Winning in High-Tech and Emerging Market: How Motorola's Global Strategy Fits into China's Development Policy

by

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Submitted to the Department of Urban Studies and Planning
in Partial Fulfillment of the Requirements for the Degree of

Master of City Planning

at

Massachusetts Institute of Technology

August 1996
[February 1997]

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ABSTRACT

The study is expected to help to recognize that in modern international competition in emerging markets, companies compete with global strategies involving not only costs or markets but also the building of strategic competitive advantage for both the foreign firms and the hosting counties. The study goes beyond costs and markets and explains why some companies are better than others at creating dynamic and evolving competitiveness based on the corporate and the national policies and strategies, from product innovation, technology transfer to economic development as well. The case study of Motorola Inc. in China's telecommunications and electronics industries serves this purpose as an empirical base.

China's remarkable economic progress has led multinational corporation, Motorola, already operating there revise radically its view of the country's opportunities and redouble its efforts to capitalize on its potential. The company is not merely in China to take advantage of its low labor costs and then jump to another country when development inexorably drives those costs up. The company is holding ground in this emerging market for the long haul by fitting corporate globalization strategy into China's strategic development policies.

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ACKNOWLEDGMENT

I feel extremely grateful to Professor Alice Amsden for her being my thesis advisor as well as my MIT program advisor, for her guidance and time with this thesis and my graduate study at the Institute. I would like to express my gratitude to Professor Paul Smoke for his reading and advice. Also, thanks to many managers of Motorola (China) and some government officials in China's ministries for their helpful information and invaluable insights. Finally, I would like to sincerely thank Professor Bishwapriya Sanyal, Chair of DUSP and Dr. Frank E. Perkins, former Dean of the Graduate School, for providing me supports necessary to complete my graduate study and earn my Master's degree at MIT.

Weimin Yao

Cambridge, MA, USA
August 1996

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Introduction

Objective and Central Theme of the Study

For the past two decades, as technologies, markets and economies are getting globalized, many multinational companies from industrialized world have been moving overseas. Among the various emerging markets in Asia, East Europe, and Latin America, China has witnessed a new wave of international competition based on not only labor costs and markets but also on technology and capital. Some players succeeded and the others failed. Why are some firms better than others at building and sustaining competitive advantage? What accounts for their success?

Motorola is one of the world's leading providers of wireless communications, semiconductors and advanced electronic systems and services. Motorola maintains sales, services and manufacturing facilities throughout the world, conducts business on six continents and employs more than 142,000 people worldwide now. As an electronic communication pioneer, Motorola sells about 45 percent of the world's cellular phones and an overwhelming 85 percent of pagers. Motorola also commands a very respectable third-place showing among the world's manufacturers of semiconductors. Now over half of its sales are made outside the United States. Continuing globalization at Motorola focuses on Asian, Eastern European, and Latin American markets in the early 1990's. In 1993, the company established Corporate America's biggest manufacturing venture in China: two plants for the manufacture of simple integrated circuits, pagers, and cellular phones. In 1995, Motorola built another joint venture with China's biggest electronic manufacturer, Panda Electronics Group, to produce and distribute systems compatible with Mac OS systems in China.

The story of Motorola's communication business is a success of American competitiveness. Subject to the same global competitive pressures that overwhelmed the US consumer electronics industry faced with rivalry from the likes of NEC and Matsushita, Motorola stands as not only the sole surviving major US manufacturer in the markets but as the world's leader.

On the other side, for the past decade, China, with the world's fastest economic growth rate, has not only been forming an emerging market and providing cheap labor, but also been

building its own knowledge base through selective international collaborations to catch up new technology express. China has been developed and is continuing developing its strategic policies of industrialization, especially in some key industries such as electronics, telecommunications and computer/information industries. Injecting foreign technology is important, but how to transfer it into the nation's competitive advantages is more crucial to China, as a late-comer. What and how does China develop its competitive industrial policies in the context of international collaborations and competition?

Considering the two sides, how can a US firm's global strategy fit into China's industrial policy to achieve a win-win end?

This empirical study is designed to understand the issue above-mentioned by exploring how the multinational high-tech giant, Motorola, has successfully built its leadership in China emerging markets on a wide variety of technology-intensive bases and how China has been developing its technological competitiveness by collaborating with and learning from foreigners.

In this study, I will analyze the corporate strategies of Motorola and industrial development policies of China, placing Motorola and China's communications/electronics industry in the historical and international context, especially in the new techno-economic regime of emerging markets. The circumstances under which "developmental" foreign subsidiaries may emerge in host regions will be reviewed and possible routes to cluster formation and the generation of dynamic competitive advantage in the industries will be explored.

Literature Review

Why are some firms like Motorola more adept than others at competing on the basis of technology in global, especially in emerging markets? How does a nation, especially a developing country, build its competitive advantage through learning and collaborating with foreign partners. To seek explanations, many theoretical insights have been derived from the literature in political economy, industrial studies, economic geography, and business strategy and management.

Contemporary scholarship offers two broad explanation for differences among firms and nations in their ability to make effective use if technology. One focuses on factors external to the firm, such as macroeconomics conditions, government policy, and industry structure, and helps account for cross-national variations. The other, which focuses on internal variables, maintains

that if firms vary in their ability to exploit technology, the reasons have to do with how they manage R&D, engineering, and manufacturing. A new direction is to the consideration of the role of general management.

Traditional industrial theory such as location theory, as developed by such pioneers as Alfred Webber (Webber, 1929) and Edgar Hoover (Hoover, 1948), relied heavily on the pulls of factors of production such as materials, markets and labor supplies, reinforced by economies of agglomeration. Product cycle-profit cycle theory maintains that as domestic market saturation is reached, in search for lower-cost production, the big monopolistic company will tend to desert the original center of production for other locations--in other regions, and even in other countries--where costs, especially of labor, are lower. Ann Markusen, Peter Hall, and Amy Glasmeier (1986), in their book "High Tech America", argue that some elements-business climate and scientific research--appear especially important for an understanding high tech location.

Increasingly, corporations must compete globally. Global strategies involve not only selling worldwide but also producing and even conducting research in more than one location. It is essential for a company to understanding the structure of its industry and position itself to gain a sustainable competitive advantage. The most comprehensive framework for analyzing the myriad external conditions that influence a firm's ability to compete in technology-intensive, global markets is provided by Michael Porter in "The Competitive Advantage of Nations". How companies succeed in international markets? Companies achieve competitive advantage through acts of innovation. Why are companies able to overcome the substantial barriers to change and innovation that so often accompany success? The answer lies in four broad attributes of a nation, attributes that individually and as system constitute the diamond of national advantage, the playing field that each nation establishes and operates for its industries. Porter describes four interdependent clusters of external conditions: "factor conditions", the richness of a nation's endowments in what economists call factors of production--human resources, physical resources, knowledge resources, capital resources, and infrastructure; "demand conditions", the sophistication, size, and nature of the domestic market for a firm's production; "related and supporting industries", the competitive strength of the network of domestic firms that supply or complement the firm; and "firm strategy, structure, and rivalry", patterns of managerial practice,

industrial structure and inter-firm rivalry that are characteristic of the nation in which the firm is based.

When study international markets, classical economists have emphasized macroeconomics variables, including interest rates, currency values, natural resources, and labor pools--all of which are quite beyond the ability of an individual firm or industry to control. The adequacy of this view has been decisively challenged. "The Competitive Advantage of Nations" argues that national prosperity can be created and is not merely a result of inherited endowments. In fact, for competing in sophisticated industries, the factor condition that matter the most are those a nation develop such as specialized human resources or specific scientific know-how. These factors, together with demanding local buyers, a sophisticated supplier network, and intense domestic rivalry, are the conditions that spawn successful global competitors.

Some scholars have been looking at the issue from the other direction--the emergence of consumer markets or consumer society in Asia. According to Hussey (1991)[1], the value to be added to the economies of Asia in the 1990's has been estimated at US$ 2.5 trillion--the same as that to be added to the American-Canadian and European Community economies combined in the same period. It is estimated that by 2000 there will be some 80 million high net worth consumers in Asia compared with some 10 million in North America with similar levels of assets and earnings. With increased wealth the consumer boom has led to a consumer culture which is based on material values--having and displaying what the market rather than the individual perceives to be the best or the most fashionable. Sophisticated consumer behavior is developed through education and experience. The wealth consumers, being able to travel, tend to develop similar tastes whatever their nationality. Spending patterns are very similar among the affluent in Europe, North America and Asia. Major corporations in North America and Europe realized during the 1980's or even earlier in the 1970's that they could no longer be successful in concentrating principally on their domestic markets and treating their international ones as less important. Therefore they gave increasing attention to their international operations. The factors driving them into this situation have been described by Ohmae (1985). He theorized that Japan, Europe and the US formed a Triad, presenting the most important strategic battlefield for companies operating on a global scale. In order to be successful, manufacturing companies have to invest

[1] Hussey, in "International Review of Strategic Management" provides detailed data.

extensively in tow activities: automation and R&D. Such companies have to move upstream to obtain access to new technology and downstream to improve the efficiency of their distribution.

Multinational manufacturers, having invested heavily in automated equipment and R&D, need to have access to affluent consumers at the same time in the different markets in which they are located since one nation market alone may have insufficient capacity for the multinational to recover its capital cost. With heavily investment in automation, R&D and more customer orientation, the products of the competing major multinationals tend to become increasingly similar in nature and content, requiring similar skill levels of product users. Differentiation comes more from packaging than from content. No multinational can keep an innovative advantage for long since lead times to bring in either competing products or clones are very short. The factors which will determine superiority are: 1) investment in automated equipment, 2) customer awareness, 3) emphasis given to R&D, 4) access to all major international markets, and 5) location of plants and ability to deliver. Asia is displaying all the signs of increasing affluence which result in consumer spending conforming with international patterns. This process will gather momentum in the 1990s. In order to service this market effectively, the multinational companies which wish to have a significant share of Asian markets will have to have a correspondingly significant presence in Asia. For American and European companies the temptation will be to develop distribution channels only into which product is shipped from other parts of the world.

There is a growing consensus that the fundamental weakness in the US economy comes from the difficulties of its manufacturing sector. This at a time when a new techno-economic paradigm is emerging based on new technologies that have internationalized production processes and globalized markets for products. Diwan and Chakraborty's book "High Technology and International Competitiveness" (1991) makes the first attempt to analyze the various dimensions of high technology's production structure and growth: productivity, input substitution, and technological change. The book provides the first empirical results on productivity and technical change in the high-technological sector. They found that capital and skilled labor are complements and technological change is non-neutral and embodied in inputs. One of the major conclusions is that labor in this sector is not a cost but an asset. This is a radical conclusion.

According to Diwan and Chakraborty, in the emerging new technology regime, it is the high technology that have growth potential in the future, and over time they will become a larger and more important part of any competitive economy. Since the new technology regime is international in character and fosters global markets, the high technologies have to compete internationally. It is high technologies that provide international competitive strength to an economy.

In addition, cost reduction and enlarged markets together provide the necessary condition for a self-propagating process. The sufficient condition is that social-economic institutions must also be consistent with this process. Institutional framework, in this context, embraces a very large spectrum containing a wide variety of institutions: economic, international, national political, and social. A new techno-economic paradigm is in place, one that is international in character and based fundamentally on microelectronics, or information-based, technologies. This paradigm is based, in an essential way, on (1) scientific knowledge, (2) skill and experience of the work force. (3) capital costs, and (4) location advantages.

Finally, Morone (1991) in "Winning in High-tech Markets" analyzed this issue, focusing on the role that have internal management plays in building and sustaining advantage on the basis of technology. The answer lies primarily with the behavior and practices of general management--the people with profit and loss responsibility who set the tone, objectives, and directions of the firm. Specifically, the analysis is pursued from three perspectives: general management's business strategies, technologies for implementing those business strategies, and the decision-making style underlying the formulation and implementation of business and technology strategies. They conclude that if very different US businesses are succeeding in markets where many others are having a hard time competing, the managerial practices of those businesses are the most likely source of their success and that successful decision makers exhibit an underlying strategy of "learning from experience" or "learning by doing."

Design of the Study and the Structure of the Thesis

Quite a number of books and papers have been written on the subject of Sino-foreign joint ventures and a few papers on technology transfer to China. However, little attention has been paid to the particular issue of dynamic relationship between multinational high-tech companies and the hosting government policies in building competitive advantages for both the foreign companies and hosting country. This study will be structured around the following three basic categories of questions.

> ***What?*** What are the unique features of Motorola's China strategy? What are the goals and objectives of China's strategic development policies in the process of industrialization, specifically the policies in communications/electronics industries? What are the forms and fields in which Motorola and China have been collaborating? What are the characteristics of their relationship?
>
> ***How?*** How are the collaborations organized and performing? How have Motorola's strategies and China's industrial policies evolved over the time in the collaboration and how do they influence with each other? In the face of uncertainty, how have Motorola management gone about evaluating new product and business opportunities? How and why have they decided to pursue some opportunities and forgo others?
>
> ***Why?*** Why have the collaborations between Motorola and China been successful so far? Should some lessons be learned from Motorola and China's experiences? Why do some nations provide an environment that enable companies to improve and innovate faster than foreign rivals? Can we identify attributes of foreign technology and business strategy that tend to be associated with favorable industrial policy of a developing country?

To address these questions, this study has been based on an empirical analysis of Motorola's China strategies and China's industrial policies, practices and outcomes in their collaborations. This has involved two-level field studies, with one focusing on strategy/policy issues and the other on practices and outcomes. In the first effort, I have first collected and analyzed historical/documentational information from Motorola Inc. and China's central government's Ministry of Electronics Industry (MEI) and Ministry of Postal and Telecommunications (MPT). For the second , I have collected and analyzed relevant data and information from Motorola (China) Electronics Ltd., which is in charge of manufacturing, distribution, sales, and R&D in China's various sites.

The thesis is divided into three parts. Part I China: Prepare for the 21st Century (Chapter 1-2). In Chapter 1, I present a brief history review of China's economic reform and development policy evolution in the 1980's and 1990's. In particular, presented are the China's strategic industrial development policies in three key industries, namely telecommunications, electronics, and computers. Part II Motorola: Road to Globalization Chapter 4-6). In this section, I first provide a review of Motorola's corporate history and business profile, focusing on its historical evolution, corporate culture, and globalization strategy targeting Asian emerging high-tech markets. Then I extend the company analysis to its cornerstones and core technological competencies. Part III Motorola-China: Win-win Success (Chapter 7-10). In Chapter 7, Motorola's business strategies and achievements since mid-1980's to date are presented. Chapter 8 focuses on the analysis of the dynamic strategic relationship between Motorola and China's governments and industries. In Chapter 9, some important implications of Motorola's China experiences and the commonplaces of successful China business practices are drawn. And finally, the Chapter 10 provides some future perspectives on China's future development in its industrialization process and challenges and problems faced by Motorola for the years coming ahead. The thesis concludes that in modern international competition in emerging markets, companies compete with global strategies involving not only costs or markets but also the building of strategic competitive advantage for both the foreign firms and the hosting counties, and that these companies are holding ground in this emerging market for the long haul by fitting corporate globalization strategy into China's strategic development policies.

Part I China: Prepare for the 21st Century

Chapter 1 China's Economic Reform and Development Strategies in the 1980's-1990's

1.1 An Overview: The Rising Giant in the East

The end of 1970's marked a significant change in China's economic strategy from central planning to "Reform and Open-door". Since then, China has been on its way of a unprecedented "New Long March" to the prosperity--the nation, with one quarter of the world's population, has dedicated itself to economic development and has shown its great development potential. Entering the 1990's, the nation achieved the fastest growth rate in the world and the exports has also increased greatly, as shown in Exhibit 1-1 and 1-2.

Exhibit 1-1. China's GDP (1991-2000)
Unit: Billions of US$

Year	GDP
1991	390
1992	450
1993	520
1994	580
1995	700
1996	730 EST
2000	990 EST

Source: China's State Statistical Bureau
* At 1996 exchange-rate value of China's currency

Exhibit 1-2. China's Exports (1991-2000)
Unit: Billions of US$

Year	Exports
1991	75
1992	80
1993	90
1994	120
1995	155
1996	170 EST
2000	200 EST

Source: China's State Statistical Bureau
* At 1996 exchange-rate value of China's currency

China's fast growth created tremendous opportunities for global businesses and foreign investments in China. The foreign direct investment (FDI) reached US$ 11.1 billion in 1992, US$ 25.7 billion in 1993 and US$ 35 billion in 1994, which lead to the total US$ 140 billion FDI in China from 1978 to 1994, the total 220 thousand of foreign investment projects and 100 thousand of foreign wholly owned ventures or joint ventures in China. In 1995, the China's vice premier Li Lanqing announced some of the ambitious development plans at the turning of the century: within the last five years of the century, the total import will reach US$ 1,000 billion; in the year of 2000, the annual import and export will total US$ 400 billion; from 1995, China will increase electric power 15 billion kw annually; to the end of the century, China will have increased 16 thousand km-long railway and 200 thousand-long highway; and in total, the investment in infrastructure including telecommunication, aviation, ports will have exceeded US$ 1000 billion in 15 years. (Engardio, 1996)

In particular, China, with its domestic base and wealth of engineering talent, plans to become a world power in a host of industries, including telecommunications, electronics, semiconductors, and computers.

1.2 Development Philosophy

So far, tremendous efforts by Western and Chinese scholarship have been put in exploration of China's economic achievements and future directions, with different perspectives and predictions, with mixed message from China's experience. To gain an appropriate long-range view, it is helpful to look at philosophy of the Chinese reform from three perspectives: development, history and culture, and political economy.

Development Chinese society has been in the midst of multiple and incomplete transition with such characteristics as (a) shift in economic vision from a Stalinist command economy to a market-oriented economy; (b) shift in business systems from an amorphous personalistic system glued together by "guanxi"(personal mutual obligation) to a modern system of transparent rules and regulations; and (c) shift in political control to the lawful civil society not under the thumb of the Party-Sate apparatus.

History and Culture There are four key problems of history and culture that still impinge on China's development. These are (a) rule--how to rule a large country with a large population from

a single place: tight central control or a diffusion of power? (b) greatness--how to restore China's greatness: what will make China strong again? (c) transformation--how to transform Chinese society: what road should China follow? and (d) foreign relations--how to deal with the outside world: engagement or isolation?

Political Economy The struggles over transformation highlights the ranges of options faced by Chinese policy-makers: (a) organization--how should the economy be organized and how much centralization of decision making is desirable? (b) human resources--in an egalitarian society, how should latent and education be recognized and rewarded? or is loyal political consciousness more important than experience? (c) management--what are the appropriate roles of the Party and the State? (d) investment balance--how should scarce capital be allocated: to heavy industry, light industry, services, or agriculture? and (e) the proper role of the foreign sector--questions about engagement with the world market.

The answers to these policy questions challenge the value of Chinese leaders. They also affect transitional issues. Reform and development depend on the answers attempted for the restoration of China's greatness and the transformation of her society. All Chinese leaders are driven by the historical memory of the "century of humiliation" of treaty ports and gun-boat diplomacy--the outcome of the disastrous collision of the declining Qing dynasty, riddled with corruption and burdened with a huge increase in population, with Western imperialism, fired by the revolutionary ideologies of free trade, Social Darwinism, and evangelical Christianity. Since the "Self-Strengtheners" of the mid-nineteenth century, the Chinese have been united in restoring China's position in the world, but have been bitterly divided over how to achieve it. How to transform Chinese society has been at the center of these conflicts. Which road should China follow? There have been many options, ranging from nineteenth century attempts at imperial restoration and constitutional monarchy through Sun Yatsen's guided republicanism and Jiang Jieshi's fascism to Mao Zedong's various solutions--"new democracy", "Sino-field" Stalinism, Cultural Revolution enthusiasm--and Den Xiaoping's "socialist market economy". Despite the vast differences between these solutions, these us a common thread: the attempt to graft new practices onto older traditions. The Self-Strengtheners felt that they could simply utilize industrial techniques to save the agriculturally-based Confucian order. Their slogan was "Zhong-xue wei ti, xi-xue wei yong"--Chinese learning as the base, Western learning for use. But the contradiction

was too strong: industrialism is not "culture-free" but leads to great transformation. Societies are complex systems--change one sector, and eventually all other sectors change as well, usually with unintended consequences. The formulation "socialist market economy" contains the same basic conflict--tight Leninist political control and markets. But economic choice builds pressures for other freedoms. Finally, to question of dealing with the outside world, the answers have run from isolation to engagement.

1.3 The Role of Technology

> *"A new technological revolution is currently taking place in the new world. this presents both an opportunity and a challenge to the economic development of our country. We should seize this opportunity and make selective use of the new scientific and technological achievements as to accelerate our modernization and narrow the economic and technological gap between China and the developed countries."*
>
> -- CCP General Secretary *Zhao Ziyang,* 1984

Technology is probably the most important element in China's four modernization plans--agriculture, industry, technology and defense, formally announced in 1978. Since then, the Chinese leadership have paid increasing attention to the critical role of science and technology for advancing their country's economy.

Particular concerns have been what China's response should be to the growing importance of four key technologies in the economic, social, and military affairs of the industrialized nations--microelectronics, information technology, biotechnology, and new materials. The Chinese leaders have realized that unless China is able to make significant advances in the fours above-noted areas, the technological gap between China and the West will grow even wider in the future. In fact, the emphasis on the "third wave" technologies has sparked a lively debate among members of the science and technology community regarding whether China should move faster in attempting to catch up with advanced country technology levels or abide by its present goal to attain Western technology levels of the 1970's and the 1980's by the year 2000.

It has been obvious to the Chinese government that technology is particularly important element of modernization in the various derivative industries made possible by microelectronics. Highly demanded consumer products in China such as TV are often embedded with Integrated Circuits (ICs) technology. As quality and precision are becoming critical in the international market place, China can no longer resort to the job shop kind of production mechanism. process

automation in both heavy and light industries are essential to upgrade quality, to improve productivity and to conserve energy. For a vast country like China, manual processing of transaction and management information is terribly ineffective. More accurate information is necessary for sound central planning. The need for new high technology is particularly acute in a planned economy, where much data collection, aggregation and distribution are necessary. information technology appears to be the key component in modernizing the infrastructure of China: telecommunications, transportation, utilities and banking. Electronics technology, therefore, has been ranked top in the development priority of China's recent three consecutive Seven Five-Year Plans (1986-2000).

China has been attempting to build a comprehensive capability of information technology in most areas of applications. To reach that goal, China has given priority to a wide spectrum of high leveragable technologies or those China is weak in.

China has recognized its needs for foreign technology for the short and intermediate term. The question was not so much to make or buy, but what, from whom, and through what channels to buy. China has been keen on establishing joint ventures with foreigners because of several advantages: shared capital exposure, comprehensive contacts with foreign technology and management know how, credibility in international market, and the alignment of the foreign partner's interest to the ongoing success of the joint venture. The emphasis on know-how was designed to reduce potential long-term dependency on foreign sources and promote China's goal greater technological self-reliance.

Traditional technology transfer literature painted the picture of huge MNCs exploiting helpless developing countries. As many MNCs hold the key technologies essential to the growth of Third World countries, they have been imposing stringent terms on the transfer of technology to developing countries, often extracting exorbitant profits, or hoarding essential technical know-how. This bleak picture may well be true for the typical developing countries whose economic growth is at the mercy of giant MNCs. This, however, is not true for China. In fact, China is known as a tough negotiator, imposing demanding terms on foreign companies attempting to establish a presence there. China's bargaining power with the suppliers of technology is two fold, its size and its centralized government. Whereas some MNCs are reluctant to enter the dubious market of a small sized developing country, Western corporations are flocking heads over heels to

conduct business in China. The vast market of one billion people, a quarter of the world population, is the dream of any marketer. While China's huge supply of cheap labor force might be an incentive, it has been becoming less attractive with the increasing popularity of automation. Before China's foreign trade is decentralized recently, all business transactions has to go through several gateways. These gateways monopolize the access to the vast market. The government bureaucracy becomes one of the most powerful buyers in the world by virtue of the sheer size they represent. China has waved the carrots of government contracts and a potentially huge China market to encourage foreigners to share their technology.

The Chinese approach to development of enhanced capabilities in computers and electronics has been premised on a two-pronged strategy that combines direct support for technical advance through larger investments in R&D and plant renovation with a well targeted foreign acquisition effort. the Chinese have targeted large-scale integrated circuit technology as their major electronics priority. Chinese efforts, however, are not merely focused on foreign acquisitions; there are very large on-going R&D programs underway throughout China's electronics industry to upgrade domestic capabilities. China is also expanding its efforts in software development.

1.4 Technology Transfer: Chinese Experience

> *"The main purpose of our policy of opening to the world is to import advanced foreign technology and managerial expertise and attract funds. In doing so, our ultimate aim is to improve the quality of our own products, to increase our capacity for self-reliance, and to speed up China's modernization."*
>
> -- Vice Premier *Tian Jiyun,* January 6, 1986

Essentially, China remains committed to the principle of achieving greater technological self-reliance. As such, any effort to understand the role and contribution of foreign technology must be made within the context of assessing on-going indigenous programs designed to enhance domestic capabilities.

Over the years, China has made a available a variety of channels, ranging from wholly-owned subsidiaries to licensing, for attracting the inflow of foreign technology. Among the various channels for absorbing foreign technology, the Chinese government has a strong

preference for joint ventures which has thus become a major vehicle for foreign investors to transfer their technology to China.

During the initial years of the economic reform, China would like to maintain a tight control over incoming foreign investment, although the control seems to have been relaxed gradually when demanded by foreign investors. The control was necessary for the central planning of the economy and for upholding the socialist ideology. Laws governing wholly foreign-owned enterprises were promulgated only in 1986, eight years after the start of the reform. At that time, the Chinese government had already gained rich experience in handling foreign investment and so was more confident in her ability to direct these foreign subsidiaries. During the past one or two years, the number of foreign subsidiaries has been increasing, but is still far behind that of joint ventures. Joint ventures appear to be the best candidate for the acquisition of technology in the Chinese context.

As the 'open-door' policy introduced more flexibility into foreign business transactions, China became increasingly interested in the more cost-effective option of purchasing know-how separate from equipment. Chinese end-users became more careful in managing project costs when they were made to take over some aspects of the financial responsibility for technology transfer. By mid-1991, China had, by signing contracts to import new technology and equipment, introduced into the country more than 4,000 items of technological transfer, with a value totaling over US$ 25 billion. China's technology buying patterns have shifted to software and know-how from hardware and turn-key projects. Before 1978 the import of "pure" technology to China comprised only 2.3% of total imports, and import of equipment 90%, but by the mid-1980's the former had already exceeded 50% while the latter fell below 50%[2].

These technology strategies have paid off handsomely. To date, China is one of the world's largest production bases not just for television sets, but also for consumer-electronics appliances such as videocassette recorders and stereo systems. Much of that production is done under foreign brands, particularly that of Japanese manufacturers. But Chinese and joint venture brand names are now commonly found on domestic store shelves as inexpensive alternatives to foreign brands.

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[2] Statistics are adapted from China Statistics Year Book, Beijing, China Statistical Publishing House, various years.

Similarly, China's leading state-backed personal-computer makers are rapidly climbing the technology ladder. Once limited to making PC components such as motherboards, several companies are moving into the fast-growing domestic PC market, thanks in part to assistance from their joint-venture partners.

In telecommunications, domestic Chinese companies are producing just under half of the switching equipment necessary to handle the 15 million phone lines being installed domestically every year. Joint ventures with foreign companies supply most high-end, central-office switches. But Chinese companies control the low end of the market.

In recent years, China has also been becoming a major source of technology because of its tremendous pool of first-rate scientists and engineers in high-tech industries. In many fields of technology, the gap between China and the industrialized nations is narrowing. In fact, since the mid-1980's China has licensed exports of more than 700 high-technology items totaling US$ 2.4 billion in hard currency earnings.[3] Many inexpressive Chinese technologies have improved to a level where they now challenge the level of Western technology in certain industries.

Talking about the technology transfer, especially the high-tech transfer, it is necessary to mention the Coordinating Committee for Multilateral Export Control (COCOM). As China is a Communist nation, certain COCOM and the US rules with regard to technology export control should be understood. In the past, a major constraint has been the export control system and COCOM, both of which served to restrict the sale of advanced technology to China. With the end of Cold War, there has been general consensus that many of these restrictions should be significantly relaxed. In accordance with this consensus, the US has taken several major steps to loosen its previous controls. In fact, ever since the US recognized China in 1979, Beijing has pressed the US to move forward in lifting restrictions on the sale of advanced technology. China was eventually moved to the less sensitive "Group V", with technology transfers being denied only if they would demonstrably contribute to nuclear weapons and their delivery systems, long-range bombers, antisubmarine warfare, electronic warfare and intelligence gathering. In short, advanced military technologies were to be strictly restricted, but many of the building-block technologies that the Chinese may use for military purposes, such as advanced materials and

[3] Statistics are adapted from China Statistics Year Book, Beijing, China Statistical Publishing House, various years.

electronics, could be exported. The relax of COCOM constraints somehow cleared the road for foreign technology transfer to China.

Chapter 2 The Evolution of China's Key Industrial Policies

2.1 Telecommunications

Telecommunications has been increasingly recognized as a key component in the infrastructure of economic development, yet for many years, telecommunication services in most developing countries including China fell far short of needs. The result is that development is constrained significantly throughout these economies.

Telecom Development in China

Despite the government's recognition of the strategic importance of telecommunications and the high growth rate in the sector, China still has one of the least developed telecom systems in Asia. With a telephone penetration rate of less than one in every 100 people in the 1980's and less than two percent in the mid-1990's,[4] China clearly has a lot of development work ahead.

Indeed, China's modernization plan is ambitious with the objective of increasing the number of telephones in use five fold by the year 2000. It has been proposed to extend the trunk network, further develop their satellite communications capacity and modernize the network with further introduction of digitized switching equipment and wireless telecommunications systems as well. Since the early 1990's, China's domestic long distance channels have been growing rapidly, at about 16% annually over the past decade. The number of exchange lines in service in China at the end of 1993 reached 30.48 million, making it one of the ten largest networks worldwide (Hayes, 1994).

Despite the rapid development in recent years, however, there are millions homes waiting for telephones in China's various places, cities and rural areas alike, with an average waiting period of six months to one year. Long distance lines are scarce, connections rate are low, and more than half of the country's villages and small towns do not have nay phones at all. (Cai, 1994)

Chinese government realizes the importance of the development of telecommunications. Telecom has been given a high priority within every Five Year Plan since 1986. As shown in Exhibit 2-1, by the year 2000, the government plans to reach a telephone density of 5-6%. Targets

[4] See "China Industry Profile: Telecommunications Part 14". Business China. August 12, 1991: 119.

have also been set that double exchange capacity and toll trunk lines to 100 million and 1.4 million, respectively. To achieve these goals, the MPT will have to purchase over $10 billion worth of switches and transmission equipment in 1995 and around $52 billion in infrastructure between 1996 and 2000. (Zita, January 1995)

Exhibit 2-1 China : Public Telecom Network Expansion, 1985-2000.

	1985	1990	1995	2000
Telephone lines	5,900,000	10,000,000	36,000,000	78,000,000**
Telephone density	less 0.5%	1%	3%	5-6%**
Exchange capacity	N/A	33,480,000 *	50,000,000	100,000,000**
Trunk Circuits	36,000	96,000	520,000	1,400,000**
% Digital	2%	79%	85%**	97%**

Sources: Adopted from Pyramid Research Estimates and China Official statistics, Eighth Five-Year plan (1990-1995)
*1993 number
** Estimated number

The telecom revolution has reached China. In many Chinese cities, telephones, pagers, cellular telephones, cable TV, satellites and even the Internet are gradually becoming a part of everyday life.

In 1995, a year-old China United Telecom Co., or Lian Tong, began to offer telephone services in four Chinese cities, breaking the monopoly on all services held by the MPT. Competition, though limited, started emerging in China's telecom market for the first time in the history.

Foreign investment and technology began entering China's telecom industry and consumers too. Although China insisted on banning foreigners from owning or operating telecom services, but allowed sales of equipment, joint venture manufacturing, consultancies and non-equity investments. But recently, large foreign carriers have been aggressively pushing the limits of the ban, creating equity-like deals with arrangements to build, operate and eventually transfer the ownership of new networks to China.

Telecom System Structure

While China's telecom systems remain inadequate, it has been aggressively building various telecom networks over the last decade. These include open wire network, coaxial cable

carrier network, submarine cable, microwave communications, special purpose communications, as well as satellite communications. However, as of 1994, only 55% of the long distance traffic was controlled by automatic switches, and only half was transmitted through microwave, modern cable (including fiber optic), and satellite transmission networks. The remainder still went through overheaded, open-wire lines (Bien, 1994). In many rural areas, the local networks were not connected to the long-distance network. Instead, only one or two phones in the nearest town or county post office are linked.

Wireless communications technologies appeared China's answer to technological leapfrogging. Cellular phones and pagers have been in high demand in China. Despite China's monumental efforts to upgrade its telecom infrastructure, the average customer could wait as long as a year to have a phone installed, even in the larger cities. This situation led many of China's budding entrepreneurs to turn to cellular communications equipment, which can be quickly obtained by those with ready cash. Even though user fees and equipment costs for cellular service were substantially higher than for ordinary telephone service, China's cellular networks had nearly 50,000 subscribers in more than 20 cities by mid-1992, a rapid increase from the 6,000-7,000 who signed on when cellular services were first offered in 1987. (Holman, 1995) That number has reached over 5 million by the mid of 1996. (*China Daily*, 1996)

Paging has been successful in China, not only because of the long wait lists for telephone installation, but also because the main alternative, cellular telephone, costs anywhere from US$ 1,150 to $1,750 (10,000-15,000 yuan) to purchase and register, more than ten times the cost of pager. As a result, paging networks have also taken off in China, with an expansion from around 430,000 subscribers in 200 cities in 1990, to over one million subscribers in 400 cities in 1991, to over 5.61 million by the end of 1993 (Bien and Pham, 1994) This technology was given an extra boost when the market was officially opened in late 1993 to organizations not affiliated with the MPT. Future demand for pagers is expected to keep rising.

In addition to the public telecom networks, China's had some other non-MPT national telecommunications networks, namely "dedicated networks". Dedicated networks had an important part of the national communications infrastructure since 1977. Among the operators of specialized national networks were the Ministry of Railways, Ministry of Water Resources,

Ministry of Electronics, Ministry of Energy, Bank of China, New China News Agency, and the peoples Liberation Army.

Institutional Framework

Before reform, China's state-owned telecom system was semi-military, highly centralized, and basically a tool for administrative needs. Throughout all of this, telecom at the national level was basically synonymous with the MPT.

The MPT is the central authority in charge of China's telecom sector. In addition to being China's only public long distance carrier until very recently, the MPT also formulates and overseas implementation of telecom policies, laws, plans, and reform programs; acts as the regulatory agency; acts as a liaison between China's central bureaucracy and the 31 semi-autonomous provincial carriers, and manages a large part of China's telecom equipment manufacturing industries. The MPT is an umbrella government entity, which includes 31 provincial level Posts and Telecommunications Administrations (PTAs) and about 2,150 county level PATs, with total 1,200,000 employees nationwide. (Liang and Zhu, 1994)

In addition to the MPT, a number of other central authorities also have some control over certain telecom sector matters. These include some important ministries of the government such as The State Planning Commission (SPC), The Ministry of Electronics Industry (MEI), The State Science and Technology Commission (SSTC), The National Defense, Science, Technology, and Industry Commission (NDSTI), and The Ministry of Finance (MOF).

The MPT's position as the single entity responsible for all telecommunications services has lead to a great deal of inefficiency as different parts of the bureaucracy often interfere with each other. Hence the government has recognized the need for establishing "an institutional structure that clearly defines separate and distinct roles for policy-making, regulation, and management". (Melody, 1991) Functional separation should not only improve policy making and regulations, but also allow service enterprises to operate more efficiently. The MPT finally split itself nominally into two parts in 1994. The MPT is now the national regulator, analogous to the FCC in the US, while the Directorate General of telecommunications (DGT) becomes the dominant carrier responsible for long distance, international, and national data networks.

Nevertheless, the MPT has been an active player in China's telecommunications/information field. It enjoyed incredible growth and expansion has over the

past decade. Its efforts have greatly raised the telephone penetration rate in China. However, with limited manpower and financial capacity, the MPT concentrates its major attention on the basic universal telephone services.

The MEI is the highest government authority responsible for China's electronics industry, to which many related industries including telecommunications and machinery formed a unique and complicated institutional framework in the reform of China's information sector. The MEI has been a constant advocator of digital technology and advanced services. This attitude is coincident with its competitive advantages and expertise. The MEI has a strong R&D and manufacturing base which covers electronic components, computer and software, and digital telecommunications equipment. This kind of horizontal integration puts the MEI in an ideal position to harvest the convergence of computer and communication technologies. Also, the MEI is in the area of advanced information systems and services that the MEI is best equipped to compete with the MPT. In addition, by promoting advanced information applications the MEI hopes to stimulate and awaken the demand for services which the MPT is not currently interested in or able to provide. The results may lead to pluralism and liberalization of the market, thus meeting a precondition for the MEI to gain a stake in the services sector and realize upstream vertical integration from product manufacturing into service operation.

Evolution of Telecom Reform and Industrial Policy

Form the beginning of the reform of telecom sector in China, the basic issue concerned by the government was how developing countries such as China should go about restructuring the sector. Is deregulation and competition the best way for these countries to upgrade their telecom infrastructures, or should they rely on a monopolistic national telecom authority as South Korea, Singapore, and Japan did? Should they follow the traditional path of playing down copper phone wires, or should they use wireless networks in lieu of wireline? How to finance the restructuring and development? And finally, to what extend should they allow foreigners play a role?

China's unique political and economic situation make the telecom policy arena very different from that of many other developing countries. China's economy continues to grow at double-digit rates, after being the world's fastest growing economy in the late 1980's, yet it is also in transition from being a socialist to a market economy. Moreover, the state retains its

political authoritarianism; decisions are not made in the open, and the structure and policy-making process behind Telecom are not fully understood. Nevertheless, some general trends and directions of the reform and future development have been emerging.

Beginning of liberalization--breaking up of monopoly

The inadequacy of telecom services, together with reforms the state enterprises, fiscal, and monetary structure of the 1990's, gave urgency to the need for a more developed telecommunications sector. Partly out of these concerns came from the MPT's agreement in late 1993 to give up its monopoly position as the sole legal operator of public interprovincial voice and data networks. Thus began the liberalization of the basic service market in telecommunications, which was marked by the arrival of two new public entrants, Ji Tong and Lian Tong, into the market. The MPT fought hard to retain its monopoly status but was ultimately unable to prevail against the combination of political pressure and unmet demand for services. Pressure for this move came largely from other ministries hoping to open up their own private networks to the public. Liberalization was eventually achieved not only because of the rivalry of government ministries but also because of the political clout of supporters of the new companies, including the highest central government leaders.

Ji Tong Communications Corporation was founded by the central government in May 1993. With twenty-six different shareholders, it was China's largest communications equity consortium. It was officially owned by the MEI. Ji Tong's stated mission from the government was to develop a nationwide information infrastructure through its role as equipment supplier and possible owner of the "Three Golden Projects".[5]

Meanwhile, the formation of Lian Tong, or China United Telecommunications Corporation, indicated the most significant change in China's telecom history. Lian Tong became the second long distance voice operator, the first time in China's telecom history. The existence of Lian Tong was a reflection of the powerful interests that the potential value of telecommunications services have attracted. Shareholders of Lian Tong include the three founding

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[55] "Three Golen Projects", China's national information technology initiatives, refer to "Golden Bridge" or "Jin Qiao", as a national economic information network, "Golden Customs" or "Jin Guan", as a national foreign trade and customs-related information network; and "Golden Card" or "Jin Ka", as a nationwide network of credit cards.

ministries--electronics industry, power and railways--and 16 other founding shareholders. Again, the MEI was the primary catalyst behind the venture. But none of them were particularly interested in Lian Tong itself. They were primarily attracted to the company's license, granted by the State Council in December 1993, to operate a second telecom network. (*Business China,* 1995) According to Lian Tong's Chairman Zhao Weichen, by the year 2000, Lian Tong would have 10% of China's long distance telephone traffic, 30% of all mobile traffic and its own international service. Officially, Lian Tong's competing relation with the MPT was supposed to be "competitive coordination." The terms of reference as stipulated by the State Council dictate that Lian Tong should use the MOR and the MEP's redundant network capacity to provide voice, data, radio, and cellular services to the public, concentrating primarily in areas where these services do not exist or where those provided by the MPT are inadequate. The dynamics between Lian Tong and the MPT are at the core of the changing nature of the telecommunications sector.

This state of play has had interesting consequences. At ministerial level the concerns are about power and prestige as the MPT battles to maintain dominance over other ministries trying to enter the telecom market. At a lower level the issues are not about power but revenue and profits. Lian Tong gets its call through: the company will compete head on with the MPT and other operators in trunk, local and mobile telephone services.

Adopting foreign technologies

Countries such as China in the Pacific Rim may be able to enter the "information society" more quickly and efficiently than those in other regions because they are not hampered by as many previous investments in outdated technology. To take advantage of this opportunity, however, new communications technologies should be carefully chosen. New technologies should be cost effective and practical, but also compatible with the needs, resources, and technical skills available. Furthermore it is important to ask what effect technology transfer will have on the relationship between developed and developing country. Developed countries may assist developing countries by transferring technologies,

but they may also reinforce their own economic power or dominance by transferring only second-rate technologies.

In China's telecom development, the primary needs are for quick diffusion of technologies that can reach many people. Cost is an important consideration, as is more technical training for

rural telecom workers. Foreign investors are willing to transfer the latest technologies to China as part of their businesses, but their transactions are constrained by government rules of both the foreign countries and China. These restrictions are largely political.

Now China's telecom market is extremely competitive, this in part reflects the size and potential of the market, but also reflects the tendency of governments of major companies in the market to provide low interest loans (soft loans) to China in order to facilitate the purchase of a particular company's equipment. The Japanese are particularly known for using this approach.

The highly competitive situation has also been encouraged by the Chinese government, they have been prepared to operate their network with at least seven different telephone switching systems when most modern networks operate within a maximum of two types of equipment. This has allowed Chinese officials to play suppliers off against each other and has often enabled them to obtain the consulting/technical advice needed as part of the equipment purchase package. Major equipment suppliers currently in the market include C.I.T. Alcatel of France, AT&T. of the US, Fujitsu Ltd. and NEC Corporation from Japan, International Telephone and Telegraph Co.'s Belgium affiliate, Telefon A.B., L.M. Ericsson of Sweden and Northern Telecom from Canada. (Forster, 1987)

The strategy for achieving this metamorphosis involves a massive investment of resources. To relieve the strain on foreign currency reserves the government is looking towards joint ventures with foreign corporations to develop the network and generate foreign exchange at the same time. They have embarked on a course of decentralization giving provinces and local telecommunications administrations responsibility for the efficient operation of the network.

The fast pace of telecom development in China has increased foreign competition to supply the sector. Increasingly, foreign firms are seeking to invest in local production facilities to ensure their positions over the long term. Foreign investors have been pressured by the MPT to raise the proportion of local content in joint ventures--a mandate that extends to foreign licensing arrangements as well. Current ministry guidelines call for production ventures, particularly those that supply China's domestic market, to source at least 60-70 percent of all inputs locally.(Gorham, 1993) Compliance with these guidelines has been greatest in ventures producing PBX, key systems, multiplexes, fiber-optic transmission systems, and certain satellite and mobile

communications systems. Even for higher-technology items, such as switching equipment, Beijing is putting increased pressure on foreign joint-venture partners to accelerate localization efforts.

Control of service markets

While China has been welcoming foreign suppliers for the telecommunications infrastructure, it has very firmly stuck to its "3 No's"--policy of no any foreign participation in the ownership, management, and operation of telecommunications services networks. Rooted in concerns about national security and pride, the ban on foreign involvement in the service sector became nevertheless weak as foreign operators began to test the limits of direct participation. These changes came at a time when the MPT's authority as the single state-owned monopoly was modified by the formation of Lian Tong and Ji Tong and by its own split into the DGT as dominant carrier and the MPT as the regulator. As the sector was reformed, however, no comprehensive regulatory regime has been able to clearly define the new role of the MPT. As a result, much international attention has been focused on attempts by various companies to participate in the service market, especially Hong Kong investors trying to break into radio paging and cellular radio projects. Many foreign analysts and investors believe that China cannot meet the target of 100 million PSTN lines by the year 2000 without direct foreign investment; according to this view, adoption of the global privatization model is China's only rational choice. Nevertheless, the MPT has responded on several occasions with stern pronouncements that foreign ownership and operation of telecommunications services is not permitted. According to an announcement by the MPT in 1993, "In China, it is not permitted for foreigners, including Hong Kong, Macro, and Taiwan entities, to participate in the joint management of postal or telecommunications operations, and the policy prohibiting foreign capital from being directly invested in these operations has not changed. All those who have violated the above principles should immediately rectify their mistakes and stop the execution of any contracts that already been signed or are now being implemented."(*National Trade Data Banks*, 1993).

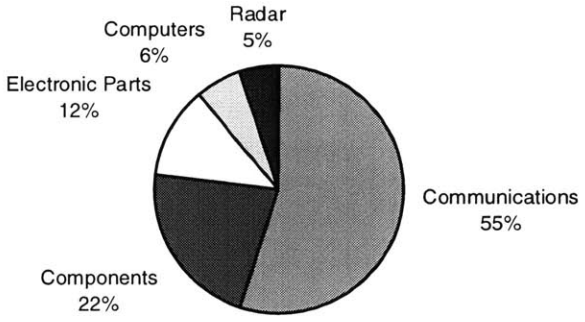
2.2 Electronics/Semiconductors

Development and Problems

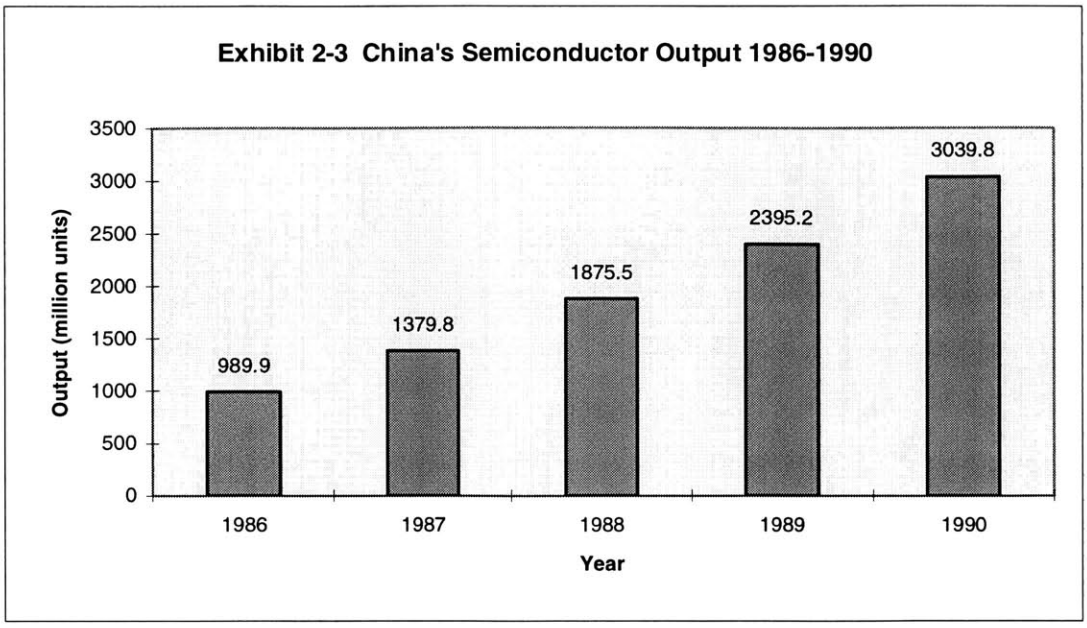
China's electronics industry has shown remarkable improvement since the 1980's. Quantitatively, China has achieved some successes in production of semiconductors and other

electronic products, as shown in Exhibit 2-1 and Exhibit 2-2. The total sector output value in 1990 was increased greatly by the early 1990's. Despite the gains, the gap between China and the rest of the world in electronics continues to widen. This is primarily due to inefficient and duplicate production, aging equipment, low labor productivity, and shortage of foreign exchange, parts, and components. Quantitatively, the problem of component shortages is still serious. Qualitatively, deep-seeded problems plague this sector, with the result that China's semiconductor industry is at least 5-10 years behind the world leaders.(Simon, 1992) The major problems are China's obsolete manufacturing facilities and inability to utilize at the factory level technological advances made in the lab. These factors have fostered continued dependence on foreign-made components in most areas. China's rapidly growing microcomputer industry, for example, still requires imports to meet over 60 percent of its demand for semiconductors and integrated circuits.(Simon, 1992)

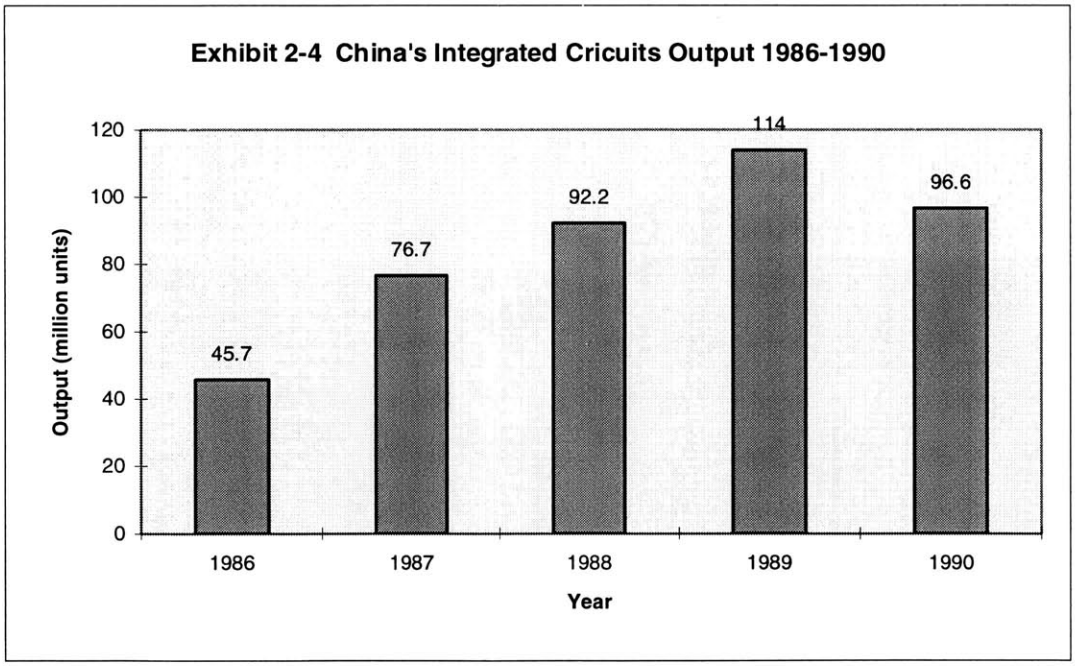
Exhibit 2-2 Sectoral Composition of China's Electronics Industry, 1989



Source: Ministry of Machinery and Electronics



Source: Ministry of Machinery and Electronics



Source: Ministry of Machinery and Electronics

Institutional Framework

Studying the organization of the electronics industry highlights the problems posed by China's complex bureaucracy.

China's electronics industry is characterized by the presence of multiple ministerial-level organizations involved in the research, production, and application of electronics technology, components, and equipment. Many of the key ministerial organizations are represented on the central government's Leading Group for the Invigoration of the Electronics Industry. But a number of other ministries are also involved in electronics-related activities. Intense rivalry and competition often emerge as each ministry attempts to build its own self-sufficient infrastructure to support all its electronics needs. This rivalry occasionally spills over into the foreign trade and investment area, forcing foreign companies to choose which ministry they conduct business with.

The MEI dominates national picture in the electronics area. The MEI has 170 enterprises under its direct control, and also has a hand in administering mist of China's 2,400 electronics factories and research institutes, many of which report to local or provincial authorities. (Simon, 1992)

Chinese officials in the electronic sector recognize that administrative interference in enterprise affairs has constrained overall efficiency and productivity, and the MEI is one of the first ministries to publicly relinquished some control over its factories. Although efforts to decentralize the sector have been put and electronics enterprises have greater overall discretion on matters of general management, decision-making authority is likely to be limited by the central government's recent tightening of controls over China's foreign trade.

Industrial Policies: Learning and Catching-up

Since the early 1980s, China's top leaders--regardless of political inclination--have sought to promote the development of the country's electronics industry. In their desire to take part in the technological revolution, Chinese leaders have steadily increased funding for the modernization of both research and development and manufacturing capabilities for semiconductors and integrated circuits, the basic building blocks of the global electronics industry. They realize that if China is to achieve a strong competitive position in the world economy, it will have to establish a strong foundation in a range of informatics-linked technologies.

Chinese policy emphasizes foreign investment and technology import as the primary mechanisms for both upgrading manufacturing capabilities and increasing local content. While export promotion is encouraged as a means of earning hard currency to pay for such purchases,

Chinese leaders stress that they do not want to import components simply to export them again in low value-added processed goods; the thrust of the strategy is to improve domestic capacity through import substitution.

Chinese officials are counting on a plumber of foreign investment projects to propel the components subsector during the 1990's. The priority being given to the electronics sector by the central government, coupled with the industry's current inability to meet demand and innovate technological advances, ensure numerous trade and investment opportunities for foreign firms in the coming years. To date, the most ambitious of these involves Motorola, which has agreed to set up an integrated circuit-manufacturing facility in Tianjin. The Motorola project, a wholly foreign-owned enterprise, involves the establishment of an assembly and manufacturing facility foe multi-purpose ICs. The company intends to gradually evolve its operations from assembly of semi and complete-knockdown kits to technology transfer and full manufacturing operations. However, few other US companies--or other foreign firms, for that matter--appear to have thoroughly investigated manufacturing opportunities for higher-end products. In the semiconductor and IC areas in particular, US companies have been too preoccupied with the markets in Japan and Europe to pay much attention to China. Although the Motorola and NEC projects may herald a new stage of higher-end foreign investment in electronics industry, many foreign companies are clearly wary of introducing advanced technology into China, a potential future competitor.

Nevertheless, China's electronics sector' dependence on foreign components will continue. This dependence will be felt most in the computer field, where China's lack of sophisticated manufacturing capability will prevent it from attaining the advanced technological levels it seeks.

2.3 Computers

Accorded priority status by Beijing, China's high-tech electronics industry, which includes computers, has received increasing investment and preferential treatment from the government. China's economic development plans bode well for computer sales figure. The government hopes to employ computers to modernize China's outdated industrial infrastructure as well as boost the

development of the nascent commercial sector, including the consumer and financial markets. Computers are now being used in nearly every sector of the Chinese economy.

Development History and National Strategy Evolution

China's drive to develop its computer industry began in the early 1980's as part of the nation's overall modernization efforts. Until 1979, China relied on imports from the Eastern bloc as well as on domestically produced data processors, which used very low-end and outdated vacuumtube technology.

During the early years of China's reform period (1981-85), China's objective was to build a complete domestic computer industry from scratch and avoid dependency on the West. China thus sought to attract foreign investment and technology, with which it would develop its own mass-production facilities. This single-minded drive to acquire technology effectively distanced foreign investors, who were unwilling to hand over their expertise without the guarantee of substantive returns.

Direct sales were another matter, however, and foreign vendors were eager to make inroads in the new China market. From 1981-85, China imported about $3.78 million worth of computer equipment, mainly high-end systems, such as mainframes. (Hui and MaKown, 1993) By 1986, China's attitude toward technology transfer began to change. Government leaders realized that their goals for technology acquisition were unrealistic, and began to negotiate more equitable deals with foreign vendors. Early in this second phase of development (1986-90), the first Sino-foreign computer joint ventures were formed, and, with this influx of foreign technology, the domestic industry began to take shape. Efforts were concentrated on building facilities to manufacture PC and small-scale computer hardware.

Since early 1990's, China has abandoned its course of self-reliance in computer production and entered a third phase of development. Instead of trying to manufacture all types of computer equipment on its own, China decided to import high-end equipment, including mainframes and minicomputers, while manufacturing low-end products. At this time, China began to focus on the previously neglected areas of software development and information technology services. The concept of software as a viable industry is still a foreign notion to many users in China, who have long relied on private software. Beijing, however, now recognizes that one of China's strengths

lies in its large pool of skilled software developers. The government is promoting these talents in the hope that China will eventually become a major center for software development.

An Important Implication: All Eyes on Chips

The most imposing obstacle facing China's domestic computer manufacturing capability was its dependence on imported chips. Until recently, China's IC production capability was low and limited to ICs used in consumer goods, such as televisions and refrigerators. In the labs, China could manufacture chips ranging from 1-3 microns, but still couldn't mass produce them. ICs at the 1-3 micron level, were necessary for the production of basic computers such as Intel's 286- and 386- platform based PCs. (Hui and MaKown, 1993)

As a result, China had to import almost all ICs needed for computer production. Although initially China was trying to build up its domestic IC production base, international restrictions imposed by the COCOM prohibited China from gaining the technology needed to produce more complex ICs. For China to reach current 1980's-1990's Western standards of semiconductor technology, at least 20-30 years of research, development, and manufacturing efforts would be needed. Realizing the odds against successful solo production, China has been actively searching for foreign partners to develop IC production capability. Foreign computer manufacturers have an important--and potential lucrative--role to play in modernizing China's computer industry.

PART II MOTOROLA: ROAD TO GLOBALIZATION

Chapter 3. History and Expansion of Motorola

With US$ 27 billion sales (1995) and 142,000 employees (1996) over six continents, Motorola is one the world's leading providers of wireless communications, semiconductors, and advanced electronic systems and services. Major equipment businesses include cellular telephone, two-way radio, paging and data communications, personal communications, automotive, defense and space electronics and computers. Communication devices, computers and millions of consumer products are powered by Motorola's semiconductors.

3.1 History Background

Founded as the Galvin Manufacturing Corp. by Paul V. Galvin in 1928, the company introduced the first commercially manufactured car radio under the brand name Motorola (Motor + Victrola = Motorola), and subsequently in 1947 adopted that name for the corporation. Over the next 40 years the company was involved in several consumer lines as well as its communications and semiconductor businesses, including car and home radios and televisions. But in the early 1970's the company's focus shifted to high-technology industrial electronics, including advanced mobile telecommunications (e.g., cellular phones) and advanced semiconductors (e.g., microprocessors).

Over the years the company expanded into a wide array of communications and electronics devices. The company grew rapidly, as shown in Exhibit 3-1.

Exhibit 3-1 Growth of Motorola (1930-1995)

Year	Net Sales	Earnings before Income Taxes	Return on Average Invested Capital	Employees
1930	487k	NA	NA	10
1940	10m	NA	NA	985
1950	177m	NA	NA	9,325
1960	299m	NA	NA	14,740
1970	797m	NA	NA	36,000
1980	3.10b	NA	NA	71,500
1990	10.9b	NA	NA	105,000
1991	11.5b	600m	7.7%	102,000
1992	13.3b	800m	9.5%	107,000
1993	17.0b	1.5b	15.2%	120,000
1994	22.0b	2.4b	17.5 %	132,000
1995	27.0b	2.75b	14.5%	142,000

Sources: Adopted from Motorola Inc.

Motorola's operations can be described as highly decentralized, with business operations structures into sectors, groups or divisions, depending on size. The company is organized in six business groups, which primary products are listed below:

- *The General Systems Sector* designs, manufactures and distributes RF-based cellular radiotelephones and systems, personal communications systems, computers and microcomputer boards.
- *The Semiconductor Products Sector* designs, produces and distributes a broad line of discrete semiconductors and integrated circuits, including microprocessors, RF devices, microcontrollers, digital signal processors, memories and sensors.
- *The Messaging, Information and Media Sector* designs, manufactures and distributes a variety of messaging products, including pagers and paging systems, wireless and wireline data communications products, handwriting recognition software, infrastructure equipment, systems and services.
- *The Land Mobile Products Sector* designs, manufactures and distributes analog and digital two-way radio products and systems for applications worldwide, from on-site to wide area communications.
- *The Automotive, Energy and Controls Group* designs and manufactures a broad range of electronic components, modules and integrated electronic systems and products for

automotive, industrial, transportation, navigation, communication, energy systems, consumer and lighting markets.

- *The Government and Space Technology Group* specializes in research, development and production of electronic systems and products for US government projects and commercial business. The group's Satellite Communications Division is developing the IRIDIUM satellite-based communication system.

In the 1990's, Motorola is the largest provider of wireless communications equipment in the world, and its semiconductor business leads the world in many of the markets it serves. Building on technology platforms such as these, it creates new markets for its products, as well as new industry segments. In terms of total sales, Motorola ranked No. 23 on the Fortune 5000. (Henkoff, 1994)

In 1995, Motorola is No.1 in the world's cellular telephone, paging and two-way radio industry and market. These wireless businesses account for about 60% of its total sales. And it the world leader in many key segments of the semiconductor industry, with its semiconductor business accounting for 29% of the company's total sales. The remainder of Motorola's sales come from advanced electronics systems and components. Motorola's compound annual sales growth rate of 24% over the last five years reflects the explosive growth of communication and electronics in the global marketplace, especially in emerging economies. The most rapid rate of growth was outside the United States. (*Motorola Annual Report,* 1995)

3.2 Corporate Culture

Motorola has a strong and homogeneous corporate culture despite the relative independence of the various sectors, groups, and divisions of the organization. Al employees act according to certain corporate values best captured in the Motorola global mission statement:

> *In each arena, we will grow rapidly by providing our customers what they want, when they want it; with Six Sigma quality and best-in-class cycle time, as we strive to achieve our fundamental objective of Total Customer Satisfaction and goals of increased global market share; best-in-class people, products, marketing, manufacturing, technology and service' and superior financial results.*

The company's philosophy is to manage for long-term growth and profitability, while consistently and appropriately investing in technology to maintain competitive leadership.

Motorola consistently emphasized Total Customer Satisfaction (TCS). In recognition of its quality initiative, Motorola won the US national Mclcolm Baldrige Award in 1988. Motorola spent nearly 10% of sales on R&D each year--over 1 billion--to maintain its engineering leadership. Yearly plant and equipment investment--especially design and production technologies--sales exceeded US$ 1 billion, and investments were made in training aimed at developing employees' abilities to work with new technologies and processes. (Henkoff, 1994)

People at Motorola are empowered as long as they could show adequate performance and aim at total customer satisfaction. For many years, Motorola stressed empowered team culture that resulted in complex organizational structures that lead to team decision making. The company recognized the value of its employees. Motorola set priorities in developing the capabilities of its people. For this reason, emphasis was placed on training. All employees were required to attend 40 hours of training per year, and this requirement was expected to increase in coming years. Once an employee had worked for ten years in the company, there was an unwritten rule stating that he/she cannot be laid off without the permission of the CEO.

3.3 Globalization and Emerging Markets

Motorola evolved from being a national company in its early years and a multinational in the seventies, to a global institution in the eighties and nineties. With corporate headquarters in Schuaumberg, Illinois, Motorola facilities are now located in 19 countries in North and Central America, Europe and Asia, and above 40% of Motorola employees were non-US From 1993, more than half of its revenue have been generated outside of the US, and international sales were expected to increase to as much as 75% of total sales by 2000, as shown in Exhibit 3-2, Exhibit 3-3 and Exhibit 3-4.

Exhibit 3-2. The Changing Composition of Global Employment at Motorola

Year	US Workforce (%)	Non-US Workforce (%)
1983	65	35
1984	65	35
1985	65	35
1986	60	40
1987	59	41
1988	58	42
1989	57	43
1990	58	42
1991	57	43
1992	56	44
1993	56	44

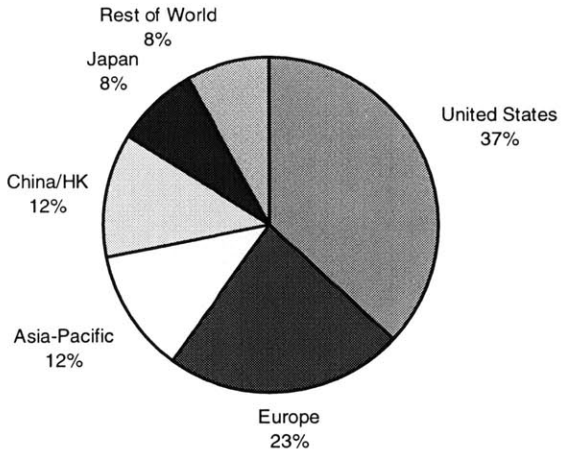
Source: Motorola Workforce Statistics

Exhibit 3-3 Motorola non-US Sales Share of the Corporate Total

	Actual				Estimated	
Year	1985	1992	1993	1995	2000	2020
% sales from Non-US	25	48	57	63	75	95

Source: Gohan, L. Janis. 1994. "Motorola-Penang". *Harvard Business School Case* 9-494-135. August 11, 1994.

Exhibit 3-4 Market Sales by Region (In percentages), Motorola Inc., 1995



Source: Gohan, L. Janis. 1994. "Motorola-Penang". *Harvard Business School Case* 9-494-135. August 11, 1994.

Chapter 4 Cornerstones and Core Competencies of Motorola

4.1 Institutionalizing Corporate Initiatives

The way Motorola does business is grounded in unchanging key beliefs with a dynamic balance of customer-focused initiatives and strategies. They combine to create a unique set of competitive strengths. Its management philosophy begins with two key beliefs--respect for the dignity of the individual and uncompromising integrity in everything they do. This helps to create an environment of empowerment for all in a culture of participation. It encourages Motorolaians to manage for long-term growth and invest in technology to maintain competitive leadership.

Total Customer Satisfaction (TCS)--"Six Sigma" and "10X Cycle Time"

Motorola's "*Six Sigma*"[6] quality initiative has been one of the driving forces in achieving competitive leadership. In the 1980's, Motorola promoted "*Six Sigma*" quality improvement as one of two key corporate initiatives, in support of a goal of TCS. The second initiative, "*10X Cycle Time*"[7] was an attempt to attain dramatic improvements in new product development time, manufacturing throughput, customer service and support functions' speed of execution. Ambitious "reach-out" goals were set. Quality was to improve to reach the six sigma level by 1992. Cycle times--across all activities of the corporation--were to improve 10X by 1992. *Six Sigma* and *10X Cycle Time* were sometimes referred to as "renewal" initiatives, in that they represented a renewed commitment to design, manufacturing, and service excellence. An Motorola Training Education Center (MTEC) quality course, utilizing the Six Steps to *Six Sigma*, was required of every Motorola employee. By 1993, 4,000 TCS teams were working on improving product designs, manufacturing quality problems, and reducing work-in-process inventory and cycle-time. Total manufacturing savings from TCS projects were estimated at over US$ 2 billion since 1989. The corporate quality manager estimated that similar savings could be

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[6] "*Six Sigma*" indicates a quality level of 3.4 defects per million. Three-sigma design yields 2,700 defective parts per million. A product design with 10,000 characteristics, either parts or manufacturing steps, yields 27 defects per finished product. Since such products are becoming more common, traditional three-sigma designs are completely inadequate.

[7] "*10X Cycle Time*" refers to the cycle time goal: to reduce the time to perform every activity--manufacturing and non-manufacturing--tenfold within five years.

achieved by administrative teams which, so far, were under-represented in the competitions. (Gogan, 1994)

Participative Management Program (PMP)

The PMP, an initiative begun in the seventies, was supposed to enhance productivity by increasing employee involvement, but by the early eighties some managers questioned its value. PMP had several goals: increase employee's commitment to the success of the organization; improve their quality of work life (and sense of satisfaction and loyalty); and encourage employees to generate ideas for improving organizational effectiveness.

In the 1990's, Motorola is trying to allay the fear of loosing competitive advantages to foreign workers by improving the productivity and motivation of workers in its US plants as well as in its overseas operations. Interestingly, Motorola is adapting motivational techniques such as team work that are successful with Malaysian workers to its US plants and is using lessons learned in its Penang plant in Malaysia to boost the morale and involvement of workers back home. This is a grand global experiment in plant management. The methods used to promote worker excellence at the Penang plant are a big part of Motorola's blueprint for developing a well-trained, motivated, and highly productive workforce, especially in emerging markets such as China and Vietnam.

Training and Education*: *Motorola University

As early as in 1980, Bob Galvin advocated making a significant commitment to training and education. He believed that new technologies created a more pressing need to increase employees' skills, especially for production workers, who would be expected to monitor their own quality and identify ways to improve processes. Motorola decided to allocate US$ 35 million to establish the Motorola Training and Education Center (MTEC). By 1989, 54,000 participants had taken *the Six Sigma* course. MTEC added to its original charter remedial skills training, supplier, customer and distributor training, and collaboration with public school systems and universities. It was re-named "Motorola University", in recognition of the broader scope of activities. By 1994 Motorola was spending about US$ 120 million on education annually.

4.2 Key Competencies

A measure of Motorola's competitive strengths is portfolio of intellectual property rights. The number of US patents issued to Motorola in the last five years has risen from 613 in 1991 to 1,016 in 1995. Motorola ranked No.3 in the United States. (*Motorola News Release*, 1995) As the software content of its products increases and the cost of computing drops, sophisticated products become easier to use and less expensive. This creates enormous new global market opportunities and spurs Motorola's investments in the skills of its people, in software development, and in its ability to manufacture efficiently, anywhere in the world. Motorola has embarked on the largest world-wide expansion in semiconductor capacity in its history. Motorola has also reshaped customer-supplier relationships as systems-level integration and combinational technologies revolutionize the industry.

Industries such as cellular and paging are built on Motorola's core technical competencies, including software, semiconductor and radio frequency design.

Technology has transformed Motorola's original two-way land mobile radio business. This market has grown from 33 million subscribers in 1992 to about 45 million at the end of 1995. (*Motorola News Release*, 1995) Astro digital technology has renewed markets such as public safety, while radius two-way radios have penetrated consumer dispatch and telephone interconnect, voice and data. IDEN systems are targeted for workgroups on the move.

Communications is also one of the fastest-growing segments of the semiconductor market. That's one reason that Motorola's Semiconductor Products Sector has achieved a compound annual growth of 23% since 1991. Motorola has a breadth and scope of products that is unmatched in the industry. In addition to wireless, Motorola is No.1 in several of the fastest-growing markets, including energy/environment and industrial; automotive; multimedia set-top boxes; personal computer printers; and interactive, microcontoroller-based smartcards. (*Motorola News Release*, 1995)

As technologies and markets converge, the PowerPC microprocessor is becoming more attractive. The PowerPC scales the full range of applications, from computing to embedded control. More than 40 companies have selected the PowerPC as their desktop, laptop, workstation or server processor, while hundreds will use the PowerPC for embedded applications.

The PowerPC platform is at the heart of a full range of offerings from the Motorola Computer Group. (*Motorola News Release*, 1995)

Part III Motorola-China: Win-win Success

Chapter 5 Motorola in China

Motorola has been one of the most successful US companies in China, operating a wholly owned group of factories and joint ventures that assemble mobile phones, pagers and semiconductors for sale in China. Its sales on the mainland have been growing at more than 50% a year and over US$ 2 billion since 1994, making China Motorola's largest market outside the US. The cash generated by those sales, however, has so far been plowed back into expanding its business in China. (*The Wall Street Journal*, 1995)

5.1 Journey to the East

Encouraged by China's prospering economy and immense market, Motorola's journey to China started in the mid 1980's when Bob Galvin, former chairman of Motorola and the company's visionary leader for 50 years, turned his attention to China. After the careful country study followed his first visit to China in 1986, he decided Motorola should invest in China. A new chapter in the annals of the company's history opened up.

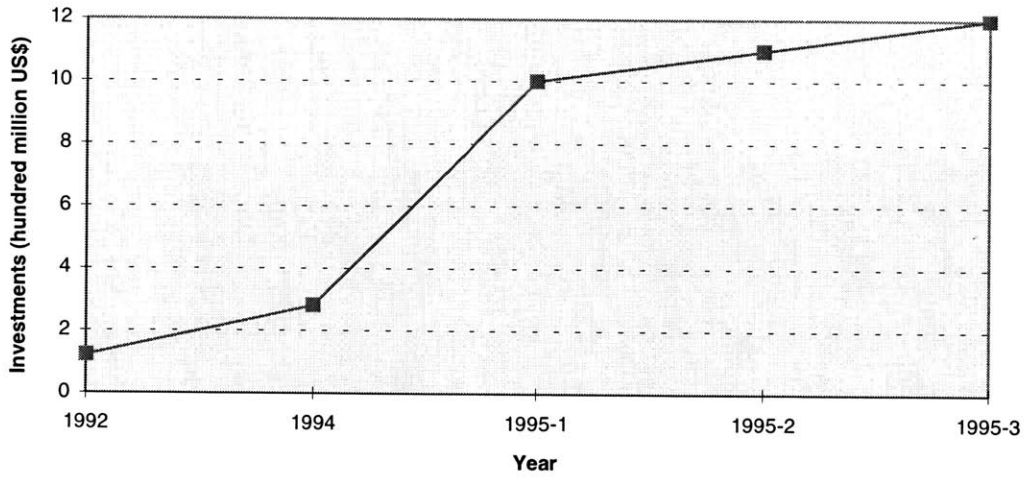
After that, Motorola set up three representative offices in China's Beijing, Shanghai, and Guangzhou. Until China-based manufacturing facilities were in operation in early 1990's, Motorola exported mostly finished goods to China, including Motorola's popular two-way radios, pagers, cellular and cordless telephones. Customers were mostly large Chinese entities like public security, transportation, and utility companies, as well as some foreign concerns operating in China.

In the 1990's, Motorola's businesses in China covers a wide variety of its major business lines, i.e. semiconductors, communications and general systems. Believing that to succeed in China, it needs to manufacture there, Motorola negotiated with Chinese government and set up a wholly owned venture in Tianjin in 1988. By year end of 1993, it completed a US$ 120 million first-phase plant in the Tianjin Economic & Technology Development Area to make pagers, simple integrated circuits, and cellular phones. A 2nd-phase plant also came on line in the following years.

In recent years, Motorola has been laying the groundwork for what will be Corporate America's biggest manufacturing venture in China. To date, Motorola has committed to invest US$ 1.2 billion in the country and branched out into half a dozen joint ventures, five years ahead of its investment target. That makes Motorola the No.1 US investor in China (See *Appendix 1*) By the mid of 1996, Motorola's over 6,000 Chinese employees work mostly in a cluster of factories around the port city of Tianjin, where they make pagers and cell phones and pack semiconductors into housings, some for domestic use, others for export.(Schoenberger, 1996)

A brief review of Motorola's China investments, as shown in Exhibit 5-1, indicates the company's commitment to the fast and important emerging market for Motorola's expansion in the region. 1995 was a milestone year for Motorola China, because it significantly increased the level of its investments with the addition of a US$ 720 million sub-micron, 8-inch, wafer fab in Tianjin, that is a mark of its commitment and confidence in China as a manufacturing base and major market for Motorola. (*Motorola (China) Electronics Ltd.,* 1996)

Exhibit 5-1 Motorola's Investments in China 1992-1995



Source: *Motorola (China) Electronics Ltd.,* 1996

To reinforce the confidence that Motorola has already expressed in China, Motorola directed its operations in North Asia from a new regional headquarters for the Greater China built in Beijing. In November, 1995, Motorola bought a 19-store and 32,000-sq m building to house

the management, marketing and engineering departments, a software center, the Asia Manufacturing Research Center, Motorola University, and a multi-function customer service center. (*Motorola (China) Electronics Ltd.,* 1996)

5.2 Strategic Moves and Achievements in China

Motorola set up the following basic strategic goals for its 1990's China businesses.

1. *Investment/Technology Transfer*: By the year 2000, total investment is scheduled to reach 1.2 billion US dollars, aimed at to introduce the advanced technology and equipment, to assist further the Chinese electronics industry, and to support the country's fast economic development.
2. *Management Localization*: Most of Motorola's operations in China will be localized during the second half of the decade.
3. *Local Souring*: To increase the proportion of local components in Motorola products.
4. *Joint Ventures and Strategic Alliances:* To develop more joint ventures from the basis of a wholly-owned enterprise.

Transferring Advanced Technologies

With consistent efforts for years, Motorola (China) has successfully worked with China's central government telecommunications authority, the MPT, to adopt Motorola's advanced paging network protocol, FLEX, as China's national standards. Motorola has signed a contract with a dozens of provincial governments and municipalities to expand their province/city-wide paging network using FLEX protocol.

In 1995, Motorola announced a major joint venture with Panda Electronics Group Company (Nanjing, China), one of China's leading electronics companies, and Motorola International Development Corporation (MIDC), Motorola's wholly-owned subsidiary in Schaumburg, Illinois. Under terms of the multifaceted agreement between the two companies, a new entity, Nanjing Power Computer Ltd., will be created to develop, produce and sell computer systems based on PowerPC microprocessors. Motorola holds a 60 percent equity investment and Panda Electronics Group Company holds a 40 percent equity in the new company. Initially, Motorola's computer group will supply Nanjing Power Computer with its Atlas motherboard

based on the PowerPC 603e(tm) and 604(tm) microprocessors for integration into new RISC PC computer systems that target the Chinese marketplace. Ultimately, Nanjing Power Computer will have the potential to develop new RISC PCs for China and other markets in Asia. The first products that emerge from Nanjing Power Computer will run Microsoft's popular Windows NT 3.51 operating system.

Also, in 1995, Motorola made two further major investments in China. The first of these investments was the announcement in September that Motorola would establish a large capacity integrated circuit wafer fab in the Xiqing Development Zone in Tianjin. The plant, with a total floor space of more than 300,000 sq m, would produce state-of-the-art technology, sub-micron, 8-inch wafers. Motorola again increased in commitment to China with a US$ 99 million investment announced in December 1995, for the production of GSA and CDMA standard products, the establishment of subsidiaries and service centers in 30 cities, the setting up of the Asia Manufacturing Research Center (AMRC), and expansion of the software design center, all to take place within 3 years. Motorola businesses have also implemented or are planning research and development centers in Beijing for Cellular Infrastructure and Cellular Subscriber Group and for Paging Products Group.

Localization and Training

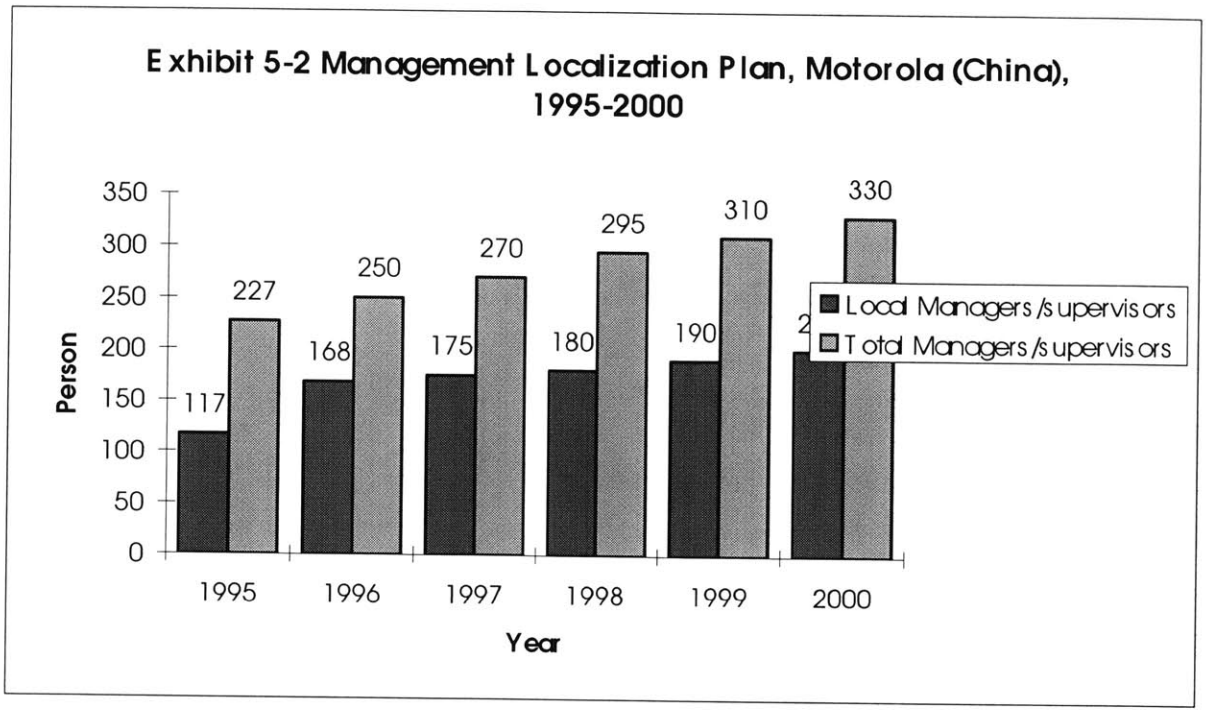
Motorola realized that without a proactive policy of localization for employees, its goal to take root in China could not be realized. Among its six thousand employees in Motorola's varied operations in China, many have been recruited from top universities/colleges and high schools in China. A plan has also been set and implemented to attract higher caliber of Chinese students studying overseas. Motorola's localization strategy has met with success and continues to make good progress, with batch after batch of quality Chinese employees joining the company and being offered a succession of key positions within the company.

Motorola understood that the company's success in China is dependent upon significant levels of local expertise among its employees, people who are not only familiar with Motorola's products and technologies, but are also accustomed to Motorola's corporate management and culture. Based on this understanding, Motorola unveiled a plan to step up the implementation of

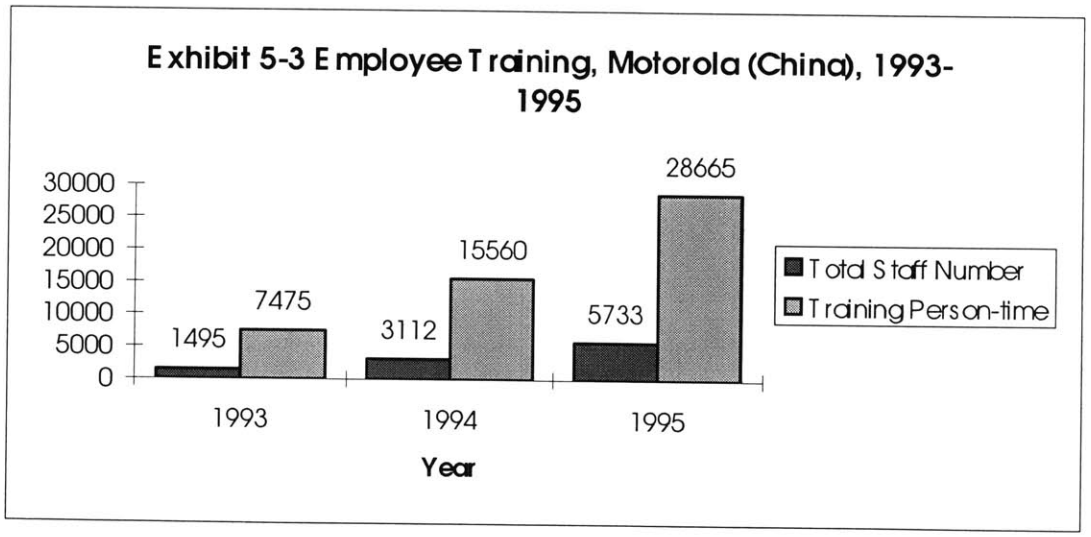
its localization policy by means of rigorous training for all. Courses were offered to Chinese employees at all levels both in-country and at other Motorola facilities around the world.

The unique Motorola University has been playing an important role as a catalyst for Change through continuous learning. Motorola University has expanded its operations both in the United States and abroad. The opening of the Galvin Center for Continuing Education in 1986 and the Singapore training Design Center in 1989 brought new educational opportunities to employees around the world. Since 1990, Motorola University had diversified further, establishing academic partnerships with institutes of higher learning around the world. Motorola University has also implemented cultural design and translation services. This has become especially important as Motorola moves into new and emerging markets in eastern Europe, South America and the Asia-Pacific region, China included.

Major localization and training programs in China have been implemented in recent years. These include localization and training for both management and employees. The management staff localization policy centers mainly on its training programs. Through these, Motorola raised the employees' engineering skills level while imbuing them with the company's culture which stresses personal integrity, respect for others, mutual corporate and loyalty. Among Motorola's numerous training programs, the China Accelerated Management Program (CAMP) stood out as the company's flagship education initiative. CAMP has become Motorola's way of translating its promise to China into reality and promise to train a certain number of Chinese people with the potential to form the future management of Motorola (China) Electronics Ltd. Exhibit 5-2 and Exhibit 5-3 show the plans for localization and training implemented in Motorola (China).



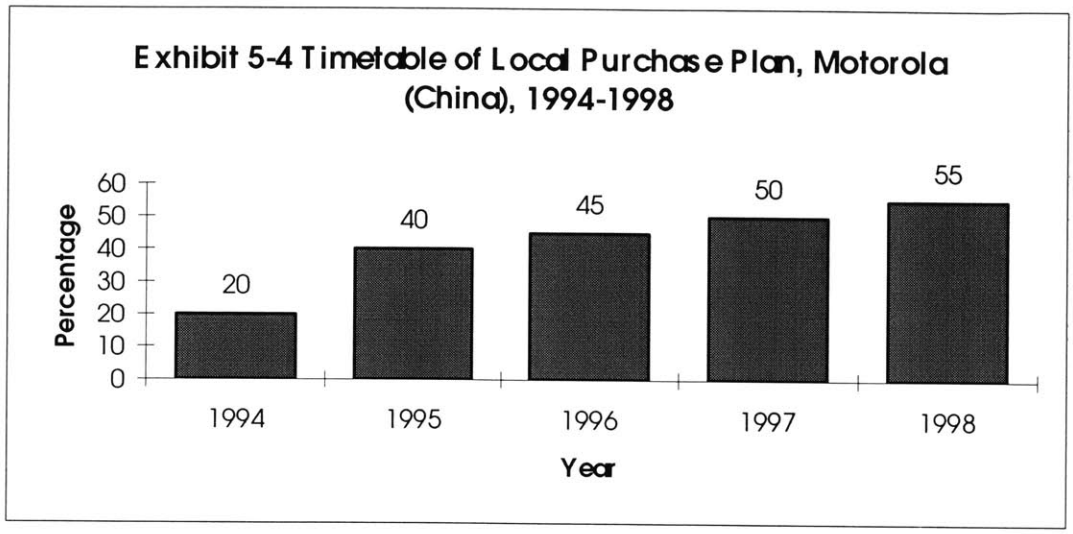
Source: *Motorola (China) Electronics Ltd.*, 1996.



Source: *Motorola (China) Electronics Ltd.*, 1996.

Another element of localization strategy is the local sourcing. Motorola, in its bid to accelerate China's modernization, is actively implementing its plan to increase the local content of its products. In Motorola (China), "Local Souring" means that the company actively develops local suppliers and provides overall support to them in technology, management and training. This investment intends to help them to become not only its preferred suppliers of components, but

also raise their technical level and allow them to expand their growth in other directions rapidly. "We are striving hard to develop twenty domestic suppliers into large-scale enterprises, or even multinational enterprises", said P.Y.Lai, President of Motorola (China) Electronics Ltd. As shown in Exhibit 5-4, the local purchases has been planed to increased to 55 percent by the year 1998 from the 20 percent in 1994.



Source: *Motorola (China) Electronics Ltd.*, 1996

Emphasis on Quality

If the localization and training are impressive, then how about the quality? Motorola is famous for its Total Customer Satisfaction (TCS) and *"Six Sigma"*. Motorola has extended its culture of strong emphasis on quality in its China business. Motorola realizes that creating a quality environment for its people is at heart of its ability to deliver on the expectations of its customers and to maintain its growth and success in the challenging years ahead in China market.

True believers at Motorola talk of quality as it is enshrined in the concepts of TCS and *"Six Sigma"*. Slogans did every well in China, and sure enough, they took--buttressed by the kind of intensive training that Motorola's total control over its operations there made possible. *(Appendix 2)* For instance, within six months after starting semiconductor assembly at one temporary facility, rookie Chinese line operators had achieved *Six Sigma* output quality, an achievement well above average.

By 1995, some of the quality awards won by Motorola's China operations included:

- The Executive Quality Award, conferred on the Tianjin Paging Factory;
- ISO 9002 Quality Certificate awarded to cellular Subscriber Group's factory in Tianjin;
- ISO 9002 awarded to Paging Products Group, licensing it to the use of the network of MPT as well as earning them UL acknowledgment;
- ISO 9002 awarded to Tianjin Semiconductor Plant.

Joint Ventures and Strategic Alliances

While maintaining and continuing to establishing independently funded and wholly-owned ventures in China, Motorola has been also branching out into half a dozen joint ventures there. Cooperation was a key to its strategy of imbuing Motorola with Chinese characteristics. Motorola's major joint venture with the MPT's Hangzhou Communication Equipment Factory on technology transfer has been a successful example. In recent two years, other major joint ventures set up or contracted include the Nanjing Power Computer Ltd., the joint venture set up with Nanjing Panda Electronics Company Ltd., to produce and sell PowerPC, and the Shanghai Motorola Paging Products Co. Ltd., a joint venture with Shanghai Radio Communication Equipment Manufacturing Company, to produce the latest technology FLEX pagers. In addition, in 1995, Motorola signed a number of contracts with the Chinese electronics and telecommunications industry and invested more in China's middle and western regions, which help China narrow the regional gap in economic development. One of them was the Leshan Phoenix Semiconductor Company Ltd., by Motorola and the Leshan Radio Company Ltd. in a central province, Sichuan, with total investment to 55.3 million US dollars. (*Motorola (China) Electronics Ltd.,* 1996)

In a telling sign of East-West synergy, another joint venture was set up to supply components for the cars that eventually roll off the line at a new factory being planned by an alliance between General Motors and one of China's biggest carmakers, Shanghai Automotive Industry.

To achieve its long-term strategic objectives of competitive advantages in China market, Motorola understood well the importance for the improvement of staff quality and national standards. It was stated that part of Motorola's goals is to accelerate China's economic development through investment in higher-education and research. Motorola therefore has

consistency to upheld its intentions to cooperate with universities and colleges in China. To date, Motorola has invested about US$ 300,000, for the establishment of scholarships in Tsinghua University, Beijing University, and other key Chinese Universities and more than 2,000 students received the scholarships from Motorola endowments; it has invested 2.5 million US dollar-worth of equipment to establish a training center in Nanjing Posts and Telecommunications College; and it has also invested another US$ 350,000 for the establishment of application and development centers in Tsinghua University, Fudan University and Guangdong Polytechnic University. (*Motorola (China) Electronics Ltd.,* 1996)

Good Corporate Citizenship

Motorola has taken its role as a responsible corporate citizen in China very seriously, as Motorola's CEO Gary Tooker said, "We seek a partnership with China for mutual development. Closely linked with this strategy is our promise to be a worthy corporate citizen of China, participating in and contributing to the building of a caring and responsible society."

As a member of society, Motorola paid particular attention to safeguarding its image and setting itself up as a model for foreign-funded enterprises in China. The company obeyed laws and regulations, paid taxes and strictly condemned unfair competition and corrupt business practices. At the same time, realizing the importance of adopting to the Chinese culture and society, Motorola wholeheartedly supported China's social welfare programs by implementing its employee housing program and has been an enthusiastic contributor to China's fundamental education and "Project Hope".

> ***EHOP*** To help employees realize their dream of owning homes and in support of China's "Comfortable Housing Project," Motorola unveiled its own Employee Home Ownership Program (EHOP). In 1995, construction began in Beijing and Tianjin on three residential developments, making the start of an ambitious project for the company. It was planed that more than 3,000 Motorola employees will own their own homes by the year 2000.
>
> ***Project Hope*** Motorola also extended its learning culture to the communities in which it serves. In China, the company has been helping build a base of elementary schools in needy regions across the country, where children might otherwise be

deprived of education--In China nearly 200 million people are illiterate, nearly 25% of the world's illiteracy rate and in the past 10 years about one million children have dropped out of school as a result of poverty. In the face of this sad fact, Motorola has risen to the challenge using "Project Hope", China's own national initiative to help combat poverty, deprivation and illiteracy, and has aroused the concerns of many circles of society including business, encouraging them to become involved in this noble cause. By the end of 1995, Motorola had donated 3.8 million yuan to Project Hope and has built 16 Hope primary schools in China. In 1996 Motorola will donate a further 3 million Yuan to be spent on improving existing school facilities and training teachers. The company also plans to build a Hope school that will serve as model for education in China. (*Motorola (China) Electronics Ltd.*, 1996)

Chapter 6 Beyond the Love Story: Dynamic High-tech Strategies

In certain industries, companies can become market leaders by developing distinctive competence in technological innovation. At the same time, this places them in a strong bargaining position with local governments. The acquisition of advanced technologies is seen by most governments as critical to the future of their countries. To be successful, the company must generate a continuous flow of innovative products as well as a continuous demand for these products. Motorola is an example of global company that uses dynamic high-tech strategies in its China business, especially in China's telecommunications and electronics sectors.

6.1 Competitive Environment and S.W.O.T. Analysis

China's economy was surging in recent years. Its telecom revolution and electronics industry development flew naturally from those changes. Demand for physical and information infrastructure as well as consumer goods has exploded, and telephones top the list. A thriving market economy and pooled family savings have put a phone within reach of many residents in almost all of China cities and some rich rural areas.

No other nation in the history of telecommunications has had more ambitious plans than China's. Take the wireline telephone service as an example, by the year 2000, China wants to raise its telephone density to 5-6 per 100 people from less than one percent in early 1990's. China's wireless (cellular and paging) communications market was believed to take off, with a possible 50% annual growth rate in the last decade of this century. (*The Wall Street Journal*, 1994)

The battle for China looms as one of the greatest industrial contests of the century. The major competitors in China's telecommunications industry are all multinational and multitechnology companies with their main activities in the computer, communications and electronics businesses. Major players include America's AT&T, IBM, and Motorola, Sweden's Ericsson, France's Alcatel, Germany's Siemens, Finland's Mobria (Nokia), Japan's NEC, Panasonic (Matsushia), Hitachi, and Toshiba as well as Hong Kong's Champion. Motorola faced fierce competition in all business fronts: products--cellular phones, pagers, and network infrastructure, distribution/sales, technology and R&D, and government relations...

With surging demand for telephones in China, many foreign firms were seeking to enter the market through operating and service agreements. Unfortunately, foreign companies were prohibited by Chinese government form operating China's telecommunications services. Open to foreigners were merely the equipment manufacturing and/or supply.

Foreign company found that the hardest part of doing business in China was coming to terms with the laborious and at times unfathomable decision-making process of the Chinese bureaucracy. Chinese customers, being they mainly government entities themselves, of these foreign suppliers were very demanding, constantly in request of more technical information and better commercial terms. Moreover, in dealing with foreign firms, Chinese government didn't not want to be dependent on one supplier and assures itself the best deal possible by making foreign firms compete with each other. This has been seen in many important projects that have been going to European firms because of their willingness to transfer technology under more flexible arrangements. European companies often view technology transfer to developing countries in a different light than Japanese or American firms.

The battle in the front of mobile telephone business, illustrates the typical competitive environments in which the major players were fighting. The following analysis examplizes this competition between Motorola and Ericsson, who together dominated China's wireless communications market for years. This illustrates comparative strengths, weaknesses, opportunities, and threats (S.W.O.T), which help explain Motorola's performance.

Ericsson, another leading telecom giant in the mobile telephone business and switching systems, has been competing with Motorola head to head in China market. Ericsson pursued an aggressive strategy to penetrate China's telecommunications market. Despite selling its first telephone to China about one hundred years ago, Ericsson did not set up a representative office in the China until the early 1980's. Ten years later, the Swedish company operated four offices, employed hundreds of staff, sold millions of US dollars of public switching equipment and cellular mobile systems, and also had manufacturing ventures in China. Ericsson's intention was to be a supplier that don't hold shares in companies that compete with its biggest customer, the MPT and its provincial counterparts has bolstered the company's position with the MPT.

Ericsson's business was quite successful on China's new, but fast growing cellular market, in which Ericsson and Motorola were the archrival. The company installed the first cellular

systems in Qinhuangdao, Hebei province of the central and the largest cellular systems in terms of numbers of subscribers in Guangzhou in the south. Ericsson now has the most systems in place in China, far surpassing its competitors, Motorola and NEC. Among many factors, an earlier entry should attribute to the huge lead.

Worldwide, Motorola has had the largest market share in the mobile telephone industry and has increased its share from 13% in 1987 to about 85% by the mid-1990s. Motorola's success has been achieved in an industry which includes some of the toughest competitors present in the industrialized world, i.e. the Japanese firms NEC, Toshiba, Matsushita and Hitachi, and the Swedish firm Ericsson. (Oskarsson, 1994)

Competition for putting in wireless telephone systems in China was fierce. Compared to Ericsson, Motorola may have been slow to get a foothold in fastest growing south of China, but it has had considerable success in the North. It put in Shanghai's main system in 1988 and Beijing's first system at about the same time. Moreover, it is stronger than the Swedish company in subscriber equipment for Ericsson only in 1990 announced a portable product. Ericsson and Pacific Link Communications of Hong Kong donated a system to Beijing, which was installed before 1990's Asian Games on Beijing. Whether had this "freebie" given Ericsson a significant advantage over Motorola in China's cellular battle? At any rate, the deal did not cause Motorola to lose any business: At the same time Ericsson was donating Beijing Telecommunications Authority (BTA) the system, BTA gave Motorola an order to expand Beijing's existing system.

What are Motorola's key strengths in wireless communications industry? Motorola is proud of its proven ability to nature and drive the growth of emerging consumer and technology market. Specific to the wireless industry, Motorola has (a) two-way, wireless communication expertise; (b) infrastructure equipment and relationships; (c) a breadth of enabling technology expertise (radio frequency, microprocessor technologies, miniaturization of technology, etc.); (d) software that will provide an industry-standard development and deployment environment; (e) a solutions-based strategy that combines a wide range of Motorola expertise integrated with other leading vendor's technologies; and (f) high-quality, low-cost manufacturing expertise.

In particular, according to industry experts, weight and size are the two most critical performance parameters for customer satisfaction. A study by Oskarsson in 1994[8] shows that Motorola has consistently introduced new generations of mobile telephones with significantly lower product weights, as much as two years before the major competitors, Ericsson included, as can be seen in *Appendix 3, 4 and 5*, which show connection technological capacities to competitive positions. Therefore, Motorola has been the leader in terms of product performance for some time. Moreover, Motorola's profitability from mobile telephones has been the highest in the industry, varying between 20% and 30%, despite the rapid growth in market shares and an aggressive cutting of telephone prices in many markets to gain further market shares. With such high margins, it is not surprising that Motorola is also judged by industry observers to be the industry cost leader, with an estimated cost advantage compared with NEC of about 5% and, compared with Ericsson and Nokia-Mobira, one of about 20%. Therefore, Motorola's pronounced generic strategy is cost leadership combined with differentiation through high product performance, i.e. a "stuck in the middle strategy". (Oskarsson and Sjoberg, 1994)

Industry experts believed that the key to the success of Motorola lies in massive investments in technologies which are both cost and performance driving. This has been drown from the relative technological positions indicated by a data that show comparative number of patents of granted in Europe for Motorola, NEC, Ericsson and Mobira. That data illustrated that, First, Motorola has invested heavily in all important sub-technologies, and is almost equal regarding the scope and depth of the technology base of its cellular terminals; Secondly, Motorola is superior to both Ericsson in both scope and depth of technological activities in cellular technologies; Thirdly Ericsson mainly invested in performance-driving technologies (mainly analogue radio technology and analogue signal processing).

In China, Motorola not only sold and installed cellular systems but also trained Chinese technicians on installation, operation, and maintenance. Training has been all part of the package that Motorola offered to its Chinese customers. The package involved formal classes in the US, on-site courses, and on-the-job training. Motorola also offered repair services and established repair facilities in China. When Motorola sold a cellular system to Chinese customers, being

[8] Detailed data and analysis are provided by Oskarsson and Sjoberg, 1994.

they usually government offices or public entities, it typically sold phone units with it --one of the China market's unusual features. The Chinese like package deals: Not only do they get an overall price discount, but they do not have to ask more than once for funding and approval.

In addition, Motorola also seeks to establish strategic alliances even with its competitors. Motorola designs and manufactures cellular telephones that can be used with its own systems or on any other standard cellular systems. In 1995, Motorola and Ericsson agreed to link their cellular telephone systems, creating what they said would be one of the world's widest cellular networks. The agreement would allow subscribers to use their telephones in all of China's 26 provinces.

6.2 Matching Dynamics: Happy Marriage?

Just as every chess piece is essential to the outcome of the overall game, Motorola's own development is irrevocably tied to that of China. It is Motorola's firm belief that only when China's economic reforms have borne fruit can be company too claim to have been successful in China.

China asserts an increasingly prevalent policy: companies must pay for access to this fast-growing market or be left out in the cold. Bolstered by the knowledge that many of the world's multinationals crave a share of China's growth, Beijing demands-and often gets-the same up-to-date technology driving the industrialized world. Motorola provides such an example with its plans to build advanced wireless messaging system and high-tech computer-chip plant in China and China plans to capitalize on its technology.

First came the story of Motorola's paging protocol deal with China. Economic Management Consultants Incorporated projects that by 1999 there will be more than 140 million paging subscribers in the Asia Pacific region, making this region the fastest growing and largest paging market in the world. According to their 1994 report, approximately 75 percent to 85 percent of pager sales in Asia Pacific will come form China, South Korea and Japan. (*The Wall Street Journal*, 1996)

China has become Motorola's key foreign market over the past six years, largely from its pager business, and Motorola has successfully had China adopt FLEX paging protocol, an

advanced paging technology from Motorola, which has been believed the key to the future of wireless messaging, as its first national paging standard. This really solidified Motorola's position as the leading technology supplier for years to come.

The MPT is the ministry in charge of telecommunications policy making and standards and is also the biggest telecommunications service provider in China. As the government body responsible for ensuring efficient telecommunications and paging services in China, it is essential the MPT has a proven technology in place that offers features such as higher capacity, roaming, flexibility to grow and new value-added services nationwide. The MPT evaluated various paging protocols from the world's leading paging manufacturers for over a year. Its decision to adopt the FLEX protocol was based on the need to provide next-generation technology for China's rapidly expanding pager subscriber base.

That, however, was not the end of the story. While Motorola was eager to keep its market dominance, it also faced new competition and criticism by China that Motorola wasn't sharing enough technology with the Chinese. Along with China's memorandum of understanding to adopt the new technology, FLEX paging protocol, Motorola was planning a joint venture with the MPT to construct FLEX-protocol pagers, in the hope that the venture could partly end the technology-transfer criticism by the Chinese.

And even that was not enough. After allowing Motorola to become the biggest seller of pagers and cellular phones in China, Beijing evidently believed that it was owed much more.

In 1995, Motorola announced its plan to spend US$ 720 million to build a computer-chip plant in Tianjin, China, considerably increasing its commitment in what has become its fastest-growing market and giving a huge boost to Beijing's dreams of developing high-tech industry. The new Tianjin facility would produce eight-inch silicon wafers etched with electronic circuitry. The wafers are then cut and assembled into operation in the first quarter of 1998 with an initial production of 3,000 wafers a week.(Smith, 1995)

Why was Motorola building a computer-chip plant in windswept northeastern China? The high-tech factory would be automated, so China's cheap labor wasn't the reason. Nor was China's market for that kind of advanced chips, which remained small. The real explanation might be more political than practical. "Motorola has earned quite a lot of money in the mobile

telephone market in China," as said Wu Jichuan, the minister of China's MPT, "It's high time for them to transfer some technology."

By the mid-1990's, Motorola had already assembled computer chips, cellular phones and pagers at its sprawling factory complex in Tianjin. Much of that production was sold to China, along with Motorola products imported from overseas. But unlike most other manufacturers selling to the domestic market from factories in China. Motorola was the sole owner of its operations--rather than sharing ownership with a Chinese partner.

That privilege dates to Motorola's bold move to invest in China shortly after the 1989 student demonstrations in Beijing's Tiananmen Square. When Motorola just started negotiating a deal for local operations moths earlier, its desire for 100% ownership proved a major sticking point. Some Chinese officials insisted that Motorola accept a joint venture, part-owned by Chinese--the usual arrangement for foreign investors. Then, reacting in horror to June 4th event, many foreign investors canceled deals, and some pulled out of China altogether. Motorola, however, stayed the course and eventually got what it wanted from the government who was then eager to cajole big investors and restore international confidence. In explaining Motorola's decision, Mr. Tam, the semiconductor division boss of Motorola who was a key player on the negotiating team, once said: "We felt the best way to help the Chinese people was to continue dialogue and engage," and "Motorola believed it was a regrettable event but not the end of the world. China basically looked to us as a friend, and the time you need a friend most is when you're in hot water." The company quickly captured a major share of the country's exploding telecommunications market: Motorola's cellular-phone and pager sales to China in 1994 topped US$ 1.5 billion, making it the company's largest market outside the US. (*The Wall street Journal*, 1995)

Ever since, however, Beijing has complained that Motorola should share its success with China. The government has been slow in granting approvals for the company to expand production at its Tianjin factories. And for months, China's leaders have pushed the company to build the computer-chip plant.

China already had several wafer-fabrication plants but was eager for more. Furthermore, China wanted to upgrade its high-tech industries from mere assembly operations so that it needn't rely on imports to supply its growing technology needs. The domestic Chinese chip industry was

chugging along--but hardly flying. Between 1992 and 1995, it tripled the annual value of its production of integrated circuits to US$ 500 million, and it is likely to hit the US$ 1.2 billion mark by the year 2000.[9] But China's wafer production was still crude by global standards, in that a key to success in the industry is imprinting ever smaller integrated circuits, or chips, in ever greater numbers on ever larger wafers of pure silicon. The Chinese then could only etch lines about one micron in width (a micron is a fraction of the width of a human hair) and typically imprint them on wafers four to five inches in diameter. Elsewhere in the world, industry leaders like Motorola could make chips as small as 0.5 to 0.35 micron on eight-inch wafers. When its Tianjin plant is finished by late 1990's, Motorola will set a new standard for Chinese chipmaking by fabricating 0.8 micron chips on eight-inch wafers. (*The Wall street Journal*, 1995)

More important for Chinese, the factory, though to be wholly-owned by Motorola, will build semiconductors from scratch and tech a legion of young Chinese everything there to know about the delicate process. Still, while no trade secrets will be officially passed along to the local competition, it will be difficult to keep the Chinese engineers employed on the site by Motorola from picking up on-the-job expertise that might be useful to rivals.

What should also be noticed is the another dimension of the politics with the deal. Until recently, much of the technology flowing into China was considered too advanced to give to a Communist state or a potential military rival by the West's COCOM. But the end of the Cold War sharply reduced those barriers. Now, China can demand access to almost any previously restricted technologies, and multinationals have little bargaining power to resist.

Chief among the technologies Beijing wants is semiconductor production. It is a tough sell. While numerous manufacturers have moved into China with chip-assembly operations, which rely heavily on cheap labor, actual chip production remains an expansive, highly automated process. As a result, few foreign companies have put chip-fabrication plants in China.

In 1994, Japan's NEC Corp. became one of the first to open a semiconductor fabrication plant in China, with a Beijing venture designed to produce chips for consumer-electronics products. But the factory wasn't entirely NEC's idea. While its investment would help fill local demand, a company spokesman concedes that "it was required by China to make fabrication and

[9] According to Semiconductor Equipment and Materials International, a U.S. trade association.

assembly of semiconductors in China" as a condition of its continued presence in the fast-growing Chinese market for telecommunication switches.

Not everyone, of course, was willing to play the game. Some were worrying that the West was giving too much. During negotiations in 1995 for a US$ 1 billion minivan deal, America's Chrysler Corp. balked at China's demand for patent rights to technology used in making the vans. That's fine--the converted award went to Germany's Mercedes-Benz ERG, instead.

Ironically, though Western technology might transform China from a customer to competitor in several key industries, few multinationals were willing to reject Beijing's demands. "China is going to be a competitor in the future," argued Robert Hitt, head of McDonnell Douglas corp.'s China operations. "If we're their partners, we'll eliminate them as competitors." Some others seem not worried, believing that there won't be much local domestic competition for a while and the Chinese "are very far behind," as said Lai, a former Intel executive, "If we were to let them catch up, it would be because we were slipping".

Is this gamble paying off? So far so good. Motorola's sales in China and Hong Kong have shattered expectations. Nearly doubling over two years to reach US$ 3.2 billion in 1995--almost 12% of the corporation's worldwide revenue. (Motorola Inc., 1995) Cellular phones account for a substantial chunk, and the potential market for these handy gadgets is enormous--three million new cellular phones a year until the end of the decade, according to a Chinese government estimate.

But what about profits? The details remain secret now. But Motorola (China)'s President Lai denied a Wall Street Journal report early in 1995 maintaining that the company loses money on every cell phone it made and sold on China. Price competition was brutal, Lai conceded, but he insisted, "we are making good profits in China." Whatever local operating profit might be, Lai said it all got plowed back into the local market.

Chapter 7 Implications: Success Formula for Foreign-China Ventures?

7.1 What Can We Say about China Markets?

To win emerging high-tech markets in China, foreign companies should acquaint themselves with the most dynamic characteristics of Chinese industry and government. While many may be worth discussion, the following sector provides some important implications drawn from the evolution of China's industrial policy and Motorola's China experience. These include: (a) the definitive influence of the State, (b) the appropriateness of technology transfer, (c) the importance of personal relations or 'guanxi", and (d) the emerging of localism.

The Definitive Influence of the State

A Chinese lawyer in Beijing once confided that the biggest problem he had with his often bedazzled Western clients was educating them to the reality that the "economy is under State control, and thus the State can intervene in any deal, at any time, under any pretext". The key importance of the state in business in China is why foreign firms must have a strategic understanding of the political dynamics of the country. It is also helpful to keep in mind that despite the promulgation of many laws, in China, firms are faced with a system of rules are contained in "neibu" (internal) documents, which are secret--and thus may be applied at the whim of the decision maker. The state of China's international relations also impacts business relationships.

An understanding of China's official priorities and bureaucratic dynamics--be they expressed in national plans, policy statements, or even dinner conversations--is important. China wants ethnology--hard and soft--plus foreign market access in certain strategic high-tech industries. If you can structure the deal to respond to these Chinese priorities, you are going to have an easier time in the bureaucratic maze of approvals, services, and inspections. And if you can find a niche that responds to those priorities--such as Motorola's and Ericsson's Telecom ventures--you have a fair shot at success. Non-priority items--such as speculative real estate deals--may be allowed, especially if when things get tight. However, watch for corruption and squeeze: more than one Hong Kong businessman employs several "government relations" employees in factories in Guangdong province.

The Appropriateness of Technology Transfer

A central dilemma foreign firms encounter when transferring technology to China is one of trying to satisfy China's desire for state-the-art technology while supplying technology that is appropriate to specific Chinese environments. Chinese factory managers often request the most advanced technology from foreign firms as a matter of protocol during initial negotiations, whether or not sufficient foreign exchange, trained personnel, or adequate infrastructure are present to support such technology. Moreover, American firms are often pressured into offering their most advanced technology--often displaying blueprints and conducting technical seminars--only to see the contract go to a European or Japanese firm offering technology a decade old and at half the price. With some notable exceptions, the reality is that the Chinese may talk quality and sophistication but they tend to base their buying decisions on price.

Japanese, European, and US firms purse different approaches to this problem. The Japanese have taken advantage of their proximity and historical links with China to penetrate interior provinces and offer technology closely tied to existing Chinese capabilities at the factory level. However, the Japanese suffer a reputation among many Chinese of not being forthcoming with even basic technological know-how, often described as "more talk, less do." Yet Japanese firms offer consistently lower prices and seen to be better prepared to interface their newer technology with older equipment inside Chinese enterprises. In contrast, European firms are said to be more willing to transfer their highest technology, and do so rapidly and straightforwardly. They also enjoy the concessionary government financing typical in Europe. Chinese leaders have courted European firms throughout the mid-1980's, stepping up competition with the United States for technology transfer projects. Lastly, the US firms have pursued a direct approach to technology transfer, though they have been neither as flexible in sharing high technology as some of the Europeans nor as able to offer the low prices of the Japanese firms.

A foreign firm's competitive edge in renovation projects depends on a combination of factors. Chinese trade officials in a position to approve contracts often consider price and credit terms more important than appropriateness, quality, and service backup. Also, technology acquisition decisions made by enterprise directors and official decision makers are often influenced by the place of origin of existing equipment in the importing Chinese enterprise.

The Importance of Personal Relations or 'Guanxi"

Given China's uncertain twists plus the immature institutional setting, it is hardly surprising that reliance on people one can trust, an old Chinese cultural tendency, is paramount. Despite the expansion of commercial laws, the key to business in China is good personal relations. More than one manager has told of difficulties with a supplier, customer, or government agency dissolving upon a word with friendly senior officials. A Beijing-based American manager, emphasized "Personal relations are everything!" According to a Hong Kong businessman, "You can't push your Chinese partner. You have to lead him, give him hints, and talk business in personal terms."

The Emerging of Localism

Under the reform program, provinces, cities, even towns, now have the authority to close deals. China's economy traditionally was regionally based, with largely self-contained regional trading and distribution systems; and today, despite efforts to create national markets, inadequate infrastructure reinforces the tendency to local self-sufficiency. Some analysts suggest China should be regarded as eight "greater" markets: Guangdong, Shanghai, Beijing, Sichuan, the Northeast, the Central provinces, the Northwest, and the Southeast; an analog with the European Union--with Beijing as Brussels--is not inapt. This division is based as much on infrastructure inadequacies as market conditions: according to some consultants, moving product from north to south can add as much as 15% to costs (not to mention the increased overhead of staff to oversee shipping in China's tangled transportation network). Local production and warehousing are the only ways to serve these local markets.

7.2 What Can We Learn from Motorola?

While is difficult to formulate business success in China because there are no ground rules here. Common belief is that people are living a case study. Nevertheless, looking at the methods employed by foreign firms that have achieved China business successes, one can delineate some areas of corporate capability that can be termed "formulaic." These strategic or tactical imperatives should remain in focus during the planning, implementation, and evaluation of China

business activities. These include, but are not limited to: (a) holding ground in China, (b) leverage technology for market access, and (c) sharing the burden of R&D.

Holding Ground in China

Some American firms enter China ventures primarily to protect and defend market share that they assumed safely belonged to them. As a firm's competitors enter the market, the prudent company might choose to hedge its China prospects by participating in a venture that promises to position the company firmly within the Chinese industrial economy. In rapidly expanding numbers, foreign corporations have found it necessary to set up collaborative or solely owned ventures in China in order to gain critically needed leverage strength in the market. Whether the involvement is in manufacturing, distribution, or services, these corporations have decided that the problems of market access can best be surmounted by deepening their relationship with the Chinese through a China venture. Unable to offer large-scale government-backed financing, or to complete with Japanese soga sosha companies in terns of price, corporate America has begun to realize that its most direct and sustainable avenue into the China market is one of equity investment in China-based enterprises. This requires the transfer of technology, the sharing of management expertise, and joint ownership. As such, many foreign firms have discovered that selling to the China market requires venturing in the China market. Establishing a production facility in China greatly enhances a foreign firm's marketing effort there.

Leverage Technology for Market Access

As Chinese policy-makers once announced in 1985, "the extent to which the Chinese market can be open to Chinese-foreign joint venture and foreign enterprises in China is closely linked with our demand for the technology [foreign firms] supply and the products they manufacture". The China market is being opened progressively to firms that offer technology to produce products that China (1) cannot produce at a sufficient level of quality in order to capture world export markets and (2) cannot produce in sufficient quantity to meet domestic market demand. Also, since successful China ventures are usually the product of a long-term evolution of stages: direct export, nonequity corporation, equity co-production, and finally, joint venture, offering technology that is attractive to the Chinese end-user can speed the evolution. One or

more of the approval steps can be bypassed if a firm offers technology that will assist China reaching its specific economic objectives in a particular sector. Knowing these objectives is crucial in attempting to tailor a firm's technology to China's needs. Foreign firms that not only understand broad Chinese objectives and specific needs but are willing to work closely with the Chinese end-users gain considerable advantage and possess additional leverage into the market. As Chinese end-users relax their insistence on obtaining only state-of-the-art technology, the quality and scope of communication and collaboration between the end-user and the foreign firm become crucial.

Sharing the Burden of R&D

Under this investment strategy, a foreign firm usually forms a joint venture partnership with a counterpart that possesses the in-house resources and/or government backing to share the expense of developing a new product that it cannot afford to develop on its own because of high cost and high risk. In China and some other Asian countries this strategy is growing in popularity as the cost of developing technologically sophisticated products skyrockets, and without a lessening of the inherent risk that the new product may fail in the marketplace, even with a concerted R&D effort behind it. Also, the increasingly modular nature of global industrial systems (in which separate parts of a complex product are developed by different countries) demands that firms share and coordinate their technological endeavors with widely dispersed business partners. For example, the exorbitant cost of developing new airliners has promoted Boeing to follow this investment strategy in Japan, where it has teamed up with a consortium of Japanese companies to share the burden of developing its 757 and 767 aircraft.

Chapter 8 Future Perspectives

8.1 Mixed Signals: Can China Become the Next "Super Power"?

Dispatches from the China business front are confusing often times. Headlines proclaim China the world's fastest growing economy. But two-thirds of state enterprises lose money and official forecasts see almost 270 million workers unemployed by the end of the decade of 1990's. Personal income, based on purchasing power parity, has soared to five figures in some urban areas--the McKinsy consulting group sees at least 16 "high potential consumer markets" emerging throughout China, from booming Shenzhen in the south to Urumqi in China's remote far west. But in parts of the countryside even clothing is in short supply. (Frankenstein, 1995)

Beijing has pledged to dampen an overheating economy, but highly touted austerity plans were abandoned. Inflation, fixed asset investment, the money supply, and nominal growth rates continue to soar while resources available to the center fall. While Chinese leaders express commitment to economic liberalization, there are also authoritative calls for rolling back the reforms and reimplementing plans and controls.

There is a growing commercial code, but little enforcement: pirated films, software, and recordings flood domestic and international markets; overseas Chinese businessmen with disputes with their mainland partners may find themselves in jail rather than in arbitration. Foreign business people report different encounters, from cooperation and success to blockage, corruption, and fraud.

Despite these mixed signals, its difficult to travel in China and not come away with positive feelings. The great variety of experience can be summed up in a phrase: Everything you hear about China is true, but none of it is reliable.

But if we understand the Beijing's rules and operations mechanism, then we can plot our activities in China's strategic space.

Essentially, China would like to emulate the modernization programs of both Japan and Taiwan as it seeks to reach a point of near technological equality with the West, the programs that involve the acquisition and subsequent improvement of foreign technological products, only later to reintroduce them on the international market as competing export commodities. Whether they can remold foreign technology with the same success as Japan, Taiwan, Singapore and South

Korea is difficult to predict. Certainly, many more obstacles block China's path to modernization than other Asian nations experienced.

Internally, Chinese leaders have found it virtually impossible to encourage exports without drastically restructuring the Chinese economy. One aspect of China's development that will slow down the development of competitive technology exports is the absence of both a marketplace for high-technology products and a competitive private sector. Externally, China's objective to catch up to the West meets additional obstacles.

However, one of the ironies of Chinese technological modernization is that the country has developed a nuclear weapons industry, put 18 satellites into space, and has launched a ballistic missile from a submarine despite their problems in implementing civilian technology. They have been able to do this largely because their centralized system can concentrate its best-educated scientists and most advanced resources on high-priority projects. In many fields of technology, the gap between China and the industrialized nations is being closed, and this disturbs many US policy-makers. Indeed, China developed its first computer in 1958, only twelve years after the United States, and only one year after Japan. It developed its first integrated circuit in 1969, eleven years after the United States and only one year after England. Finally, China possessed its own hydrogen bomb by 1967, fifteen years after the United States, and one year before France.

Indeed, China is trouble. Its political system is unclear and plagued by corruption, its booming economy us perilously brittle. The people show little respect for copyrights. For all those drawbacks, however, China is proving irresistibly attractive to the world's most advanced technology companies.

What's drawing Motorola and the rest of these all-stars is the prospect of an enormous shift in the high-tech world's center of gravity? Sometime in the early 21st century, many are betting, China will emerge as the world' largest consumer of electronics products--everything from PCs and TVs to microwave ovens and telephones. It may also become a major competitor for the electronics industry's Japanese, European, and American powers that be.

In the end, of course, China's place in the global high-tech hierarchy will depend on its ability to restructure its inefficient economy. But it also hinges in no small part on the size and nature of the investments made by the foreign powerhouses now hurrying into this promising but risky new territory--Motorola foremost among them. How's this for impact? By popularizing the

cellular phone in China, where it is now a market leader, Motorola is helping the Chinese leapfrog one particular stage of industrial evolution for which Western nations have had to pony up many billion dollars--the need to tie every home and business together with copper wire.

8.2 Challenges and Problems: Motorola Investing for Long Haul

Mention Motorola, the company that almost everyone loves to love and the accolades fairly gush: titan of TQM, epitome of empowerment, tribune of training, icon of innovation, and prince of profits. The foremost wireless communications provider in the world, it is so ubiquitous that in China people simply say Motorola when they mean cellular phone. At issue now is whether Motorola can keep getting as it keeps getting bigger, whether this huge, decentralized, multinational corporation can avoid falling victim to the bureaucracy, complacency, and hubris that have afflicted so many other American businesses. In particular, in China market, can Motorola maintain its competitive advantages with new challenges and problems.

Worldwide, Motorola's more pressing problem may be convincing shareholders that investing an additional half a billion dollars in a developing nation plagued by widespread corruption, social dislocation, a patchy legal structure, and an opaque political process is a great idea. It's even harder to sell at a time when the semiconductor industry has a lot of capacity, and there are persistent fears that the growth of the PC business, a crucial customer for chips, is slowing down. Already, the global capital-spending budget is being scaled back in Motorola's semiconductor division, and plans for a new chip plant outside Richmond, Virginia, have been pushed back a year.

Now, in China, changing tax rules, inflation and competition from Motorola products being smuggled into China are bleeding the company. With competition rising and problems cropping up on several fronts, investors are starting to ask if Motorola has its fingers in too many pies. Indeed, Motorola faces tough challenges and problems, especially the increasing costs and labor problems.

In Tianjin, Motorola's major manufacturing base in China, where the company hires most of its six thousand employees to date, entry-level jobs on the assembly line pay a competitive US$ 125 a month per worker. Motorola sweetens the deal with an innovative home-ownership policy

aimed at retaining the workers it trains. But pressure to raise wages keeps increasing. The company has handed out two wage rises in 1993, so that the total compensation package for production workers, including transport costs, is now about 850 yuan or US$ 98 a month. Rates are determined by surveying what other firms in the area paying and then trying to keep Motorola at the head of these rates. Motorola is drawing its new staff--nearly 90% of whom are women--mainly from a pool of schools around Tianjin. But because of the zone's location--50 kilometers east of the city proper--staff have to be busses in at a cost of US$ 40 per employee per month--the equivalent of around two-thirds of their basic pay.(Business China, 1994)

Accommodation near the plant in a "Motorola village" is being planned for expatriate staff, about 60 by the mid-19995 and ultimately to 100. Now, most commute for one-hour from the Tianjin International Building in central Tianjin, where rents for a two-room apartment are US$ 7,000 a month. Motorola also opened an international school for the children of its expat staff in 1994.

The company has a roughly 16-strong employee service committee which handles most employment-related issues, but not wages. Layoffs, of course, are never easy in a country where the concept of the "iron rice bowl"--cradle-to-grave welfare benefits and lifetime employment--is still strong. How would Motorola lay off and move out an unproductive engineer already comfortably ensconced in a home? After all attempts to retrain the deadbeat had been exhausted, the company insists it would nullify the mortgage, compensate the engineer and his family for paid-in principal, and show them the door. The plant has no union, nut the main issue at stake appeared to be communist party representation in factories--the company is allowing party meetings to be held on its premises.

Nevertheless, Motorola figures that high costs today will add up to advantage tomorrow. Certainly, CEO Tooker believes that China deserves the large place it now holds in Motorola's future. "I think people who have invested in Motorola over the years understand that we maybe have a longer-term view than some of our competitors."

8.3 Cooperation with Competition: Toward Mutual Benefits

Motorola (China) Electronics Ltd. was set up with the vision to be a added partner in modernizing China by providing leadership in creating a conductive business environment for Motorola China to grow beyond.

Regardless all of the challenges and problems faced with both Motorola and China, it is believed that the future of the cooperation of both sides is optimistic. This is based on the belief that cooperation, with competition, will help both sides achieve a win-win success and mutual benefits. A brief summary of Motorola's China practices in its manufacturing, R&D, organization setting and people development in the recent years illustrates the initial outcomes achieved by both sides.

Motorola and China's cooperation has been basically in tow business lines, one in low-end production and the other in high-end technology development. The collaborative activities and organizational structure also vary depends on the different product/technology lines of Motorola and industry sectors of China.

Paging Products and Technology

Motorola's biggest business line in China, paging, has been developed over time from merely manufacturing simple products to providing technical supporting and services and finally to developing its own R&D capacity for the local market.

Motorola organizes its businesses in Greater China region with different functions, as shown in the following chart:

Sales and Marketing	Service Center	Manufacturing R&D	Technology Support
			USA
Beijing	Beijing		Beijing
		Tianjin	
Shanghai			
Guanhzhou			
Taipei	Taipei		
Hong Kong			
Singapore	Singapore	Singapore	Singapore

Headquartered in Singapore, with offices throughout Asia Pacific, the Asia Pacific Paging Subscriber Division, is a select team of sales, service and technical professional focused exclusively on customers in the region. While focused in Asia Pacific, Motorola is structured to ensure that customers benefit from its experience and resources both in the region and around the world. This allows Motorola to assemble a customized team of professionals with the specific technological and market knowledge needed to provide solutions to its customers' individual needs.

Motorola's commitment to making paging systems and products the finest in the world means it invests heavily in research and development. To be closer to its customers, the Singapore Design Center was established in 1983. The Center has a team of engineers and designers dedicated to paging products. The team works with their counterparts in the United States researching and developing new paging products for Asia Pacific and the world. The Motorola Confidant and Scriptor LX2 pagers are a result of the Singapore team's development efforts.

After about ten year-development in Singapore, Motorola has been now able to transfer the Asia expertise to China, by establishing research and development facilities in Beijing which support all the China manufacturing and services.

Motorola China Paging Subscriber Division started its building of technical capacity, with the establishment of a R&D entity-China Design Center, located in Beijing in 1994. Equipped with the most advanced instruments from Motorola, the center has a mission to gradually develop R&D expertise to fully support Motorola's China paging business, though currently the research work in Beijing are basically secondary based on the technology developed in the US and Singapore where Motorola started its Asia exposure more than a decade ago. Among the twenty- to thirty- work force, most of them are local technical professional, under the guidance of three to four expatriates from US, Singapore and Hong Kong. Local professionals are recruited from university graduates and people who have a few years work experience after graduation form school, most of them have master's or Ph.D. degree.

Semiconductor and Related Technology Development

Toward achieving "Total Customer Satisfaction", Motorola (China) Electronics Ltd.'s Semiconductor Products Sector (SPS) has set up offices in Beijing, Shanghai, Guangzhou and Tianjin to provide its products and services to its customers, Supported by Hong Kong R&D capacities. SPS is committed to growing with the China electronics industry and to maximizing semiconductor market share in China.

In the early period of Motorola's China operations, SPS served as a representative sales office for Motorola Semiconductors Hong Kong Ltd. It also promotes the computer, consumer, automotive, industrial and telecommunications with a broad line of discrete semiconductors and integrated circuits in the China market. Gradually, SPS has made achievements in help China building its semiconductor industry. The major steps including the following:

1. The Tianjin Manufacturing Plant in TEDA was competed and fully operational in 1993.
2. In 1995, an agreement was signed with Leshan Radio Co. Ltd. for a joint venture Leshan Phoenix Semiconductor Co. Ltd.
3. Also, in 1995, Motorola expanded investment of US$ 720 million to construct Wafer Fab and equipment manufacturing facility (dubbed MOS 17) in the Xi Qing Economic Development Zone at Tianjin. It will be completed in 1998 within the "Nine Five-year Plan". MOS 17 is the most funded and fully equipped submicron project in China now, making Beijing-Tianjin the submicron base, also known as "China's Silicon Valley".
4. In accordance with the "University Support Program", SPS has established MCU Application Centers with Tsinghua, Fudan and Guandong Poly Technology University, SPS, built a Joint Development Lab with Chinese Academy of Science and donated EVM and Motorola SPS products Databook to 38 universities. SPS also organized HC11 & HC05 MCU Design Proposal contests joined by students and researchers.

Due to high demand of desktop computers and workstations in the computer market, in the Q4 of 1993, IBM, APPLE and Motorola have joined together to develop the new product of PowerPC-PowerPC 604. PowerPC is designed by the three electronic giants at the design center in Austin Somerrest. The production sites of PowerPC are IBM Burlington Vts semiconductor

Ltd and Motorola TX. PowerPC is suitable for the use of portable computer, desktop computer, workstation and servo control.

A Joint Development Laboratory for Advanced Computer and Communication Technologies (JDL), founded in Beijing on January 1, 1996, is a joint venture between Motorola Inc. and the National Research Center for Intelligent Computing System (NCIC). The laboratory engages in joint research and development efforts on advanced computer and communication technologies based on Motorola's semiconductor architectures and the latest science achievements produced by the State 863 Hi-tech Project. According to the agreement, all prototype systems and associated intellectual property rights are equally shared by the two parties.

The Steering Committee has eight members, four from Motorola and four from NCIC. Currently, the laboratory has 20 engineers, 10 from Software Center, Motorola China, specializing in signal processing, intonation recognition, computer graphics, man machine interface and tone frequency technology, and computer telecommunications technology. Motorola people include Motorola corporate VP and President of Motorola (China) Electronics Ltd., Corporate VP and Assistant General Manager of Asia Pacific Semiconductor Group headquartered in Hong Kong, VP and Director of External Technology Planning for Motorola Corporate Office in Schaumburg, Illinois and Managing Director of Wireless Systems Center, Sector Technology, Motorola Semiconductor Products Sector in Austin, Texas, Chairman of the JDL Steering Committee.

Shanghai Motorola Automotive Electronics Co., Ltd., located in Pudong Development Area and founded in March 1996, Shanghai, China. This joint venture was established between the Automotive and Industrial Electronics Group (AIEG) of Motorola and Shanghai Instrumentation Group Corporation (SIC).

Motorola AIEG, a business unit of Automotive, Energy and Controls Group (AECG), is one of the largest, leading and independent suppliers of advanced automotive electronics products in the world. AIEG's strengths are the design of custom electronic solutions that match customer needs, including high quality, high volume manufacturing; application knowledge and engineering expertise; efficient management processes; and a customer oriented culture.

SIC, a corporation directly under the Shanghai Instrument and Electronic Industry Bureau, is a leading industrial corporation in China focused on development, manufacturing and marketing of various products for instrumentation systems, office automation, computer peripherals, and electric appliances. Currently, SIC was assigned by the Shanghai Municipal Government to develop automotive electronics in support of the rapid growing automotive industry in China.

By establishing this JV, SIC will elevate its level of technology development as well as acquire necessary technologies and skills to compete in the automotive market; and AIEG will expand cooperation with several automotive OEMs and systems suppliers, which are strategic partners with AIEG in the US and Europe. In addition, this JV will foster electronic component localization and select product export on a global basis.

Having received the broadest possible business charter allowed by the Shanghai government, SMAE will engage in the design, application, manufacturing, sales and technical support for automotive electronics products including electronics control units for electronic fuel injection systems (EFI), anti-lock braking systems (ABS), electronically controlled suspension systems, electronically assisted steering systems, in vehicle communication and navigation systems, body electronics and sensors.

In keeping with the terms of the agreement, SMAE will adopt all key Motorola management practices such as Motorola Code of Conduct, Advanced quality Control System, Continuing Cycle Time Reduction, and Enhanced Training Program, to ensure Motorola's fundamental objective: Total Customer Satisfaction.

It is believed that, with all these joint efforts made by both China and USA, Motorola's China operations will become an integrated elements in China's modernization process. It is the common desire of Motorola and China that Motorola (China) will become a Chinese domestic and international oriented, first class and independent electronics and telecommunications pioneer and the key force in the rapid growth and development of modern industry in China.

Conclusions

Those foreign firms offering the technology that will assist China in accomplishing its national strategic objectives are finding the market remarkably accessible. While this may sound like a rather simplistic quid pro quo, it is not as easy to accomplish as it may appear. Many foreign firms lack the necessary preparation to assist China in assimilating technologies or to correctly assess China's exact technological needs. Others simply lack adequate incentives to do so.

China has targeted world markets for its export goods through a program which develops export manufacturing based on imported technology, equipment, and managerial expertise. Import decision makers place high priority on acquiring the most advanced technology available in order to endure product exportability and prevent rapid obsolescence. Areas of emphasis include telecommunications, electronics, and computers, and other projects likely to promote high-tech industries and exports, reduce energy consumption, and lessen China's dependency on imports.

For the time being, Motorola has a competitive edge over foreign telecom and electronics manufacturers. It holds a technological edge particularly in wireless telecommunications. The ultimate competitor to the US telecommunications industry in the future, however, will not speak French, or Japanese, or German, but Chinese. "By the turn of the century, the big question will not be China as a military threat to the US but China as major economic competitor" Says William Archey, Acting Assistant Secretary of Commerce for International trade.[10]

By including technical data transfer and training course in most foreign contracts, the Chinese intend to master what they purchase. In time they will be able to manufacture System 12 switches themselves, create variations on the IBM PC, and roll out AMC trucks to sell internationally. With no R&D costs to cover, and low labor costs, China may take the edge away from the West's industry front-runners. The contest will be especially fierce in the emerging Third World markets where the nascent technological base does not require sophisticated, expensive or compatible equipment.

Nevertheless, the China market is becoming increasingly important as the US trade deficits demand export promotion and as the American economy moves towards a high tech base. While American technology is preferred by the Chinese now, international competition in China is growing due to similar economic tends in other industrialized countries. The sales to China

[10] See "Capitalism in China" *Business Week* . January 14, 1984: 54.

currently help American industry, but may pose the challenge of competition from China in the future.

Of course, thus far, filled with the Chinese business environment--the political and economic context in which it operates--is still the uncertainty regarding its future. It is well and good to talk of being in China for the long term, but plans in the face of other outcomes should be prepared.

No one doubts that participating in China's investment opportunities entails great risks. However, as is well known to all, the higher the risks, the more the possible opportunities. The general business environment in China does shape the opportunities available to firms there, opportunities for those foreign firms who not only access the Chinese market through technology transfer and show a longer term commitment to enhancing China's technical base, but also for those who develop R&D capacity within China so that the technology transfer could eventually be in two directions--As Motorolaians are all quick to remind you, they are in this game-playing with the Chinese for the long haul: to achieve a win-win success in the emerging high-tech world.

Appendix 1.

The 12 US Companies with the Biggest Stakes in China

(In total dollars spent or committed to be spent by the end of 1996)

Motorola: $1.2 billion. The company's most recent commitments include several joint ventures and a $560 million semiconductor wafer fabrication plant in Tianjin.

Atlantic Richfield: $625 million. Arco has completed China's largest offshore natural gas project, a 41.13 billion pipeline half owned by the Chinese government.

Coca-Cola: $500 million. Coke, Fanta, Sprite, and Hi C are bottled at 16 locations. Seven more facilities are being constructed.

AMOCO: $350 million. Amoco started producing oil in March from a development project in the South China Sea.

Ford Motor: $250 million. Ford has three factories making auto components, light trucks and vans; two other plants are under construction.

United Technologies: $250 million. UT's Otis subsidiary makes elevators and escalators; Carrier manufactures air-conditioning equipment.

PepsiCo: $200 million. Pepsi has 12 bottling plants, two joint ventures producing Cheetos, 62 KFC franchises, and 19 Pizza huts.

Lucent Technologies: 4150 million. The AT&T spin-off is involved in seven joint ventures, including a $70 million project to provide digital private-line service to Beijing.

General Electric: $150 million. GE is part of 14 joint ventures, including those that make X-ray and other medical systems; it owns 80% of the largest lighting manufacturer in China.

General Motors: $130 million. Delphi, a subsidiary, is a partner in three auto-parts facilities. Not counted, because the money is not yet committed, is GM's 50% partnership in a $1 billion project to build cars in Shanghai.

Hewlett-Packard: $100 million. HP has been investing in China for 12 years and now manufactures computers, medical systems products and analytical chemical equipment.

IBM: $100 million. IBM has six joint ventures, producing computers, electronic cards, advanced workstations for the banking industry and software.

Source: Schoenberger, Karl. 1996. "Motorola Bets Big on China". Fortune May 27, 1996:116-124.

Appendix 2.

Wallet Card Carried by all Motorola (Asia) Employees

Our Fundamental Objective
(Everyone's Overriding Responsibility)

Total Customer Satisfaction

Key Beliefs: How we will always act --

- Constant respect for People
- Uncompromising Integrity

Key Goals: What we must accomplish --

- Best in Class
- People
- Marketing
- technology
- Products
- Manufacturing
- Service
- Increased Global Market Share
- Superior Financial Results

Key Initiatives: How we will do it --

- Six Sigma Quality
- Total Cycle Time Reduction
- Product, manufacturing and Environmental Leadership
- Profit Improvement
- Empowerment for all in a Participative, cooperative, and Creative Workplace.

Source: Gogan, L. Janis. 1994. "Motorola: Institutionalizing Corporate Initiatives". Harvard Business School Case 9-494-139. October 20, 1994.

Appendix 3.

Market information of new generations of hand-portable analog cellular terminals., and the terminal's most important performance parameter (weight), by the major competitors between 1983 and 1992.

Unit: gram

Company	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Motorola	6300	800[a]	–	–	–	–	303/350[b]	–	220/270[b]	170/193[b]
Ericsson	–	7000	5800	–	900	–	420	–	–	330
Nokai-Mobira	–	5000	–	790	–	680	–	470	–	280
NEC	–	7200	3800	–	650	–	–	400	–	220
Hitachi	–	–	–	–	600	–	–	–	–	270
Panasonic	–	7300	–	–	3100	–	–	380	–	–

[a] This model introduced by Motorola was the first cellular which was a handset. The previous models were portable car cellular telephones.

[b] These products were introduced by Motorola with two different batteries. With the larger battery, the operating time became the longest in the industry in comparison with the competitors' products

Source: Oskarsson, Christer. and Niklas Sjoberg. 1994. "Technology Analysis and Competitive Strategy: The case of Mobile telephones". Technology Analysis & Strategic management, Vol. 6, No. 1, 1994: 12.

Appendix 4

Patents granted in the US between 1979 and 1988 in semiconductors and telecommunications (three-digit level) for major competitors.

	Matsushita	Hitachi	Motorola	Toshiba	NEC	Ericsson
Semiconductors						
1979-1981	29	126	85	111	55	2
1982-1984	32	100	130	186	45	3
1985-1987	44	176	227	337	132	1
1988	14	66	92	105	58	0
Sum 1979-1988	119	468	534	739	290	6
Telecommunications						
1979-1981	29	92	115	60	56	17
1982-1984	52	88	150	75	81	17
1985-1987	46	46	226	127	191	46
1988	9	9	62	47	72	9
Sum 1979-1988	136	136	553	309	400	89

Elaboration on data supplied to the science Policy Research Unit, Sessex, by the US Department of Trade and Commerce, Patent and Trade mark Office. The data are granted patents in US between 1979 and 1988 on the three-digit level.

Source: Oskarsson, Christer. and Niklas Sjoberg. 1994. "Technology Analysis and Competitive Strategy: The case of Mobile telephones". Technology Analysis & Strategic management, Vol. 6, No. 1, 1994: 15.

Appendix 5

Patents granted in Europe for cellular terminal sub-technologies between 1979 and 1990 for the four major competitors.

	Ericsson	Nokia-Mobira	Motorola	NEC
Battery technology				
1979-1981	0	0	7	0
1982-1984	1	0	1	0
1985-1987	1	0	4	3
1988-1990	1	0	6	7
Sum 1979-1990	3	0	18	10
Analogue radio technology				
1979-1981	18	0	83	43
1982-1984	30	1	106	153
1985-1987	27	4	80	221
1988-1990	71	59	209	244
Sum 1979-1990	146	64	478	661
Liquid display technology[c]				
1979-1981	0	0	1	4
1982-1984	0	0	10	4
1985-1987	0	1	4	9
1988-1990	0	2	2	10
Sum 1979-1990	0	3	17	27
Analogue signal processing				
1979-1981	7	0	60	23
1982-1984	5	2	64	72
1985-1987	12	0	39	81
1988-1990	18	44	117	128
Sum 1979-1990	42	46	280	304
Analogue VLSI design (for radio applications)[e]				
1979-1981	0	0	3	1
1982-1984	1	0	5	2
1985-1987	0	0	3	10
1988-1990	2	0	8	12
Sum 1979-1990	3	0	19	25
VLSI production (for relevant VLSIs)[f]				
1979-1981	0	0	3	3
1982-1984	0	0	14	11
1985-1987	1	0	27	20
1988-1990	0	1	42	46
Sum 1979-1990	1	1	86	80
Assembly technology and DFMA[g]				
1979-1981	1	0	8	1
1982-1984	1	0	15	11
1985-1987	0	1	6	27
1988-1990	1	4	25	13
Sum 1979-1990	3	5	54	52

The table is complied from patenting in Europe on the six-digit IPC patent classification. Patents filed and granted in Europe.
The data were supplied by the Swedish Patent Office.

[a] IPC patent classes*: G05f, G08B, G09G, H01M, H02J, H04B, H04M.
[b] IPC patent classes*: C04B, C01R, C01S, G08B, G11C, G02F, G05F, G056F, G10L, H01L -> H04Q.
[c] IPC patent classes*: G02F, G06F, G06K, G09F, H04M.
[d] IPC patent classes*: C04B, G01R, G06K, G09F, G09G, H04M.
[e] IPC patent classes*: G05F, G06K, H01L.
[f] IPC patent classes*: G23K, C23F, H01L, H05K.
[g] IPC classes*: B23K, B32B, H01L, H05K.
* certain patent subgroups on six-digital level within the following four-digit patent groups.

Source: Oskarsson, Christer. and Niklas Sjoberg. 1994. "Technology Analysis and Competitive Strategy: The case of Mobile telephones". Technology Analysis & Strategic management, Vol. 6, No. 1, 1994: 14.

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