have had extensive associations with the electronics industry.

Li Peng. Former Vice Premier and Director of the Leading Group for Electronics Development under the State Council, Li Peng became Premier after Zhao Ziyang resigned that office to become Party Chairman. At 58, Li is the youngest member of the five-man Standing Committee of the Politburo. The adopted son of former Premier Zhou Enlai, Li studied engineering in the Soviet Union and at one time was in charge of China's nuclear program. Although many Western political analysts believe he is more conservative than the leading reformers, more interested in stable economic growth than radical reform, his views on what China needs to do to modernize the electronics industry, so that it can take a leading position in a modernized China (see Chapter 1), show a sensitivity and understanding of Chinese conditions and needs which belies any notion that he will stand as an impediment to reform. Li Peng's views are important. If he achieves anywhere near the political longevity of his foster father, he could be running the Chinese government well into the 21st century.

Jiang Zemin. When Jiang Zemin wrote his policy statement on modernizing China's electronics industry (see Chapter 1), he was then Minister of Electronics. Since that time, he has become Mayor of Shanghai, a post of considerable political importance and influence in China. His star continues to rise. He was selected for membership on the Politburo at the 13th Party Congress. Not coincidentally, Shanghai is now clearly favored to become the key center of China's electronics/telecommunications development.

Li Tieying. When Jiang Zemin left the Ministry of Electronics, he selected Li Tieying to succeed him. A protege of Li Peng, Li Tieying at 51 is the youngest member selected to the Politburo. While he was Minister of Electronics, Lie Tieying also served as Director of the State Commission for Restructuring the Economy, a body which was originally set up in the mid-1980s with Zhao Ziyang as its first head. Li Peng recently took over this commission, while Li Tieying moved on to become Minister of Education when the Ministry of Electronics became a part of the Ministry of Machine Building. Earlier in his career, Li Tieying headed China's leading semiconductor research institute and then served as Party Secretary for Liaoning Province. Li Tieying is known for his advocacy of a high-technology approach to modernizing China's economy; his rise to power is another indication of Deng Xiaping's success in replacing the older generation with a group of leaders oriented toward modernization and reform.

In his report[1] to the 13th Party Congress, Zhao Ziyang touched on many of the problems and issues discussed in the body of this paper. Selected quotations below indicate the direction China's new leadership intends to steer in the mid-term, and the importance placed on C&I technologies in China's strategy for economic development.

> The primary objective of scientific and technological work is to revitalize the economy. Emphasis should be placed on modernizing the technology and equipment of industries devoted to large-scale production . . . such key industries as . . . communications . . . .
>
> . . . Qualified personnel should be organized without delay to start research and development in high technology, especially in the fields of microelectronics [and] information . . .
>
> We must continue to import advanced technologies from abroad, and integrate them closely with scientific and technological research at home, and we should intensify our efforts to master and assimilate imported technologies and to improve upon them.
>
> We must create a social environment in which knowledge and educated people are respected and must continue to improve the working and living conditions of intellectuals so as to turn human resources to best account. The initiative and creativity of the workers, peasants and **intellectuals** should be brought into full play . . . . [Emphasis added.]
>
> The basic direction of the adjustment and reform of the structure of production for a fairly long time to come should be as follows:
>
> -- to strive to develop consumer-goods industries and at the same time to pay adequate attention to basic industries and infrastructure, accelerating the development of . . . communications

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[1] Zhao Ziyang, "Advance Along the Road of Socialism With Chinese Characteristics: Report at the 13th National Congress of the Communist Party of China on October 25, 1987." Beijing: Beijing Review Publications, 1987.

> (principally comprehensive systems of dissemination of information);
>
> -- to vigorously develop the machine-building and electronics industries, so as to provide more and more advanced technical equipment to serve the modernization programme . . . .
>
> To open wider to the outside world and constantly expand economic and technological exchange and cooperation with other countries [this is a subheading in the speech under the major heading The Strategy for Economic Development].
>
> Efforts should be made to improve the laws governing business relations with foreigners, to implement the preferential policy and to improve the investment environment, so as to enable foreign businessmen to run enterprises in China according to international practice and to attract more foreign investment.
>
> Chinese-foreign joint ventures, co-operative enterprises and exclusively foreign-owned enterprises also constitute a necessary and useful supplement to China's socialist economy. We should protect the legitimate interests of foreign investors and improve the investment environment for foreign businessmen.

These quotations from Zhao's speech illustrate the continued relevance of the questions, problems, and issues discussed in the body of the paper. Delivered by the Party Chairman to the Party assembled in Congress, this speech will be the basic party line until the next Congress or Plenary Session of the Central Committee (which may be five or more years away).

One final note before bringing this addendum to a close. A spate of Iranian attacks against tankers and oil terminal facilities in Kuwait during October 1987, using *Silkworm* missiles of Chinese origin, disrupted the planned liberalization of export controls governing high technology transfers to China. Although China denied selling *Silkworms* to Iran directly, the United States threat to hold up further transfers of technology and defer the review of further export control liberalization prompted a Chinese pledge to halt all future sales of the *Silkworm* on the international market. Only in March 1988, after watching the situation for several months, did the United States revive its plan to ask COCOM to raise the level of technology that could be sold to China.

This temporary disruption of the trend toward liberalizing export controls on high-technology transfers to China illustrates perfectly the political dimension of these controls. They are not just a means to prevent Soviet acquisition of militarily significant technology (as is sometimes claimed), but a powerful instrument of foreign policy. Business people subject to the export control laws must realize that if their business plans include the export of high technology to China, those plans can be held hostage to the vagaries of the international situation. This vulnerability is an additional risk for any business selling either hens or eggs to China.

ACRONYMS

CAD	computer-aided design
CAM	computer-aided manufacturing
CAT	computer-aided testing
CATIC	China National Aero-Technology Import and Export Corporation
CCDOS	Chinese character disk operating system
CCL	Commodity Control List
CCTSC	China Computer Technical Service Corporation
CEIEC	China National Electronics Import and Export Corporation
C&I	communications and information
CMOS	complementary metallic oxide semiconductor
CNEIC	China Nuclear Energy Industry Corporation
COCOM	Coordinating Committee on Multilateral Export Controls
CSTC	China Software Technology Corporation
DJS	*dianzi jisuanji* - electronic calculating machine
DOC	U.S. Department of Commerce
DOS	disk operating system
EPROMs	erasable, programmable read-only-memory chips
EQUIMPEX	China National Machinery and Equipment Import and Export Corporation
FESCO	Foreign Enterprises Service Corporation
FETs	field effect transistors
FTCs	foreign trade corporations
GDP	gross domestic product
GWIC	China Great Wall Industrial Corporation
IC	integrated circuit
LAN	local area network
MCTL	Militarily Critical Technologies List
MEI	Ministry of Electronics Industry
MIPS	million instructions per second
MOFERT	Ministry of Foreign Economic Relations and Trade
MOS	metallic oxide semiconductor
MPT	Ministry of Posts and Telecommunications
MTBF	mean time between failures
PLA	People's Liberation Army
PRC	People's Republic of China
RMB	*ren min bi* - People's dollars
SPC	stored program control
VLSI	very large-scale integrated circuits
VS	virtual storage