

The China Advantage – A Competitive Analysis of Chinese High-Tech Industries

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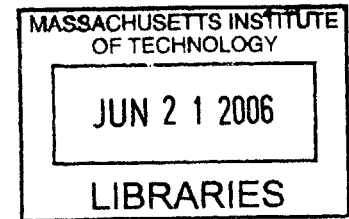
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*To my parents Fuhai and Qindi
and my wife Weixin*

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ABSTRACT

The emergence of China as a rising economic power has surprised many pundits and commentators around the world. It first gained its status as one of the largest manufacturing centers in the world, creating companies from toy makers to networking gear manufacturers, which successfully used their low cost advantage to compete against firms based in developed countries. As western countries including the U.S. started to attribute China's success to the abundance of low cost labor, a few Chinese firms rose up to challenge the dominance of multinational corporations. In the high-tech industries, in particular, some firms have started to combine their low wage advantage with sophisticated end-to-end strategies by ramping up competencies in important areas in the value chain, including research and development, manufacturing and supply chain management, marketing, and strategy.

This thesis examines the competitive advantage and disadvantage of Chinese high-tech industries by studying a number of firms in the information technology sectors. It demonstrates that the competitive advantages of those industries include low cost structures, a pool of highly skilled engineers and scientists, a sophisticated science and technology infrastructure, a growing domestic market with enormous potential, and a cluster of related high-tech industries that benefit each other. The thesis also reveals that most Chinese high-tech firms still lack financial capital, brand recognition, talents, managerial competencies, and technological capabilities. The thesis concludes by offering a set of recommendations to Chinese high-tech firms to help them become more respectable global players. In the meantime, this work also proposes a different set of strategies that US high-tech firms can use to gain the "next" innovative advantage in this extremely competitive global business environment.

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1. INTRODUCTION

1.1 Motivation

In recent years, China has become one of the largest manufacturing centers in the world. Chinese companies from toy makers to networking gear manufacturers are competing against U.S. industries with incredibly low prices that some dubbed “the China Price¹” and are inflicting significant pain on their U.S. competitors. In 2004, the U.S. had a trade deficit of \$162bn against China.²

Until most recently, U.S. industries attributed China’s success to its cheap labor costs. The “conventional wisdom” has been that the U.S. will be leading in knowledge-based industries while China focuses on lower-skill sectors. In reality, however, China is now combining its low wage advantage with sophisticated end-to-end high tech strategy. Its high tech industries are rapidly ramping up competencies in product design and development, operations, supply chain management, marketing, branding, and strategy. In addition, unlike its neighbor, India, which primarily focuses on business process and information technology outsourcing, China is in fact building its own product businesses. Successful companies include Huawei Technologies, Lenovo, and TCL, among others.

The success of Chinese high tech industries could potentially have a huge impact on the U.S., businesses and workers alike. This impact will be two-folded – on both the lower-end and the higher-end of the business value-chain. On the lower end of the

¹ Engardio, Pete, and Roberts, Dexter. “The China Price.” Business Week Print Issue. December 6, 2004.

² FTD Statistics, <http://www.census.gov/foreign-trade/balance/c5700.html#2004>, accessed June 15, 2005.

value-chain, a lot of manufacturing and supply chain functions will take a flight to China, while, on the higher-end of the value-chain, research and development, as well as marketing and branding, would be influenced by China. A case in point is Huawei Technologies, which is marketing itself as a reliable networking gear provider with a significant reduction in total cost of ownership.

This two-way approach³ by Chinese companies will change the world technology order in next two decades. Therefore, it is worth examining the competitive advantage and disadvantage of Chinese high-tech industries⁴ vis-à-vis their US counterparts. This thesis will analyze these industries and suggest mutually advantageous strategic road-maps. On the one hand, this work will help the Chinese companies become respectable global players, while on the other hand it will help the US industries gain the “next” innovative advantage in this extremely competitive global business environment.

1.2 Objectives

The primary research objectives of this thesis are:

- Perform a value chain analysis on Chinese high-tech product businesses to identify the competitive advantage. Specifically, I will study the following elements of the value chain:
 - **Strategy** – corporate strategy, technology strategy, marketing strategy, and product portfolio strategy
 - **Marketing** – corporate marketing, branding, and product marketing

³ Perfecting the lower end of value-chain and improving capabilities in high-end value chain.

⁴ My focus within the industry will be on **product centric** businesses.

- **Research and Development**
- **Product** – product design and development
- **Fulfillment** – manufacturing and supply chain management
- **Services**
- Identify the best practices and lessons learned from these Chinese high tech industries.
- Compare the practices of Chinese high tech companies with those of US competitors.
- Make recommendations to Chinese high tech companies on how they can improve their practices and processes in order to become respectable global players
- Make recommendations to US high tech companies on how they can improve their practices and processes in order to thwart the competitive threats from their Chinese competitors

In short, the intent of this thesis is to understand the competitive advantage and disadvantage of Chinese high-tech product companies in product design and development, operations, supply chain management, marketing, branding, and strategy, and propose a strategic road-map that these companies can use to become global players. At the same time, this work will propose a different set of strategies that US high-tech product businesses can use to maintain their global supremacy.

1.3 Structure of Thesis

The structure of the thesis is as explained below.

- **Chapter 1 “Introduction”** discusses the motivation, the objectives, the approach, and the structure of the thesis.
- **Chapter 2 “Background”** gives an overview of China’s recent economic history, discusses its current general market condition, and finally introduces the emergence of product businesses.
- **Chapter 3 “Framework – The Competitive Advantage of Nations”** introduces Michael E Porter’s famous “diamond” framework, which will be applied in the analysis of the competitiveness of Chinese high-tech industries.
- **Chapter 4 “Overview of the Chinese High-Tech Industries”** first defines the scope of this thesis, which is limited to the discussion of those high-tech industries related to the information technology, then discusses the IT value chain, and finally gives an overview of the market conditions of the computer hardware and networking equipment industry, software industry, and semiconductor industry.
- **Chapter 5 “Case Study: Lenovo (Legend)”** performs a value chain analysis of the company, analyzes the competitive advantage and disadvantage of the firm, and gives recommendation on areas of improvement.
- **Chapter 6 “Case Study: Huawei Technologies”** performs a value chain analysis of the company, analyzes the competitive advantage and disadvantage of the firm, and gives recommendation on areas of improvement.
- **Chapter 7 “The Competitive Advantage of the Chinese High-Tech Industries”** performs a competitive analysis on the three IT industries using Porter’s framework, based on the in-depth analyses of Lenovo and Huawei Technologies. This chapter also serves as a conclusion of the thesis.

- **Chapter 8 “Recommendations”** presents a set of recommendations to Chinese firms to help them become more competitive global players, and recommends a different set of strategies to U.S. firm to help them gain the next innovative advantage in the increasingly competitive global market.

A quick note to the notation of currency in this report: unless otherwise specified, all dollars are in US dollars.

2 BACKGROUND

In this Chapter, I will provide some background information to set up the context of our discussion. I will first go over the history of China's economic development from 1978 till mid-1990s. Next, I will lay out the current general market condition in China including main demographic indicators, market characteristics, and the challenges. Finally, I will discuss the emergence of product businesses in the high-tech arena.

2.1 Evolution of China's Economy (1978 – Mid-1990s)

After the Chinese Communist Party (CCP) took power in China and established the People's Republic of China (PRC) in 1949, the country went through an era of Mao Zhe Dong's reign,⁵ during which the economy hardly advanced. The Maoist era (1949-1976) could be divided into four periods: political consolidation and economic reconstruction (1949-1957); the Great Leap Forward (1958-1960); economic recovery (1961-1965); and the infamous Cultural Revolution (1966-1976).⁶ The political movements initiated by Mao sent the entire China into chaos and paralyzed the economy at every corner of the country. More than 60% of the population lived on less than one dollar a day, the international poverty line, there was virtually no rule of law, and famine was an ever-present concern.⁷ The discussion of the Maoist period is beyond the scope of this thesis and we will pick up the discussion from the end of the Mao's regime and the beginning of the "Deng's reformist era."

⁵ Mao Zhe Dong was the Chairman of China between 1949 and 1976.

⁶ Kennedy, Robert E. "China: Facing the 21st Century." Harvard Business School Case. 1998.

⁷ Kennedy, Robert E. "China: Facing the 21st Century." Harvard Business School Case. 1998.

Real economic reform in China started in 1978, when Deng Xiao Ping, a long time CCP leader who had been purged from the party during the Maoist era, regained power and became the paramount leader in the country. A pragmatic figure whose famous slogan was “Who cares if a cat is black or white, as long as it catches mice,” Deng’s reform strategy involved two simple principles: “reform measures were legitimate if they promoted rapid economic growth and if they did not weaken the Party’s control of the political system [and]; everything else was subject to compromise.”⁸ With these principles, Deng moved to both internationalize and marketize the economy. Although he also created a sphere of private activity to depoliticize the society, political reform in the meantime was relative; it was clear that CCP would remain in a monopoly position in terms of political power and no attempt towards democracy would be permitted.

While the economic reforms since 1978 should clearly be attributed to Deng’s effort, only a few policies were imposed directly from the center. First and foremost, Beijing was responsible for maintaining political stability, thanks to the backing of the Peoples Liberation Army (PLA). In addition, the exchange rate policy and the high savings rate were also a result of the central government policies. Most other reforms, however, were initiated from below. Deng gave much latitude for local officials to experiment with different policies, which was met with great enthusiasm. Good local policies would be duplicated and eventually endorsed by the central government, while bad ones were discarded.

⁸ Quoted from John Bryan Starr, *Understanding China*, New York: Hill and Wang, p79, 1997.

Between 1998 and mid-1990s, China underwent a number of reforms which included: population control, reform in the countryside, trade and investment reforms, state-owned enterprise reform, and institutional reform.⁹ We now discuss these reforms in more detail.

Population Control

Mao believed that a large population meant power and left population growth largely unchecked. By 1982 the population was just over 1 billion,¹⁰ compared with 400 million in 1949. During the first 20 years of the PRC, birth rate was consistently above 30 per thousand population. Realizing that controlling population growth was a precondition for economic development, China's premier, Zhou En Lai, launched a two-child policy in 1971, which had limited success.

Deng initiated a one-child policy in 1978, with the overall goal to keep the total population within 1.2 billion through the year 2000, on the premise that the Four Modernizations program¹¹ would be of little value if population growth was not brought under control.¹² The policy required women to obtain permission too have more than one child, with monitoring and enforcement provided by the units (*dan wei*), the lowest layer of control in the CCP administration. The government implemented a variety of rewards and punishments, such as subsidies, social sanctions, destruction of property, and sometimes forced abortions, to enforce the policy.

⁹ The section that discusses reforms between 1978 and mid-1990s was adapted from the Harvard Business School Case – “China: Facing the 21st Century” written by Professor Robert E. Kennedy in 1998.

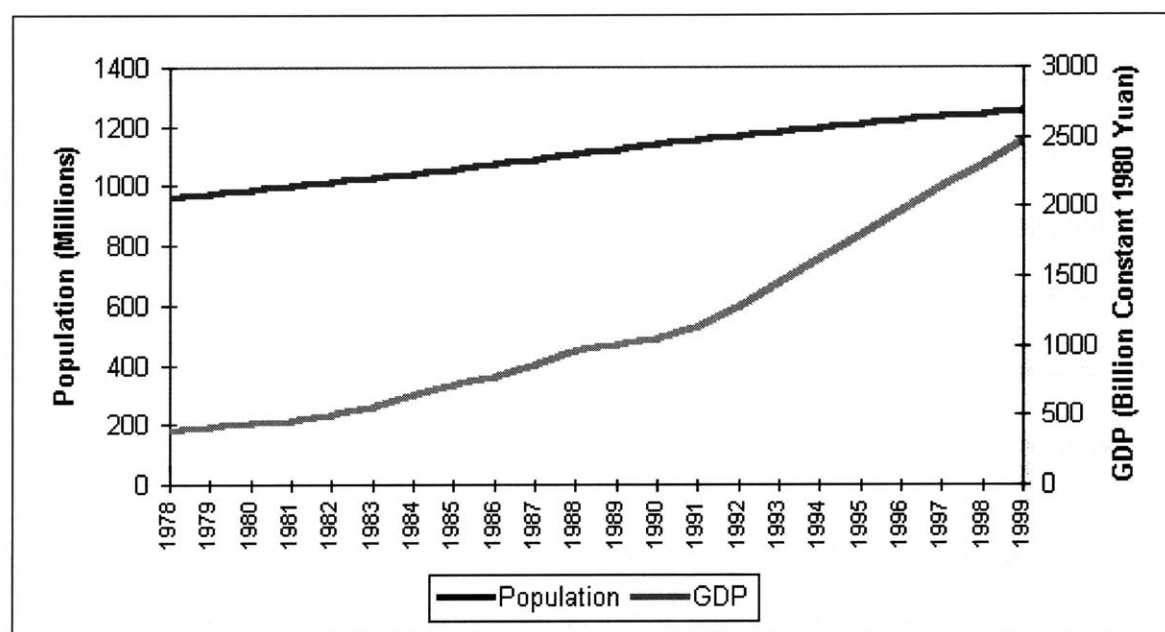
¹⁰ U.S. Library of Congress. “China – Population.” <http://countrystudies.us/china/33.htm>, accessed June 15, 2005.

¹¹ An integral part of Deng XiaoPing's reform agenda was the modernization of agriculture, industry, science and technology and the military.

¹² U.S. Library of Congress. “China – Population Control Programs.” <http://countrystudies.us/china/34.htm>, accessed June 15, 2005.

The policy was more successful in the urban area than the rural area where the program was fiercely resisted. The government relaxed the policy in areas where the resistance was the greatest, in order to keep social peace. Although the policy had mixed results in different areas, overall the original goal of reducing population growth were accomplished. Its population by the end of 1999 was around 1.2 billion (see Figure 2-1), and in 2005 the population reached 1.3 billion¹³.

Figure 2-1 China's Population Growth



Source: *China Statistical Yearbook 1999*

Reform in the Countryside

In 1978, around 80% of the population was peasants who lived in rural communes. Most of them were instructed to produce a fixed amount of agricultural products to meet the plan set by the government. In an attempt to raise the crop product and improve rural income, Deng

¹³ “CIA – The World Fact Book – China.” <http://www.cia.gov/cia/publications/factbook/geos/ch.html>, accessed June 15, 2005.

instructed local officials to increase prices for central plan quotas. In addition, realizing that some local officials had started to allow peasants to produce more than the contracted quantity and sell the additional products at an open market above the official price, Deng began to allow above-quota output to be freely sold, essentially creating a “dual price” system, in which a fixed quantity of output was used to meet the plan and all additional output was sold at market-determined prices. Deng also relaxed restrictions on inter-provincial trade in agricultural products and increased state investment in agriculture.¹⁴

A related innovation was the “Household Responsibility System,” under which local communes leased plots of land to individual households and, as payment, the family was responsible for managing production and delivering a fixed quantity of products to the commune. The system, which had spread to 98% of farming households by 1983, shifted control of production decisions from communes to households, leading to improved enthusiasm among the rural population and largely different behavior.

The impact of the reforms could not be overstated and all types of production jumped sharply. The most rapid gains in agricultural output occurred between 1978 and 1984, when grain yields grew at a 5.7% rate, the production of oilseeds doubled, and cotton output tripled.¹⁵ Beef, pork, and mutton production all grew by at least 80%.¹⁶ After 1984, the growth slowed to about 2%, its long term average. The annual rural household income increased from RMB 133.6 to RMB 397.6 in 1985, and gross savings by rural households increased from RMB 55.7 billion

¹⁴ Michael Ying-Mao and Susan H. Marsh, eds., 1993, *China in the Era of Deng Xiaoping: A Decade of reform* (Armonk: M.E. Sharpe, Inc.), p.107.

¹⁵ World Bank, 1997, *China 2000: Development Challenges in the New Century*

¹⁶ Kau and Marsh, p106.

to 438.1 billion between 1978 and 1984.¹⁷ The Chinese official media heavily publicized those “*Wan Yuan Hu*” (family worth over RMB 10,000) families who had made their fortune thanks to the agricultural reforms.

Increases in productivity as a result of the reforms freed up surplus labor in the rural areas and, by the mid-1980s, more than 100 million adults had given up farming and were working in villages and townships across China to produce industrial output.¹⁸ This trend continued and by 1995, 23 million “Township and Village Enterprises” employed 129 million people.¹⁹

Trade and Investment Reforms

The self-imposed isolation during the Cultural Revolution had inevitably led to an isolated economy, with a trade to GDP ratio of only 10% and zero stock of foreign direct investment (FDI). It was necessary to internationalize the economy because reform in the countryside had led to strong demand for imports, primarily in fertilizer and capital equipment, and there were not enough foreign exchange reserves to fulfill the need. Despite the obvious factors for the internationalization of the economy, hardliners in the CCP were concerned about foreign influence.

Nevertheless, in spite of the resistance from the hardliners, three distinct reform paths took their own shape: piecemeal trade reform, liberalization of FDI, and foreign currency reform. Piecemeal reform started in 1979 and continued through the mid-1990s. An important component of the reform was to allow local foreign trade corporations (FTCs), through which all foreign trade had to flow. Prior to 1979, there only existed 12 central government FTCs, but the

¹⁷ China Statistical Bureau

¹⁸ Liberthal, Kenneth. *Governing China*. New York: W.W. Norton and Company. 1995.

¹⁹ China Statistical Yearbook, 1997.

reform made possible local firms to bypass central FTCs. In the meantime, the number of domestic firms with foreign trade rights increased dramatically, reaching nearly 10,000 in the mid-1990s.²⁰ In addition, the central government started a slow reduction in import tariffs in the early 1980s, although many non-tariff barriers remained.²¹

Liberalization of FDI involved a compromise between the reformers and the hardliners. Instead of opening up FDI across the country, the government set up so-called “Special Economic Zones (SEZ)” which initially included four coastal cities – Shenzhen, Zhuhai, Shantou, and Xiamin. These SEZs were used to study the costs and benefits of FDI. The local governments were permitted to experiment with tax rates and approval procedures for foreign investment. The results of these SEZs were quite promising. Shenzhen, for example, a small town on the border of Hong Kong’s New Territories, saw its industrial output grow at an annual rate of 56% between 1979 and 1983 and increase to 100% in both 1983 and 1984.²² In 1984, 14 more SEZs were opened along the major coastal cities. The issue of currency conversion was a persistent roadblock during the early years of investment until 1986, but foreign trade continued to increase in the second half of the decade after the expansion of the SEZ experiment.²³

The central government also relaxed the control of foreign currency as a third component of the trade and investment reforms. Prior to the mid-1980s, foreign currency transactions were tightly controlled and all capital transactions required central bank approval. Domestic firms were required to seek regulatory approval and foreign-currency allowances to import goods and they had to turn over all export earnings to the state banking system. Firms located in the SEZs

²⁰ Naughton, 1996, “China’s Emergence as a Trading Nation,” *Brookings Papers on Economic Activity*, p.273-344.

²¹ Naughton, 1996, p.297.

²² Joint Economic committee, 1986, *China’s Economy Looks toward the Year 2000* (Washington: U.S. Government Printing Office), p.355.

²³ Joint Economic committee, 1986, *China’s Economy Looks toward the Year 2000* (Washington: U.S. Government Printing Office), p.355.

were exempt from such control and allowed to trade freely. In the mid-1980s, a complex system was introduced by the government to allow domestic firms to keep a portion of the foreign exchange they generated. In 1986, the government also introduced a dual exchange rate system and domestic firms could buy and sell limited amounts of foreign currency on this system.

The reforms dramatically opened up China to the outside world: exports grew from \$11 billion in 1978 to \$24 billion in 1984 and, by 1996, exports had reached \$154 billion. Between 1978 and 1984 exports increased from 4.9% to 18% of GDP. FDI initially grew slowly, but it soared from \$7.2 billion in 1992 to \$42 billion in 1996. Since 1993, China has become the largest recipient of FDI among developing countries.

State Owned Enterprise Reform

State owned enterprises (SOEs) in China were inefficient, overstaffed, and poorly managed, but they contributed to 78% of industrial output and 19% of total employment in 1978. In addition, SOEs provided shelter, health care, education, and life-time employment for their workers. However, the reforms in the countryside and the emergence of the SEZs increased pressure on the SOEs to reform because the sharp increases in production and incomes in the rural areas and in SEZs put SOEs in sharp contrast.

With an ad hoc “Management Responsibility System,” a counterpart to the Household Responsibility System in the agricultural sector, on a firm-by-firm basis, new freedoms were negotiated: increased autonomy over production and investment decisions, the right to retain a portion of profits, and the right to sell above-plan output at market prices. Unlike the reforms in the countryside, reforms designed to improve performance among SOEs had very limited success. Their share of industrial output fell from 78% in 1978 to 55% in 1990 but their share of

employment only fell by one percentage point from 19% to 18%. Their share of the revenue to the central government declined from 38% of GDP to only 3.6% during the same period. In addition, the Management Responsibility System subjected SOE officials to corruption in that the dual-price system created the opportunity to earn large profits by shifting plan-output to the unregulated market.

Institutional Reform

The Chinese central government implemented a series of institutional reforms between 1978 and 1995. First of all, it increased provincial autonomy with regard to taxation and industrial development. Under a so-called “tax contract system,” local governments were granted significant tax collection authority, which resulted in sharp decline in central government revenue (from 9.6% of GDP in 1986 to 6.0% in 1992). This development was viewed by the central government with alarm as the fiscal contraction at the center eroded the government’s ability to centrally manage the economy. In 1994, the central government implemented an extensive tax reform and established a National Tax Service that was responsible for direct collection of national taxes. In addition, it reduced number of taxes, introduced value-added tax, and moved toward more uniform treatment for domestic and foreign-invested firms. This new system effectively reversed the fiscal contraction, and the central government’s share of consolidated revenue increased dramatically from 22% in 1993 to 50% in 1996.²⁴

Next, the central government moved to strengthen the monetary functions of the People’s Bank of China, the central bank of China, in order to thwart the issue of excessive credit expansion and a rising share of bad loans in local branches. A new Central Bank Law was

²⁴ China Statistical Yearbook. 1997.

introduced in 1995 to prohibit overdrafts to government agencies and recentralized monetary control in the central bank.

Lastly, the government reformed the currency convertibility. As mentioned earlier, RMB (or *yuan*) was largely inconvertible before 1986. A dual exchange rate system was introduced in 1986 to allow domestic firms to buy and sell limited amounts of foreign currency. In 1994, the government abolished the dual exchange rate and the market and official rates were merged at the market rate. This move effectively devalued the yuan by 50% and gave a significant boost to Chinese exports. The trade surplus reached \$18 billion in 1995 and FDI also increased dramatically since 1993 to reach \$42 billion in 1996 (compared with \$7.2 billion in 1992). These factors led to rapid accumulation of foreign reserves.

2.2 Current General Market Condition in China

2.2.1 Main Demographic Indicators

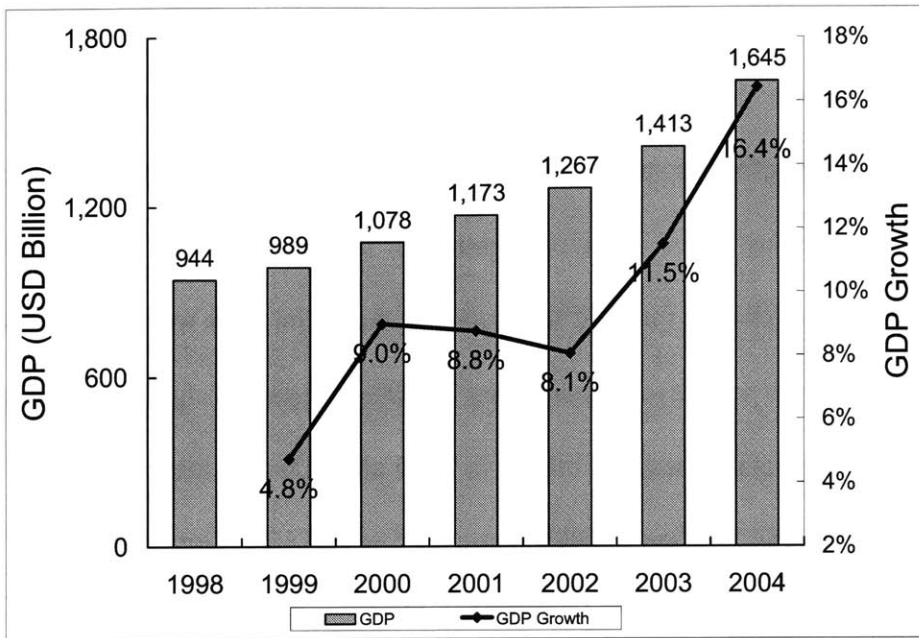
Over the past 26 years since it opened to reform and foreign investment in 1978, China's progress has been staggering: its real GDP has expanded at an average of 9% annually to reach \$1644.8 billion in 2004, growth in foreign trade has averaged 15% a year, and more than \$1 billion of FDI flows into the country every week in 2004 to reach a total of \$53.5 billion during the that year.²⁵ The rapid growth has been fueled by the growing consumer demand and the continued growth in the export-led manufacturing sector.²⁶ The growth has also ensured political stability while internationally the country has become more a respectable partner than a threat.

Figure 2-2 through 2-5 present some of the major indicators of the economy.

²⁵ The Economist Survey. "Behind the Mask." March 20" 2004.

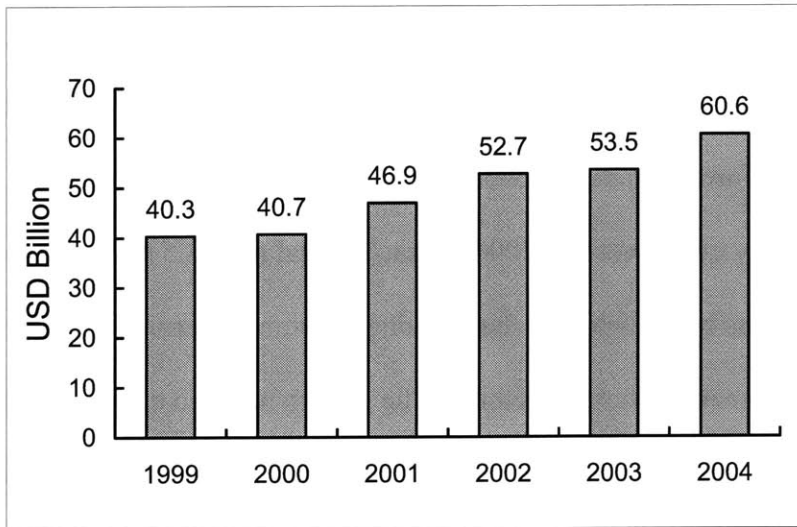
²⁶ International Finance Corporation (IFC). "The ICT Landscape in the PRC – Market Trends and Investment Opportunities." March 2005.

Figure 2-2 China GDP Growth 1998 – 2004



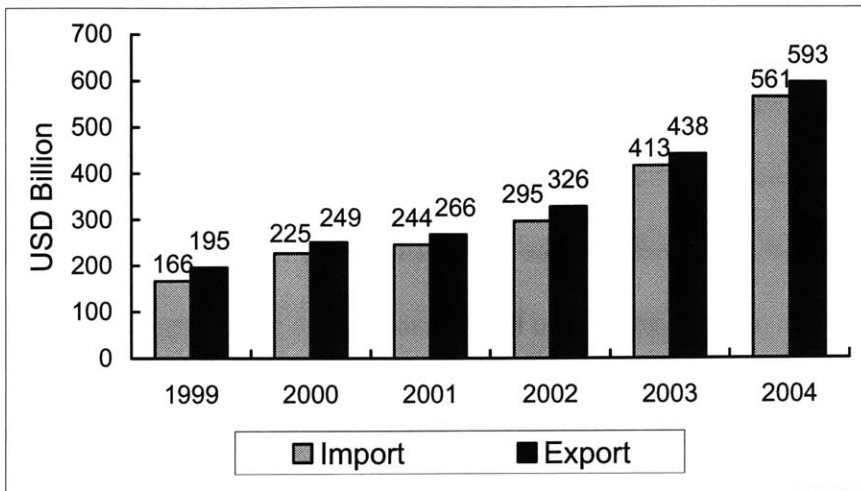
Source: BDA (China 2004 Yearbook, Ministry of Commerce of China)

Figure 2-3 China FDI Growth 1999 - 2004



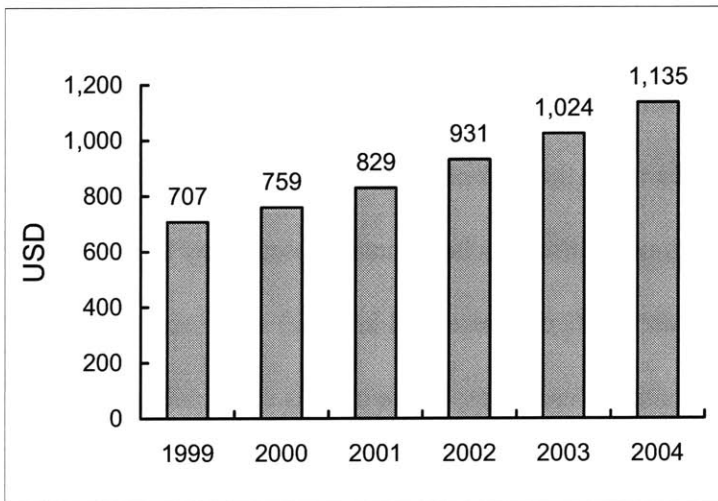
Source: BDA (China 2004 Yearbook, Ministry of Commerce of China)

Figure 2-4 China Import & Export 1999-2004



Source: BDA (*China 2004 Yearbook, Ministry of Commerce of China*)

Figure 2-5 China Urban Disposable Income: 1999-2004



Source: BDA (*China 2004 Yearbook, Ministry of Commerce of China*)

2.2.2 Market Characteristics and Challenges

While its rapid economic growth, political stability, and potential have made it one of the most attractive business environments in the world, China faces a number of challenges:

- **Unemployment and job creation.** According to the Economist, a British magazine, China needs 12 million – 15 million new jobs every year just to keep up with its population growth; it has to provide opportunities for the 800 million people living in rural areas who have been left behind by the current boom (a third of them are under- or unemployed); and it must deal with the 100 million -150 million migrant workers in the cities who have no job security, no health care and no long-term housing.²⁷
- **An overheating economy.** The economy has shown signs of overheating in recent years, particularly in property, steel, and car markets. Demand in power consumption causes power generation to run up against capacity constraints. More important, overinvestment as a result of the government’s easy lending policy has led to massive overcapacity. Its level of investment is unusually high (in 2003, investment in fixed assets grew by 30% and contributed 47% of GDP) and China’s growth is astoundingly wasteful (it needs more than \$4 of investment to produce \$1 of additional growth). The waste on capital has been made possible by the extraordinarily high savings rate (40% of household income) and uncontrolled exploitation of the country’s natural resources, but neither is sustainable.²⁸
- **Lack of respect for law.** It is often said that China is ruled by man rather than by law. Although China has many laws on paper, it does not always enforce them with full strength. It has yet to develop its respect for property rights and free markets.
- **SOE Reform.** As we discussed in Section 2.1, SOE reforms since 1984 have not been successful and the financial performance of SOEs have continued to deteriorate.

²⁷ The Economist Survey. “Behind the Mask.” March 20” 2004.

²⁸ The Economist Survey. “Behind the Mask.” March 20” 2004.

The political environment does not allow the central government to enact explicit policy to privatize SOEs. Liquidating insolvent SOEs could lead to job loss of one third of the 100 million SOE workers, which would cause political and social instability.²⁹

- **An inefficient financial sector.** The banks do not allocate capital rationally, and they are vulnerable to external shocks.³⁰ The stock market has no accountability and private firms have extreme difficulty in obtaining capital.

2.3 Emergence of Chinese Product Businesses

Over the past two decades, we have seen the emergence of a number of Chinese high-tech companies which have successfully rolled out their products under their own brand names. Some of these companies are privately owned, such as Huawei Technologies, a telecommunications equipment maker, while others are state-owned, such as Haier, a major appliances maker. Some of these companies have been taken public in China or overseas, while the others remain private or owned by the government. Many of them have aspirations to become global players. Unlike India, a neighboring country which has developed quite a few successful high-tech outsourcing businesses such as Infosys and Wipro, China has seen many of its firms building their own products and brand names.

Chinese firms have been busy upgrading their research and development (R&D) capabilities in the past two decades. The proportion of R&D personnel to total employees in large and medium-size enterprises has grown from 2.6% in 1987 to 3.9% in 1998, and the share of

²⁹ Kennedy, Robert E. "China: Facing the 21st Century." Harvard Business School Case. 1998.

³⁰ The Economist Survey. "Behind the Mask." March 20, 2004.

scientists and engineers among R&D personnel increased from 28.2% in 1987 to 54.4% in 1998.³¹ Science and Technology enterprises, typically spin-offs or affiliates of research institutions and institutes of higher education, are leading the way, joined by a new breed of university spin-offs.³²

I will introduce some of the Chinese product companies in Chapter 4, 5 and 6.

³¹ MOST 1999, cited by Oded Shenkar in *The Chinese Century – The Rising Chinese Economy and Its Impact on the Global Economy, the Balance of Power, and YourJob*. Wharton School Publishing. Upper Saddle River, NJ. 2005.

³² *China in the World Economy*, OECD, 2002: 206, cited by Oded Shenkar in *The Chinese Century – The Rising Chinese Economy and Its Impact on the Global Economy, the Balance of Power, and YourJob*. Wharton School Publishing. Upper Saddle River, NJ. 2005.

3 FRAMEWORK – THE COMPETITIVE ADVANTAGE OF NATIONS³³

Considered one of the most ambitious books of our times, *The Competitive Advantage of Nations* offers the first theory of competitiveness based on the causes of the productivity with which companies compete.³⁴ Based on research in ten leading trading nations, it reexamines the nation state, and argues that traditional comparative advantages created with factor inputs themselves “have become less and less valuable in an increasingly global economy” and that macroeconomic accounts of competitiveness are insufficient. Michael E Porter, a professor at Harvard Business School and the author of the book, suggests that the basic role of government today is an economic one and that, even in an international economy, the government has a key role to play in ensuring the competitiveness of the firms operating within its borders by “creating a business environment, along with supporting institutions, that enable the nation to productively *use* and *upgrade* its inputs.” The book introduces Porter’s “diamond” framework, a radical new way to understand the competitiveness of industries and nations in global competition, which has become an integral part of international business thinking. In addition, Porter introduces the concept of “clusters,” groups of interconnected firms, suppliers, and related industries arising in particular locations, which contribute substantially to national success.

3.1 The Competitive Advantage of Firms in Global Industries

“Firms, not nations, compete in international markets.”
- Michael E. Porter

3.1.1 Competitive Strategy

³³ Section 3.1 is based on the first four chapters of Michael Porter’s book – *The Competitive Advantage of Nations*, 1998 Edition with Porter’s New Introduction.

³⁴ Introduction from the dust jacket of *The Competitive Advantage of Nations*, 1998 Edition with New Introduction.

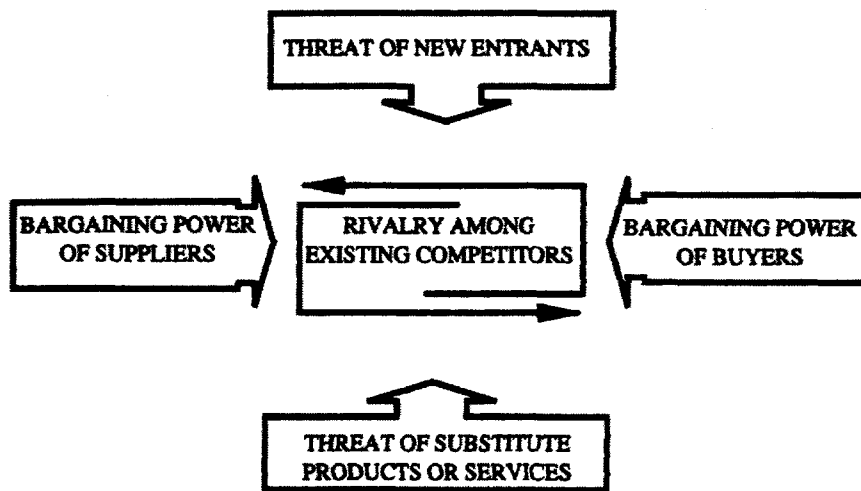
The industry, an arena where competitive advantage is won or lost, is the basic unit of analysis for understanding competition. Companies devise competitive strategy to compete in their industry that is both profitable and sustainable. Because there is no universal strategy for all industries, only those strategies that are tailored to a particular industry and to the skills and assets of a particular firm succeed.

The *industry structure* in which the firm competes and *positioning within an industry* are two central concerns that underlie the choice of a competitive strategy. Both concerns are required to guide the choice of the competitive strategy for the firm, and they are dynamically changing.

The Structural Analysis of Industries

Competitive strategy must be built out of a sophisticated understanding of the structure of the industry and how it is changing. Porter's "*five forces*" – the threat of new entrants, the threat of substitute products or services, the bargaining power of suppliers, the bargaining power of buyers, and the rivalry among the existing competitors – embody the nature of competition, domestic or international (see Figure 3-1). The strength of the five forces, which varies from industry to industry, determines long-term industry profitability, for they shape the costs companies have to bear, the prices they have to charge, and the investment required to compete in the industry. "The strength of each of the five competitive forces is a function of industry structure, or the underlying economic and technical characteristics of an industry." Every industry has its own unique structure, and it is relatively stable but can change over time as an industry evolves.

Figure 3-1 The Five Competitive Forces that Determine Industry Competition



Source: Porter, Michael E, *The Competitive Advantage of Nations* (1998): p35

Industry structure is significant in international competition because (1) it creates differing requirements for success in different industries; (2) industries important to a high standard of living are often those that are structurally attractive; and (3) structural change creates genuine opportunities for competitors from a nation to penetrate new industries.

Positioning within Industries

Positioning is more than just a firm's product or target customer group; it involves its total approach to competing and, thus, at the heart of positioning is competitive advantage. Two basic types of competitive advantage are *lower cost* and *differentiation*. The former refers to the ability of a company to design, produce, and market a comparable product more efficiently than its competitors, while the latter is the ability to provide unique and superior value to the buyer in terms of product quality, special features, or after-sale service. Porter argues that "it is difficult, but not impossible, to be both lower-cost and differentiated relative to competitors," and, in the long run, "competitors will imitate and force a choice of which type of advantage to emphasize."

He suggests that a successful strategy pays “close attention to both types of advantage while maintaining a clear commitment to superiority on one.”

The other important concern in positioning is the breadth of the firm’s target within its industry, called *competitive scope*. Competitive scope is important in that companies can sometimes gain competitive advantage from breadth through competing either globally or from exploiting interrelationships by competing in related industries.

Combining the type of advantage and the scope advantage, we develop the notion of *generic strategies*, or different approaches to superior performance in an industry (See Figure 3-2). There is no one type of strategy appropriate for every industry and different strategies can coexist successfully in many industries. A firm must make choices as to which strategy to pursue, as “the worst strategic error is to be stuck in the middle.”

Figure 3-2 Generic Strategies

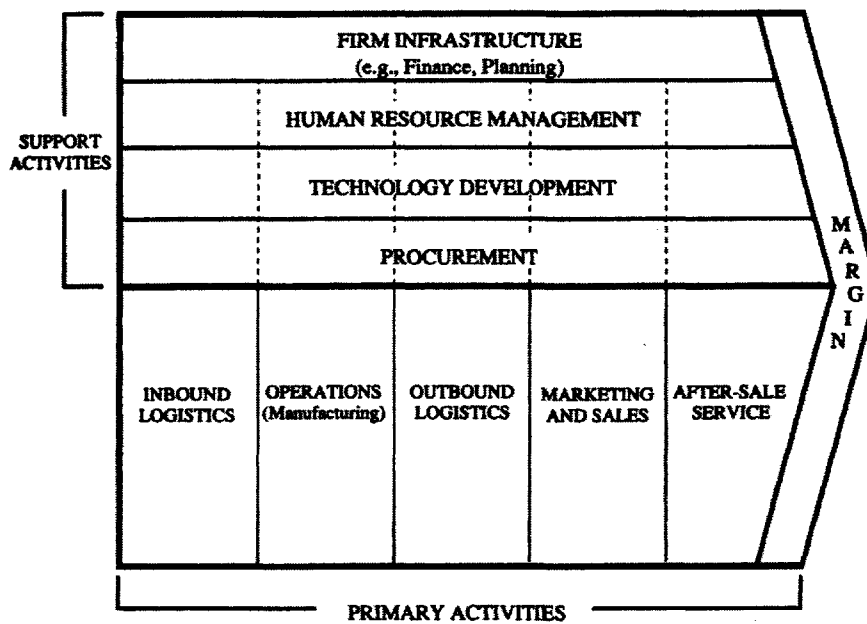
		COMPETITIVE ADVANTAGE	
		Lower Cost	Differentiation
COMPETITIVE SCOPE	Broad Target	Cost Leadership	Differentiation
	Narrow Target	Cost Focus	Focused Differentiation

Source: Porter, Michael E, *The Competitive Advantage of Nations* (1998): p39

Sources of Competitive Advantage

Competitive advantage grows out of the way companies organize and perform discrete activities, and the sources of competitive advantage can be found in various activities in the value chain, an interdependent system or network of activities, connected by linkages (see Figure 3-3). A firm is more than the sum of its activities, and it gains competitive advantage from conceiving of new ways to conduct activities, employing new processes, new technologies, or different inputs.

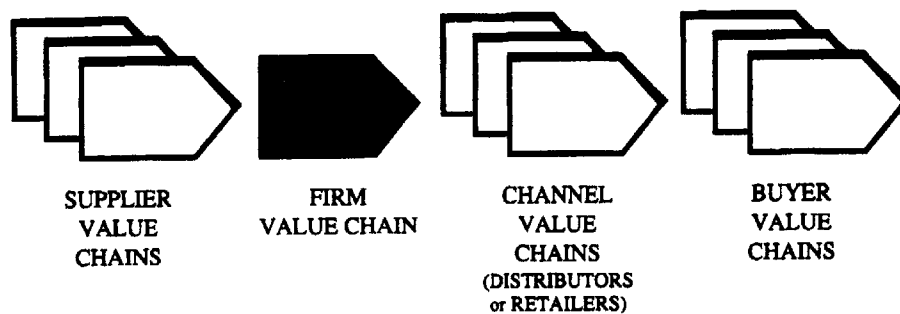
Figure 3-3 The Value Chain



Source: Porter, Michael E, *The Competitive Advantage of Nations* (1998): p41

A firm’s value chain for competing in a particular industry is embedded in a larger stream of activities called *value system* (See Figure 3-4), which includes suppliers, channels, and buyers.

Figure 3-4 The Value System



Source: Porter, Michael E, *The Competitive Advantage of Nations* (1998): p43

Creating Advantage

Firms create competitive advantage through innovation, which can be broadly defined to include both improvements in technology and better methods or ways of doing things. The possibilities for new ways of competing usually comes out of some discontinuity or change in industry structure. The most typical cause of innovations that shift competitive advantage include: new technologies, new or shifting buyer needs, emergence of a new industry segment, shifting input costs or availability, and changes in government regulations. In international markets, a firm's innovation must anticipate both domestic and foreign needs to yield competitive advantage.

Sustaining Advantage

The sustainability of competitive advantage depends on three conditions:

- The particular source of the advantage. (lower-order advantage vs. higher order advantage)
- The number of distinct sources of advantage a company possesses.
- Constant improvement and upgrading.

In order to sustain its competitive advantage, a firm must first relentlessly improve its performance against its existing advantages. In the long run, it must expand and upgrade its sources of advantage. In other words, sustaining advantage requires change and a firm may have to destroy old advantages to create new, higher-order ones.

3.1.2 Competing Internationally

The pattern of international competition is significantly different from industry to industry. At one end of the spectrum, there is the form, termed *multidomestic*, in which firms compete in each nation independent of other nations. At the other end of the spectrum, there are *global* industries, in which “a firm’s competitive position in one nation significantly affects (and is affected by) its position in other nations.” Companies in global industries compete on a worldwide basis, and competitive advantages come out of their entire network of worldwide activities.

Competitive Advantage through Global Strategy

With a global strategy, a firm sells its product in many if not all of the nations that present significant markets for its products and it employs an integrated worldwide approach to doing so. A worldwide approach to strategy enables a company to gain competitive advantages or offset domestic disadvantages in two ways. First, a global firm can spread its activities to serve the markets around the globe. Second, it could coordinate its dispersed activities to reach synergies.

Thus, we can summarize the strategic decisions unique to global strategy in two essential dimensions.

- **Global Configuration.** When deciding where and in how many nations to perform each activity in the value chain, a firm faces two broad choices. One is whether to disperse activities to many nations or to concentrate them in one or two nations. Obviously different industries must be treated differently.
- **Global Coordination.** Global firms must strategically coordinate their global activities in order to share information, allocate responsibility, and align efforts. Coordination will enable a global firm to create competitive advantage from the various activities in the value chain.

Furthermore, distinctions between location-based advantages and system-based advantages must be taken into consideration. Global competition will be possible only after some firms gain an advantage home that allows them to penetrate foreign markets. On the other hand, a firm will not be successful in global competition unless it develops system-based advantages throughout its activities worldwide.

The reason industries globalize is that changes in buyer needs, technology, country infrastructure, or government policy create major disruptions in competitive position among firms from various nations or make the advantage. Early global industry leaders always start with some advantage created at home, but in order to sustain the advantage, in the long run, firms must improve and upgrade the advantage. Sometimes, a global strategy could contribute to supplementing and upgrading the initial advantage that is hard to sustain.

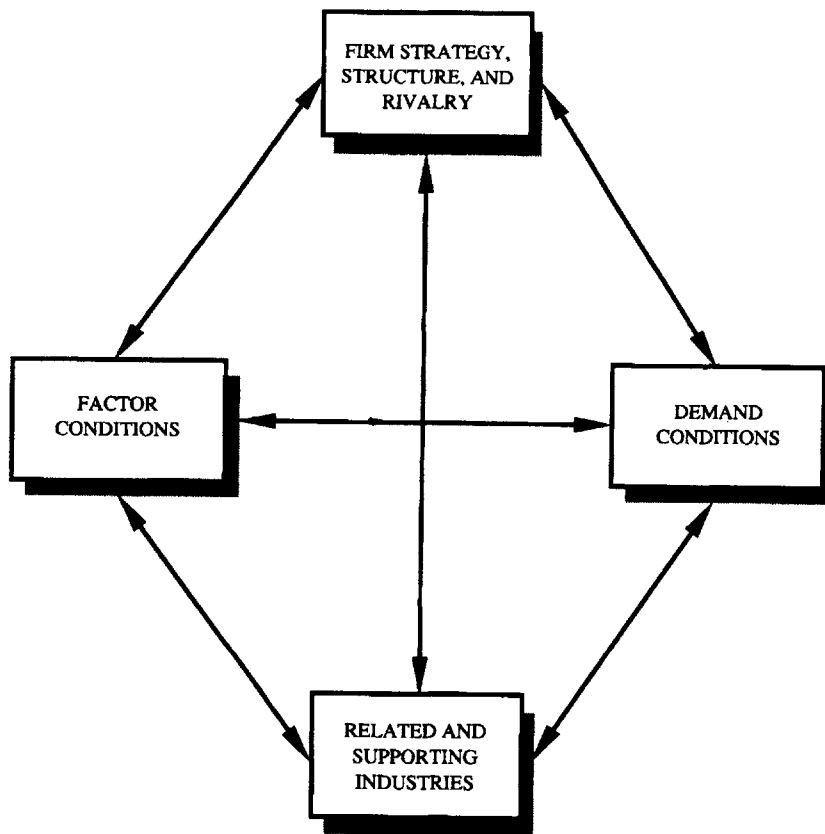
3.2 Determinants of National Competitive Advantage

To answer the question why a nation achieves international success in a particular industry, we should turn to four broad attributes (or *determinants*) of a nation that shape the environment, in which local companies compete, that promotes or impedes the creation of competitive advantage (see Figure 3-5):

- **Factor conditions.** Factors of production are the inputs necessary to compete in any industry, such as labor, natural resources, and capital. “A nation will export those goods which make intensive use of the factors with which it is relatively well endowed.” The factors most important to competitive advantage in most industries are not inherited but created within a nation.
- **Demand conditions.** Demand conditions refer to the nature of home demand for the industry’s product or service. According to Porter, home demand conditions had some influence on every industry he studied, and the more important influence of home demand is dynamic rather than static. There are three broad attributes of home demand that are significant. They are home demand composition (or nature of buyer needs), the size and pattern of growth of home demand, and the mechanisms by which a nation’s domestic preferences are transmitted to foreign markets. The significance of the latter two attributes depends upon the first.
- **Related and supporting industries.** This determinant refers to the presence in the nation of supplier industries or related industries that are internationally competitive. Competitive advantage in some supplier industries gives potential advantages to a nation’s companies in many other industries, for they produce inputs that are widely used and important to internationalization or to innovation.

- **Firm strategy, structure, and rivalry.** This determinant refers to the conditions under which firms are created, organized, and managed, and the nature of domestic rivalry. The firm strategy and structure are often affected by national circumstances. Nations with leading world positions often have a number of strong local competitors.

Figure 3-5 The Determinants of National Advantage



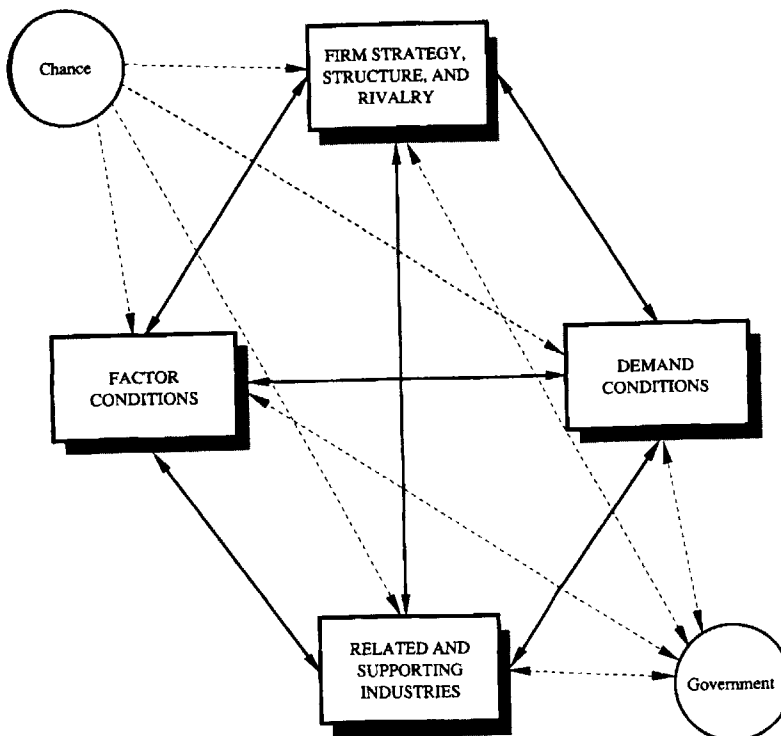
Source: Porter, Michael E, *The Competitive Advantage of Nations* (1998):p72

This is the famous “diamond” framework created by Porter. In addition to the four broad determinants that shape the environment for competing in particular industries, two additional variables can also influence the national system in important ways. These are *chance* and *government*, both of which are necessary to complete the theory (See Figure 3-6):

- **The role of chance.** Chance events are occurrences that are beyond the power of firms or national governments. They are important in that they create discontinuities that allow changes in competitive position.
- **The role of government.** The government's actual role in national competitive advantage is to influence the four determinants. It can both influence and be influenced by each of the four determinants either positively or negatively. In particular, government has an important influence on national competitive advantage, although its role is often partial.

Finally, the individual determinants define the national environment and are mutually dependent, for the effect of one often is contingent upon the state of others.

Figure 3-6 The Complete System



Source: Porter, Michael E, *The Competitive Advantage of Nations* (1998):p127

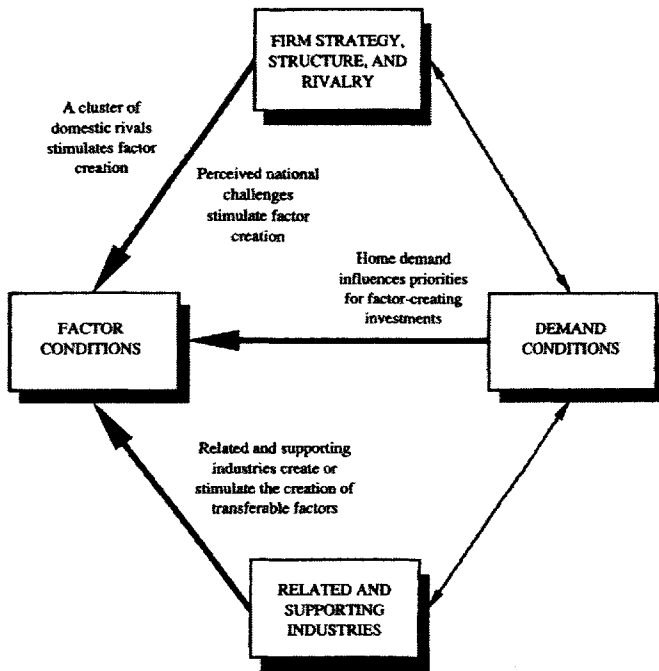
3.3 The Dynamics of National Advantage

The four determinants of national advantage, along with two additional variables, constitute a complex system, through which a great number of national attributes influence the competitive success of the industry. This system is also a dynamic one, which evolves continuously rather than being static. The self-reinforcing interplay of advantages in several areas leads to sustained competitive advantage in an industry, and create a business environment difficult for foreign competitors to emulate. It is fair to say that the national system is as important as (or more important than) the individual parts. In addition, due to workings of the system of determinants, a nation's competitive advantages are not spread evenly through the economy; rather, they are connected in *clusters* comprising industries related by links of various kinds.

Relationships among the Determinants

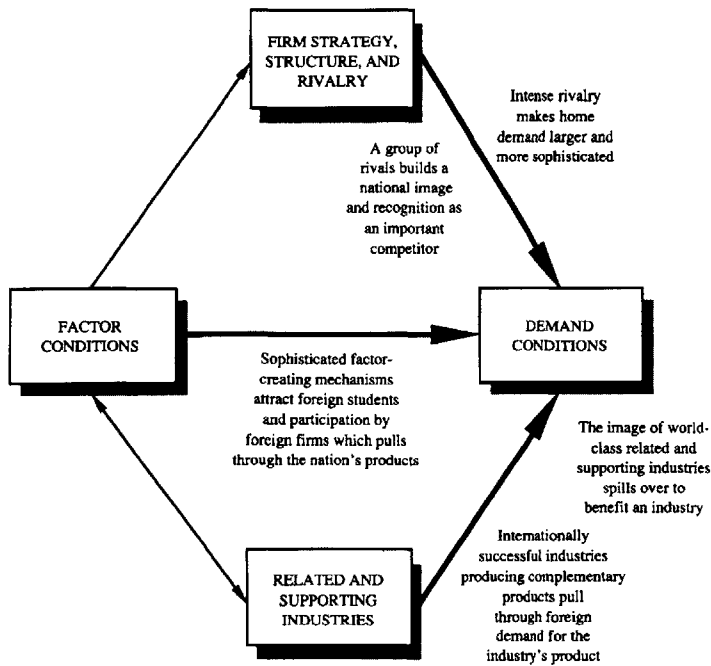
In the diamond system of national advantage, determinants constantly influence and reinforce each other and proliferate over time in fostering competitive advantage in an industry. Figure 3-7 through Figure 3-10 illustrate how some determinants influences other determinants.

Figure 3-7 Influences on Factor Creation



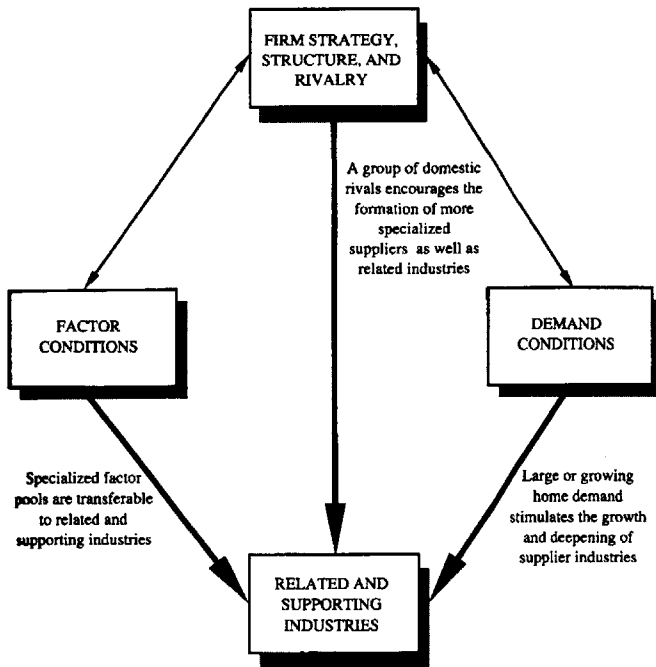
Source: Porter, Michael E, *The Competitive Advantage of Nations* (1998): p133

Figure 3-8 Influences on Home Demand Conditions



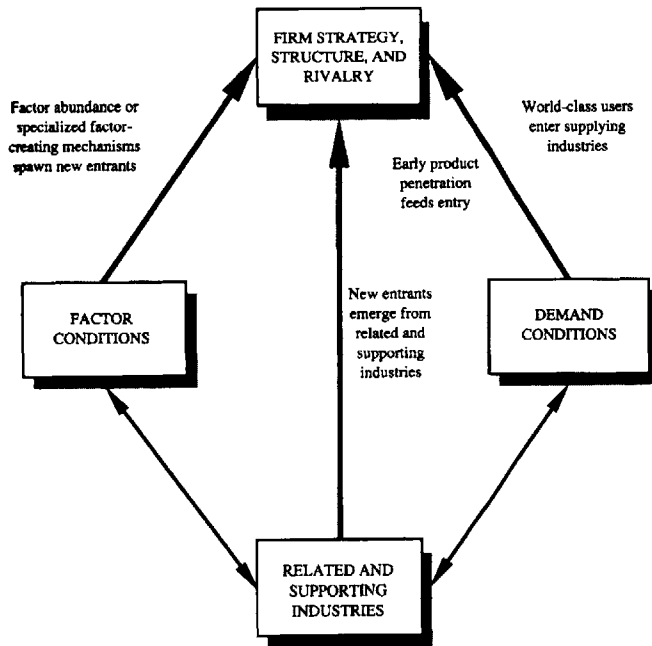
Source: Porter, Michael E, *The Competitive Advantage of Nations* (1998): p136

Figure 3-9 Influences on the Development of Related and Supporting Industries



Source: Porter, Michael E, *The Competitive Advantage of Nations* (1998): p139

Figure 3-10 Influences on Domestic Rivalry



Source: Porter, Michael E, *The Competitive Advantage of Nations* (1998): p141

The Determinants as a System

Countries succeed in international competition where they have advantages in the “diamond.” However, nations cannot expect to be successful in all industries because the requirements for success in industries and industry segments are widely different and because a limited pool of resources makes impossible success in all industries. In simple and resource-intensive industries and in the standardized segments of more sophisticated industries, it is not always necessary to possess advantages in the entire “diamond” to become successful. On the other hand, competitive advantage in more sophisticated industries and industry segments often require more than one single determinants because competitive advantage in these industries rely fundamentally on the rate of improvement and innovation and because the interplay among the determinants introduce new information, new skills, and new players into industry competition which leads to more rapid innovation and competitive upgrading. In most cases, a country becomes successful because it is able to combine some broadly applicable advantages with advantages that are specific to a certain industry or small group of industries.

The Diamond in Perspective

The system of determinants of national competitive advantage is essentially a theory of investment and innovation, and “the determinants in the ‘diamond’ and the interactions among them create forces that shape the likelihood, direction and speed of improvement and innovation by a nation’s firms in an industry.” A country has the potential for competitive advantage when the underlying determinants are favorable or can be developed. Further, a nation’s competitive advantage comes out of “conditions in a nation that signal, channel, or steer its firms to perceive opportunities for improvement and innovation and move early and in the proper directions to

capitalize on them,” and it emerges from challenges, pressure, and adversity – anything but an easy life.

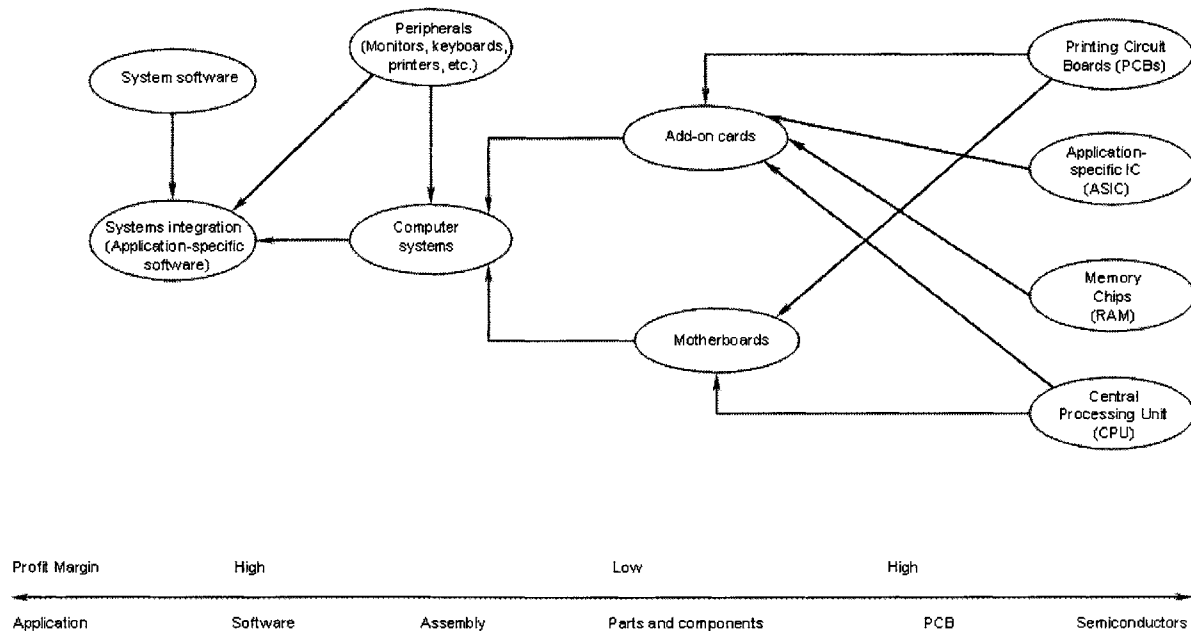
4. OVERVIEW OF CHINESE HIGH-TECH INDUSTRIES

Like Chapter 2, which provided essential background information for readers to understand the context of our discussion, this chapter presents an overview of the Chinese high-tech industries. Because of the limited scope of the thesis, I will focus our discussion on the high-tech industries related to *information technology (IT)*, which include telecom equipment, integrated circuit (IC) and fables chip design, software, computer hardware, and mobile handset, among others. Furthermore, our discussion will be limited to industries that produce tangible products, as opposed to the service industries such as e-commerce and online gaming.

I will first present a picture of the value chain of major IT industries, and then in each of the following sections, we will introduce key sector trends followed by key domestic players.

4.1 The Value Chain of the IT Industries

Figure 4-1 The Value Chain of the IT Industries³⁵



³⁵ Source: Lu, Qiwen (2000).

Figure 4-1 is a detailed illustration of the value chain of the IT industries. On the one end of the value chain is the high-input, high-yield, but high-risk business of semiconductor manufacturing. Because it is capital and knowledge intensive, it has high barriers to entry. On the other end of the value chain is the systems integration business which is highly localized and which has very limited competition. It commands very high profit margins. Manufacturing of PC mostly involves assembly, and the technologies are relatively mature. Therefore, the profit margin is higher at the right end of the chain and drops as it approaches the middle and then increases again as it goes to the left end of the chain.³⁶

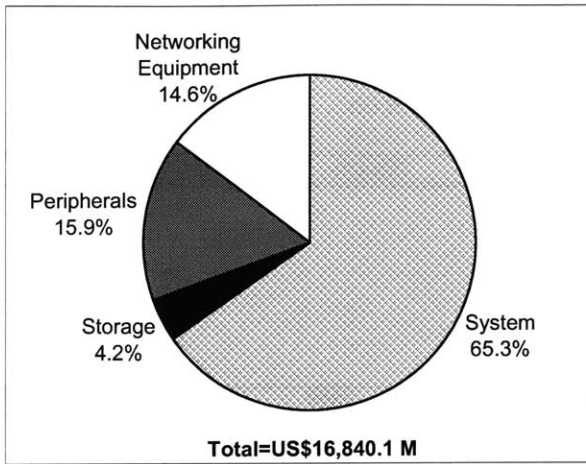
4.2 Computer Hardware

4.2.1 Key Industry Trends

The computer hardware industry includes four major product categories – system (servers and personal computers), storage, peripherals, and networking equipment. According to International Data Corporation (IDC), in 2002 China's computer hardware market was \$16.8 billion, of which systems accounted for \$11.0 billion (65.3%), storage for \$707.4 million (4.2%), peripherals for \$2.7 billion (15.9%), and networking equipment for \$2.5 billion (14.6%) (see Figure 4-2).

³⁶ Lu, Qiwen (2002).

Figure 4-2 China Hardware Revenue, Breakdown by Product Category, 2002



Source: IDC, 2003

Growth Trend

In 2002, storage revenue grew the fastest at 26.3%, followed by peripherals at 12.4%. Both system and networking equipment seemed to be severely affected by the market downturn and industry restructuring and saw negative growth at -5.3% and -7.6% respectively.

Between 2002 and 2007, peripherals were expected to grow the fastest at an annually compounded rate of 14.8%, followed by system at 11% (see Table 4-1 through 4-3).

Table 4-1 China Hardware Revenue, Value and Projection by Product Category, 2002 – 2007 (US\$M)

	2002	2003	2004	2005	2006	2007
System	10,900.8	11,164.0	12,475.4	14,429.3	16,349.3	18,522.7
Storage	707.4	779.5	847.8	918.9	967.2	1,006.9
Peripherals	2,679.9	2,981.1	3,577.6	4,202.4	4,795.9	5,334.9
Networking Equipment	2,462.0	2,567.5	2,780.1	3,056.4	3,374.3	3,734.1
Total Hardware	16,840.1	17,492.0	19,680.9	22,607.1	25,486.7	28,598.7

Source: IDC 2003

Table 4-2 China Hardware Revenue, Breakdown by Product Category, 2002 - 2007

	2002	2003	2004	2005	2006	2007
System	65.3%	63.8%	63.4%	63.8%	64.1%	64.8%
Storage	4.2%	4.5%	4.3%	4.1%	3.8%	3.5%
Peripherals	15.9%	17.0%	18.2%	18.6%	18.8%	18.7%
Networking Equipment	14.6%	14.7%	14.1%	13.5%	13.2%	13.1%
Total Hardware	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: IDC 2003

Table 4-3 China Hardware Market, Growth Trend, 2002 – 2007

	2002	2003	2004	2005	2006	2007	2002-2007
System	-5.3%	1.6%	11.7%	15.7%	13.3%	13.3%	11.0%
Storage	26.3%	10.2%	8.8%	8.4%	5.2%	4.1%	7.3%
Peripherals	12.4%	11.2%	20.0%	17.5%	14.1%	11.2%	14.8%
Networking Equipment	-7.6%	4.3%	8.3%	9.9%	10.4%	10.7%	8.7%
Total Hardware	-2.2%	3.9%	12.5%	14.9%	12.7%	12.2%	11.2%

Source: IDC, 2003

4.2.2 Key Players

Table 4-4 lists some of the key players in the hardware manufacturing space.

Table 4-4 Key Players of Hardware Industry

Company Name	Company Description
<p>Huawei www.huawei.com.cn</p>	<p>Key facts: Headquartered in Shenzhen, Huawei is China's leading telecom equipment vendor. Its product have been deployed in over 40 countries through its 32 branch offices worldwide, and its international partners include 3Com, Micoroft, Siemens, Qualcomm, Motorola and Infineon. 41% of its total revenues came from international sales in 2004.</p> <p>Main products: Access Networks, Switches, Optical Networks, Data Communications, Mobile Data Services, Multimedia Products, Wireless and NGN.</p>
<p>Lenovo www.lenovo.com</p>	<p>Key facts: Headquartered in Purchase, NY, Lenovo is a global leader in the PC market. It develops, manufactures, and markets PC products and value-added professional services. It acquired the IBM Personal Computing Division in December 2004 for \$1.25 billion.</p> <p>Main products: Personal Computers (PCs), Servers, Laptops, Networking Equipment, Digital Cameras.</p>
<p>ZTE www.zte.com.cn</p>	<p>Key facts: ZTE was founded in 1985 and is headquartered in Shenzhen. It is China's largest listed telecom equipment provider. ZTE had its start as part of a government-funded initiative to improve domestic telecom capabilities and is still majority-owned by the government. ZTE has emerged as a full-scale equipment manufacturer with 15,000 employees, and it sells its products in more than 40</p>

	<p>countries. In 2004, ZTE's revenues mainly came from its PHS and CDMA products.</p> <p>Main products: Network Centralized Surveillance, PHS, NGN Wireless, Switching System, Access Network, Optical Transport, Mobile Communications, Data Communications, Videoconference</p>
<p>UTStarcom www.utstartcom.com.cn</p>	<p>Key facts: UTStartcomm growth has been driven by the sale of its PHS products. The company has entrenched relationships with China Telecom and China Netcom and is promoting other products in new markets such as 3G and NGN.</p> <p>Main Products: PHS; Broadband; Wireless; 3G Mobile Communications; Optical Networking; Soft Switches</p>

Source: IFC 2005 and Company Websites

4.3 Software

4.3.1 Key Industry Trends

The China's Ministry of Information Industry (MII) and the National Bureau of Statistics define the country's software industry as a combination of software products, system integration and services. Although it is still relatively small, the industry has grown rapidly in the last few years. According to the MII and the National Bureau of Statistics of China, the industry reached \$19.67 billion in 2003, 48.5% higher than in 2002.

The Market

The Software Industry Association's forecast indicated that the market in 2004 would grow at an annual rate of 29% to reach \$25.3 billion, of which \$12.1 billion were expected to be products and \$13.2 billion would be system integration and software services.³⁷

Two thousand new software companies entered the market in 2003, making a total of 8,700 registered software companies by the end of 2003.³⁸ Most of the software companies are located

³⁷ IFC. The ICT Landscape in the PRC: Market Trends and Investment Opportunities. March 2005.

³⁸ IFC. The ICT Landscape in the PRC: Market Trends and Investment Opportunities. March 2005.

in Beijing, Guangdong, Shanghai, and Zhejiang, and the market is dominated by private and foreign software companies.

China's software industry exports reached \$2 billion in 2003, up 33.3% from 2002, although such exports accounted for only 1.4% of total IT industry exports. The biggest export market for Chinese software products is Japan, representing 61% of the total export, followed by the U.S.³⁹

Government's Role

The government plays an active role in supporting the software industry. Its policies include tax breaks to software companies (no tax during the first two years of operations, and a 50% tax reduction in the third and fourth years), simplified administrative procedures (such as relatively quick approval to secure international investment), and preferential treatment to research facilities that successfully commercialize their research.⁴⁰

The government also represents a major market for software companies, with 30% of its IT investment spent on software and IT services (according to CCID⁴¹). CCID forecast that total e-government expenditure would reach \$4.8 billion in 2004, including \$1.7 billion in software and services. E-government expenditure is expected to grow to \$5.9 billion in 2005.

The government also uses its software procurement to support the domestic industry by channeling a portion of the purchasing to domestic software companies. According to the MII, sales of software packages by companies with wholly Chinese equity increased 43% last year, to

³⁹ IFC. The ICT Landscape in the PRC: Market Trends and Investment Opportunities. March 2005.

⁴⁰ IFC. The ICT Landscape in the PRC: Market Trends and Investment Opportunities. March 2005.

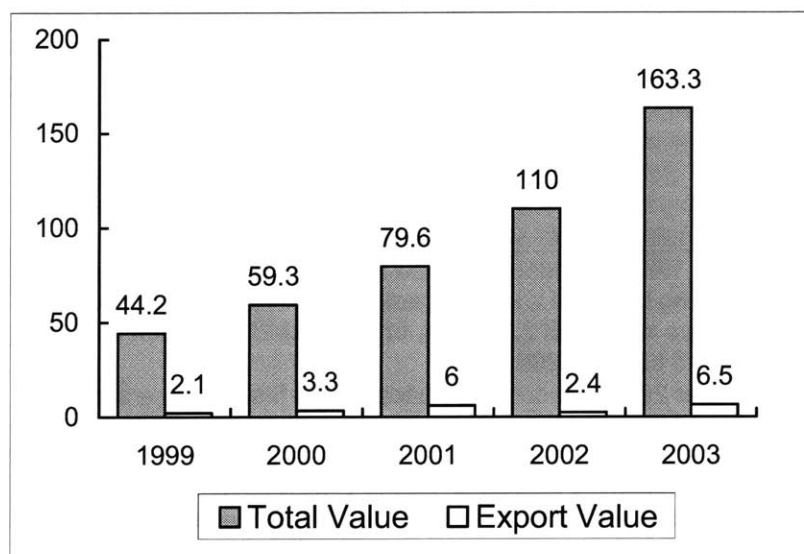
⁴¹ CCID stands for China Center for Information Industry Development.

\$55.9 million, of which 13%, or \$7.4 million, came from provincial governments. However, such support may not be enough to sustain the lagging domestic software industry.⁴²

Growth Prospects

According to the Software Industry Association’s forecast, the software market would reach \$25.3 billion in 2004, representing an annual growth of 29%.

Figure 4-3 1999 – 2003 China Software Market Size (RMB billion)



Source: *MI*, 2004

4.3.2 Key Players

Table 4-5 lists a number of Chinese players in the software industry.

Table 4-5 Main Chinese Players in the Software Industry

Company Name	Company Description
Kingdee International Software Group, Ltd. global.kingdee.com/en/	<ul style="list-style-type: none"> Kingdee has 46 branch locations and more than 2,700 employees, with approximately 1,000 developers in three development centers across China. Domain expertise in enterprise software sectors includes ERP, CRM, SCM, Knowledge Management, e-commerce services, and

⁴² US Information Technology Office. “Can Government Procurement Save China’s Software Industry?” <http://www.usito.org>, accessed June 15, 2005.

	<p>middleware integration tools.</p> <ul style="list-style-type: none"> • Technical capabilities include MS Windows, Unix, Linux, OS/400, OS/390; J2EE, .NET; Java/Java Script, Visual Basic/VB Script, C/C++, HTML, XML, JSP, ASP, PHP; Rational Rose, UML; MS SQL Server, Oracle, DB2 and more. • Kingdee is one of only 100 companies to achieve ISO9001 and SEI CMM 4 level certification. • Expects to be SEI CMM level 5 compliant in 2005. • Listed on Hong Kong's Growth Enterprise Market (GEM).
<p>UF Soft www.ufsoft.com.cn</p>	<ul style="list-style-type: none"> • Established in 1988, UF Soft became listed on the Shanghai Stock Exchange in May 2001 (ticker: 600588). In 2003, UF Soft's listed subsidiary posted revenue of RMB 602 million and profit of RMB 75 million. • The company has 35 branches and 15 representative offices nationwide, with nearly 4,000 employees, including over 1,000 software developers and 1,000 software implementation consultants. • Originally focused on financial management software, UF Soft's product line has expanded to many other areas including ERP, SCM (Supply Chain Management), CRM, HR, EAM (Enterprise Assets Management) and OA. • UF Soft services clients in the electronics, finance, auto, medical, retail and chemicals industries. • In 2004, UF Soft announced that it was seeking to become the largest management software supplier in Asia by 2006 and the world's top management software supplier by 2010.
<p>Neusoft www.neusoft.com</p>	<ul style="list-style-type: none"> • Founded in 1991 and headquartered in Shenyang, Neusoft is one of China's leading software suppliers, employing over 6,000 people. Its 2003 revenue was RMB 2.2 billion, up from RMB 2.0 billion in 2002 and RMB 1.8 billion in 2001. • In December 2002, the company became the first Chinese software company to pass CMM5 certification. • Key areas covered include Software & Services, Digital Medical Products & e-Hospital Solutions, and IT Education & Training. Its listed subsidiary, Shenyang Neusoft Co., Ltd. (ticker: 600718), posted revenue of RMB 2.0 billion, of which 74% was from software and system integration, and 24% from medical-related products. • The company has 40 branches nationwide and has set up software parks in Shenyang, Chengdu, Dalian and Nanhai. It also has branches in the U.S., Japan, and Hong Kong. • Key software clients are in various industries including telecoms (e.g. GSM and CDMA billing systems and China Unicom's Java platform), government (e.g. tax management systems and social insurance management systems), enterprise and e-commerce, power, communications, education and finance. • Clients include Haier, Chunglan and Qilu Petrochemical. • The company set up a joint venture with Nokia in 2000 to develop mobile data platforms.
<p>CS&S (China National Computer Software and Technology Service Corporation) xexploit.css.com.cn</p>	<ul style="list-style-type: none"> • Founded in 1990, CS&S is a large state-owned enterprise specializing in computer software, IT product development, systems integration, information services and software outsourcing. Currently, the company has over 3,000 employees. • 2002 revenue hit RMB 1.3 billion with profits of RMB 89 million. The company is listed on the Shanghai Stock Exchange in 2002 (ticker: 600536). • CS&S passed CMM2 in 2001.

	<ul style="list-style-type: none"> • Key businesses include software development, system integration and software outsourcing. • CS&S's products cover operation systems, OSS< government and enterprise office management systems and application products (e.g. tax compliance system). • The company set up a joint venture with CA in 2001 to sell ERP products.
<p>Huawei Technology www.huawei.com</p>	<ul style="list-style-type: none"> • Although Huawei is better known as a telecom equipment vendor, it also possesses strong software development capabilities. In the MII's list of 2004's Top 100 Chinese Software Companies, Huawei was ranked No. 1 with software revenue of RMB 6.2 billion. • Huawei's India software institute passed CMM5 in August 2003, while its Beijing and Nanjing software institutes passed CMM4 in January and June 2003 respectively. • Unlike Kindee and UF Software, whose software products cover a wide range of areas, Huawei focuses on software development for telecom equipment, such as mobile gateways, intelligent network products and base stations. Huawei sells most of its software bundled with telecom equipment, and is not focused on software as a major business. • Huawei has around 24,000 employees including an R&D staff of over 14,000, of which over 70% are estimated to be involved in software development.

Source: IFC 2005

4.4 Semiconductor

4.4.1 Key Industry Trends

The semiconductor industry has been recognized by China's leaders as a strategic high-growth industry. China's IC industry includes design, manufacturing, and encapsulation and testing. Revenues from design and manufacturing are growing quickly in China as China-based design houses bring new products to market and new foundries (manufacturing facilities where chips are made) open.⁴³ However, despite the rapid growth in manufacturing capacity, China still falls behind other markets in terms of domestic design capability.⁴⁴

Table 4-6 lists the sales of IC broken down by categories.

⁴³ IFC. March 2005.

⁴⁴ IFC. March 2005.

Table 4-6 Development of China's IC Industry Segments 2003.

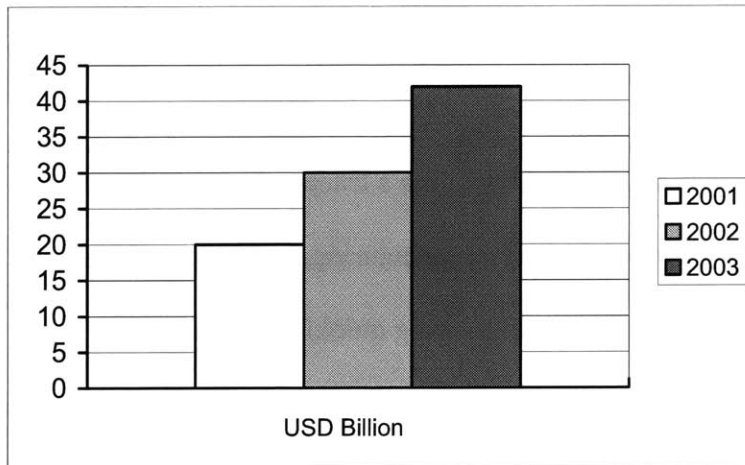
Industry Segment	Sales Revenues (billion RMB)	Growth (%)	Proportion of IC Industry (%)
Design	4.49	107.9	12.8
Manufacturing	6.05	80.3	17.2
Testing	24.60	15.4	70.0

Source: *CEInet, 2004*

The Market

One of the world's fastest growing IC markets, China accounts for 13% of the world's demand for semiconductors, up from 7% in 2000.⁴⁵ Although domestic IC consumption grows at almost twice the global rate, domestic production capacity grows much slower than domestic demand, which results in 90% of the domestic demand being met by imports.⁴⁶

Figure 4-4 Chinese Import of Semiconductors 2001 – 2003



Source: *China Semiconductor Association*

As Figure 4-4 shows, in 2001, China imported \$20 billion in chips. In 2002, the number increased 50% to \$30 billion, and in 2003, the number increased another 40% to \$42 billion.

⁴⁵ IFC. March 2005.

⁴⁶ IFC. March 2005.

Ironically, 90% of the chips manufactured in China are actually exported, and a large share of these exported chips would be re-imported after processing.⁴⁷

The products

The Chinese IC market sells four main products: oxide semiconductors (MOS) micro parts, MOS storage, MOS logic parts, and MOS analogical parts. The four products account for 97% of the total market in 2003, with MOS micro parts taking 41.7% of this figure.⁴⁸ In 2003, computer, consumption, and network communication held 86.5% of the total demand for ICs in China.

Government's Role

Chinese government officials are now inviting foreign investors into China in order to fuel the growth of the industry. According to FSA, \$3.5 billion was invested between 2000 and 2002. Support has come from central and provincial governments and science parks in the forms of government investments, bank loans subsidized by public authorities, tax reductions (withdrawn due to U.S. government pressure) and the founding of design centers. China's 10th Five Year Plan sets out two major goals (figures from RAND⁴⁹):

1. By 2005, national IC wafer production would reach \$2.4 billion with sales reaching between \$7.2 billion and 9.6 billion. The production would constitute between 2 – 3% of international sales and meet 30% of domestic demand.

⁴⁷ IFC. March 2005.

⁴⁸ CEInet stats, quoted by the IFC report March 2005.

⁴⁹ Quoted by the IFC report, March 2005.

2. By 2010, national IC wafer production would reach \$6 billion with sales of \$24 billion.

The production would constitute 5% of world sales and meet 50% of domestic demand.

In order to accomplish these goals, the government will take the following approaches:

1. Establish a national IC R&D center to research and develop large-scale technology production and system-level IC.
2. Support an independent design group with annual sales of more than \$100 million.
3. Build a number of fabs (6-12 inch, capable of manufacturing 0.13-0.18 μ m process technology) as well as five or six packaging plants.

Government contracts will continue to be an important source of revenue for some companies.

4.4.2 Key Players

Table 4-7 and 4-8 list some of the major foundries and IC design firms.

Table 4-7 Selected Foundries

Company Name	Company Description
Advanced Semiconductor Manufacturing Corp. Ltd. (ASMC) www.asmc.com	<ul style="list-style-type: none"> Established in 1995. Headquartered in Shanghai. A leading foundry for analog, power and smart card applications. One of the largest wafer fabrication companies in China. The company has one 5 inch wafer fab with 40,000 wafer output per month, one 6 inch wafer fab with 35,000 wafer output per month, and one 8 inch fab with 30,000 wafer output per month capacity.
Central Semiconductor Manufacturing Corp. (CSMC) www.csmc.com.cn	<ul style="list-style-type: none"> Established in 1997. Size: 700<. Headquartered in Wuxi, Shanghai. The first foundry opened in China. Three main future objectives: <ul style="list-style-type: none"> a) expand capacity in the mainstream manufacturing market in China; b) maintain cost effective operations through procurement of reconditioned equipment; c) increase business with Chinese fabless design houses and further develop relationships with international customers. Received IFC investment in 2003.
Grace Semiconductor (GSMC)	<ul style="list-style-type: none"> Established in 2000. Located in Zhangjiang Hi-Tech Park in Pudong, Shanghai. Two 12 inch fabs have been constructed.

www.gsmcthw.com/ index.html.en	<ul style="list-style-type: none"> • Expects to reach a monthly capacity of 27,000 8 inch wafers by the second half of 2004. • Makes mixed-signal chips for customers including Oki Electric Industry. • Investors in Grace, which is legally domiciled in the Cayman Islands, include Silicon Storage Technology. • Technology: 2003: 0.25μm/0.22μm/0.18μm/0.15μm; 2004/2H: 0.13μm Full Copper Technologies; Logic, Flash, SRAM, Mask ROM, Mixed Signal, RF, High Voltage etc.
Semiconductor Manufacturing International Corp. (SMIC) www.smics.com	<ul style="list-style-type: none"> • Established in 2000. Headquartered in Shanghai, with factories in Tianjin and Beijing. • One of China's largest microchip makers. • Opened its 5th factory in September 2004. • China's first plant to process 300 mm wafers.
Shanghai Hua Hong NEC Electronics Co., Ltd. www.hhnec.com.cn	<ul style="list-style-type: none"> • Established in 1997. Size: 900<. Headquartered in Shanghai Pu Dong Jin Qiao Export Zone. • A joint venture of Shanghai Hua Hong Group and NEC Corporation. • China's first 200mm foundry. • 0.25μm-0.13μm Logic/MIX/RF CMOS process, 0.18μm in yield production in June 2004. • Monthly capacity objective is 80,000.
SIM-BCD www.simbcd.com	<ul style="list-style-type: none"> • Established in 2001. Size: 247 (2003). Offices in Shanghai. • China's first 6 inch bipolar fab and 2μm bipolar power IC foundry. • Capacity of 40,000 6 inch wafers/month and 20,000 4 inch wafers/month.

Source: IFC, 2005

Table 4-8 Selected IC Design Companies

Company Name	Company Description
Comlent www.comlent.com/en/index	<ul style="list-style-type: none"> • Established in 2002. Headquartered in Shanghai, with R&D center in Southern California. • A fabless RFIC design house focusing on the wireless communications markets in Greater China and Asia Pacific. Products under development include PHS/PAS and 2.4GHz short range devices. Investors include Intel, 3i, and DF ePlanet Ventures.
Datang Microelectronics Technology Co. www.datang.com/english/index.html	<ul style="list-style-type: none"> • Established in 2002. Size: 3600. R&D in Beijing and Shanghai. • Datang Microelectronics' leading products include high-capacity digital switching series, light communication series, mobile communication series, data communication series, digital microwave communication series, software and system integration series, micro-electricity and dedicated integrated circuit series.
Hangzhou Silan Microelectronics Joint-stock Co., Ltd. www.silan.com.cn/english/cpfb/cpfb.htm	<ul style="list-style-type: none"> • Established in 1997. Headquartered in ShengZhen and Hangzhou and offices in Xiamen and Korea. • Silan specializes in IC products. The company possesses advanced EDA tools in IC design and testing capability in both wafers and finished products. Dedicated to invest more than 10% of gross profit in R&D, Silan introduces dozens of new products and models to the market every year.
Huada Electronic Design Inc., Ltd	<ul style="list-style-type: none"> • Established in 2002. Size: 120. Offices in Beijing and GuangZhou. • CIDC (HED) provides IC design, system application development

<p>www.hed.com.cn/english/indexx.htm</p>	<p>and EDA Tool Development. HED also has strong experience and business operations in IC card chips. ASIC designs and DVB set-top product development.</p>
<p>Shanghai Huahong Integrated Circuit Co., Ltd. www.shhic.com/new/index.asp</p>	<ul style="list-style-type: none"> • Established in 2000. Headquartered in Shanghai. • Shanghai Huahong Integrated Circuit Co., Ltd. is one of the top five semiconductor design companies in China. The company focuses on the technology development and production of smart card chips and is extending into consumer and automobile electronics.
<p>Shenzhen State Microelectronics Co., Ltd. www.assmec.com</p>	<ul style="list-style-type: none"> • Established in 1993. Office in Shenzhen. • Shenzhen State Microelectronics Co., Ltd. (SSMEC) is the first integrated circuit design company started up by the national Project 909. The company is primarily engaged in design, development, and sale of digital audio & video IC, embedded CPU & DSP chips and ASSP for consumer electronics. The company provides customized service in IC design and development, as well as application solutions for customers.
<p>Trident Multimedia Technologies Co., Ltd. www.tridentmicro.com/tti.asp www.trident.com.cn</p>	<ul style="list-style-type: none"> • Established in 1987. Size: 100. Headquartered in Sunnyvale, California. • Trident Multimedia Technologies Co., Ltd. develops video processors and highly integrated system-on-a-chip devices, targeting the converging HDTV-ready and PC-ready digital CRT TV, LCD TV, PDP TV, and DLP TV applications.
<p>Vimicro Corporation www.vimicro.com/english/index.html</p>	<ul style="list-style-type: none"> • Established in 1999. Headquartered in Beijing with offices in Shenzheng and Silicon Valley. • Vimicro develops embedded multimedia signal processing chips and solutions that enable multimedia applications for mobile phones over 2.5G/3G network and PCs over broadband Internet.

Source: *IF*, 2005.

5 CASE STUDY – LENOVO (FORMERLY LEGEND)

Headquartered in Purchase, NY, Lenovo is a global leader in the PC market. The current company is a result of the \$1.25 billion acquisition of the IBM Personal Computing Division (PCD) by Lenovo Group Ltd., a subsidiary of Legend Holdings Ltd. in December 2004, creating a behemoth with \$13 billion in sales and 8% of the world's PC market.⁵⁰ It develops, manufactures, and markets PC products and value-added professional services, and its main products include personal computers (desktops and laptops), servers, networking equipment, and projectors, among others. Table 5-1 shows its key financial figures in 2005 and 2004.

Table 5-1 Lenovo Key Financial Figures

For the year ended March 31	2005 (HK\$m)	2004 (HK\$m)	Increase/ (Decrease)
OPERATING RESULTS			
Turnover	22,555	23,176	-2.70%
EBITDA	1,174	1,125	4.30%
Profit attributable to shareholders	1,120	1,053	6.40%
Earnings per share - fully diluted (HK cents)	14.97	13.99	7.00%
FINANCIAL POSITION			
Total assets	9,032	8,342	8.30%
Cash and cash equivalents	3,019	2,650	13.90%
Shareholders' fund	5,204	4,489	15.90%
FINANCIAL RATIO			
ROA (Return on assets) (%)	12.7	14.4	-11.80%
ROE (Return on equity) (%)	23.1	24.7	-6.50%
Current ratio (times)	1.9	1.9	-

Source: *Corporate Website, 2005*

5.1 Founding of the Company⁵¹

⁵⁰ Roberts, Dexter and Lee, Louise. "East Meets West, Big-Time: Lenovo's deal for IBM's PC unit led to a merger of talent – and a threat to Dell," *Business Week*, May 6, 2005. McCraw-Hill Companies, Inc.

⁵¹ Section 5.1 through Section 5.4 are, in large part, based on Chapter 3 from Lu, Qiwen's book, *China's Leap into the Information Age: Innovation and Organization in the Computer Industry*, Oxford University Press, 2000. All references to this book will not be explicitly cited in these four sections.

Founded in November 1984, Legend (the original name of Lenovo) was a result of two important developments in Communist China during the early 80s. First, the government was reforming the national science and technology system, and second, new non-governmental science and technology companies were emerging in the Zhongguancun area of the Beijing Haidian District, where dozens of research institutes were located. The Institute of Computing Technology (ICT) under the Chinese Academy of Sciences (CAS) was caught in the middle of the reform and had been forced to look into ways to make money by itself instead of relying on lucrative state-funded projects. Inspired by the emergence of the non-governmental science and technology enterprises in Zhongguancun where ICT was located, eleven research fellows from ICT founded ICT Co.⁵², which was renamed to Legend in 1988.

ICT Co. was set up as an “institute-run enterprise” (*suoban gongsi*), funded by RMB 200,000 from the ICT. The company received three types of preferential treatment from ICT:

1. Complete autonomy in managerial decision-making, financial budgeting, and employee recruitment.
2. Full access to ICT’s rich tangible or intangible science and technology resources.
3. Privilege to use the name of ICT in making business deals.

5.2 Early Growth

None of the eleven founders had experiences in business and trade, and the first several months after the founding proved to be chaotic when the entrepreneurs tried to adapt to the new environment in order to sustain themselves financially. The management tried everything from selling roller skates to contracting an RMB 700,000 project in which the company installed and

⁵² In some instances, the names of Legend and ICT Co. are used interchangeably.

tested ICT's 500 imported computers, trained operators, and provided maintenance. While the ICT project provided the company with the essential capital for future growth, it became clear to the founding team that the company's prosperity in the long run depended on its ability to develop its own commercially viable products.

Its close ties to ICT, which had the greatest concentration of information technology talent in China, proved to be invaluable to ICT Co.'s goals of developing its own products. A crucial step ICT Co. took was to persuade Ni Guangnan, one of the most experienced and promising scientist in the institute, to join the company. At the time, Ni was developing a Chinese word-processing technology, which he successfully commercialized in 1986. The Chinese word-processing system (an add-on card for IBM PC) incorporated artificial intelligence and demonstrated stellar performance. As a result of the company's commitment to the continuous improvement of the product through upgrades, the product soon took 50% of the market share.

By 1988, ICT Co. had successfully commercialized 27 profitable technologies, among a total of 156 technologies it had tried to bring to the market. Products associated with these technologies, directly or indirectly, accounted for 80% of the company's sales, and its revenue grew rapidly (see Table 5-2). In the meantime, the company has not only set up branches in major Chinese cities and a joint venture in Hong Kong, but also built its own research and development capabilities and set up two of its own R&D centers.

Table 5-2 Legend's Financial Performance – the Early Years (not including Hong Kong Legend)
(Currency figures in RMB 1,000)

	1985	1986	1987	1988	1989	1990	1991
No. of Employees	44	86	199	318	363	507	630
Sales revenues	3,000	18,000	70,140	134,000	220,000	250,000	680,000
Taxes*	210	2,425	6,246	4,879	10,398	23,213	42,376
Remittance to ICT	1,200	1,200	1,200	1,200	1,200	1,200	1,200

* Including sales tax and income tax

Source: LXZGBD, 1993; Legend Group (Hong Kong), *Fifth Anniversary Brochure*, June 1993; Lu, Qiwen (2000).

In the same year, ICT Co. was reorganized into Legend Computer Group Co that comprised two major subgroups – Beijing Legend Computer Group Co. and Hong Kong Legend Computer Group Co. The two subgroups conducted complementary businesses: Beijing Legend supplied a third of the initial capital, along with R&D and managerial skills and a back-up market for Hong Kong Legend; Hong Kong Legend became one of the world’s largest suppliers of PC motherboards and add-on cards. In addition, Legend built a manufacturing base in southern China, one of the largest in East Asia.

At this point, Beijing Legend was able to leverage Hong Kong Legend’s capability of PC-motherboard and add-on card manufacturing and shift from a Chinese word-processing add-on card manufacturer to a personal computer manufacturer. In 1993, Beijing Legend overtook China Great Wall Computer Co., the largest traditional state-owned computer manufacturer, to become the largest domestic PC maker in China, with sales behind only foreign companies AST and Compaq in the Chinese PC market.

5.3 Creating Competitive Advantage

As we discussed in Section 3.1, firms create competitive advantage over their rivals through either low cost or differentiation. While imitating competitors and basing advantage on cheap labor or raw materials is possible in less sophisticated industries or industry segments, such advantage is rarely sustainable and cannot be the basis for economic development beyond a certain level.⁵³

⁵³ Porter, Michael E. *The Competitive Advantage of Nations with a New Introduction*. New York: The Free Press. 1998.

In this section, we will discuss how Legend created its competitive strategies in its early years.

5.3.1 Relationship with ICT

A major characteristic that differentiates Legend from other state-run enterprises in China in the 1980s was its close ties to ICT. To begin, ICT was China's leading research institute in computer science and technology, and the fact that Legend was initially named after ICT as ICT Co. was an invaluable asset to the company – the ICT name lent Legend instant credibility in front of its potential customers. Next, Legend's close ties to ICT landed its first major contract which was picked up from CAS through internal contacts. This contract was crucial to the survival of the company in that Legend accumulated RMB 700,000 of capital that later enabled it to launch its first major product – the Chinese word-processing add-on card. More importantly, Legend owed its success to the rich pool of technology resources within ICT. Not only did it have direct access to the technologies under development at ICT, but it was also able to use the talents from the institute. As mentioned earlier, Legend commercialized dozens of ICT technologies with great success in the 1980s.

Although it received direct support from ICT, Legend had complete managerial autonomy and remained fully independent from the institute. The autonomy enabled the management to make business decisions more efficiently and effectively. In fact, the company top management attributed Legend's rapid growth to both the strong technological back-up from ICT and its managerial independence.

As the company grew, Legend's relationship with ICT also evolved. In 1995, CAS authorized the company to run ICT as a further attempt to reform the academy, with the intention of fully integrating ICT into the company.

5.3.2 Product Development and Marketing

In developing its products, Legend took a service-centered strategy in which it used close linkages with the users as a source of ideas for continuous improvements and upgrades. The members of the product development were actively participating in service practices, such as speaking at company-sponsored technology fairs and acting as salespersons at the company's trade shows and retail centers. The company built an organizational structure that integrated research and development, marketing, manufacturing, and after-sales services, which made it possible for it to react quickly to market needs. In fact, during the first few years, Legend put one-third of its technological employees, including senior scientists, in an integrated team of development, manufacturing, and marketing of the Chinese word-processing add-on card system. As a result, the firm was able to quickly churn out improved versions of products to serve the needs of its customers. In short, the company was committed to technological services and continuous technological upgrading when it came to product development, which made it a leader in the industry.

By reaching out to the customers, Legend also built a nationwide sales network for distributing the Chinese word processing add-on cards and AST personal computers.

5.3.3 Technology Strategy

The company adopted a strategy of “forward engineering” in the development of proprietary technologies and integrated it with trade, which not only enlarged the revenue and accelerated capital accumulation, but also helped to build a nationwide sales and service network. The concept of forward engineering refers to the traditional process of moving from high-level abstractions and logical, implementation-independent designs to the physical implementation of a system.⁵⁴ This was a strategy that many other companies also pursued but they lacked the technological capabilities that Legend had as a result of its close ties with ICT. Legend used this strategy to commercialize the Chinese word-processing add-on cards by designing the card to be installed in IBM or compatible computer. Realizing that the add-on cards would drive the sales of IBM computer systems, Legend signed a contract with AST to resell AST machines with the Chinese word-processing add-on cards, which boosted the sales. Another example was the development of a complementary Chinese operating system to drive the sales of IBM PS/2s in 1988.

5.3.4 International Expansion and Industrialization

After gaining a foot in the computer component business, Legend was aiming at its ultimate goal of developing, manufacturing and marketing its own computer systems. However, in the late 1980s, the domestic market in China was not big enough for large-scale ventures.⁵⁵ In addition, the Ministry of Electronics Industry, the part of central government that controlled manufacturing of electronics in the country, did not give Legend a manufacturing license. Consequently, the senior management of Legend started an ambitious overseas expansion plan which included three steps:

⁵⁴ Thefreedictionary.com. <http://computing-dictionary.thefreedictionary.com/forward%20engineering>. Accessed July 10, 2005.

⁵⁵ LXZR 1992: 108-9. Referenced in Lu, Qiwen (2000).

1. Form a trading company in Hong Kong;
2. Build an industrial base that would integrate R&D, marketing, and manufacturing;
3. Establish itself as a major concern by going public on the Hong Kong Stock Exchange (HKSE).

5.3.4.1 Step One: The Forming of Hong Kong Legend

The purpose of establishing a trading company in Hong Kong as the first step of Legend's overseas expansion is to accumulate capital and break into market niches. Legend chose Daw, a small computer trading company based in Hong Kong, as a business partner because Daw offered crucial skills in several areas including its familiarity with international marketing, English skills, and knowledge of local customs and culture, all of which complemented Legend's strong technological and manufacturing capabilities and access to a large domestic market in China.

In addition to taking on Daw as a business partner, Legend also courted China Technology, a joint venture among several major Chinese government-backed business concerns in Hong Kong, to be a partner in the new company. China Technology had deep financial pockets and international legal expertise, two strengths that were complementary to those offered by Legend and Daw.

In April 1988, Hong Kong Legend started operations after the existing trading businesses of Daw and Legend (then still called ICT Co) in Hong Kong and China were merged. This marked an important milestone in the history of Legend in that this joint venture opened up international markets to the previously China-centric company.

The complementary strengths of the three joint venture partners demonstrated themselves from the very beginning. To begin, Hong Kong Legend was very successful in generating sales revenues by tapping into both the Hong Kong and Mainland China markets. In fact, in its first year of operation, over 60 % of the sales revenue of Hong Kong Legend was generated from the Mainland market, mainly through distribution channels of Legend.⁵⁶ The enlarged orders (for both markets instead of just one) provided economies of scale, lowering cost and increasing profit margins, as compared with smaller Hong Kong trading firms. In addition, China Technology guaranteed loans which provided crucial financial resources for larger orders.

As a result, Hong Kong Legend was a very profitable and fast growing business. As a matter of fact, the joint venture partners recovered their investment within three months.⁵⁷

5.3.4.2 Step Two: Building an Industrial Concern Abroad

The second stage of overseas expansion started with Legend's acquisition of a small Hong Kong manufacturing plant – Quantum Design Inc (QDI). QDI was a typical small Hong Kong-based manufacturing company managed by owners. It had only a few dozen workers, designing and manufacturing PC motherboards. Legend saw the acquisition as a starting point for the company's entry into PC manufacturing.

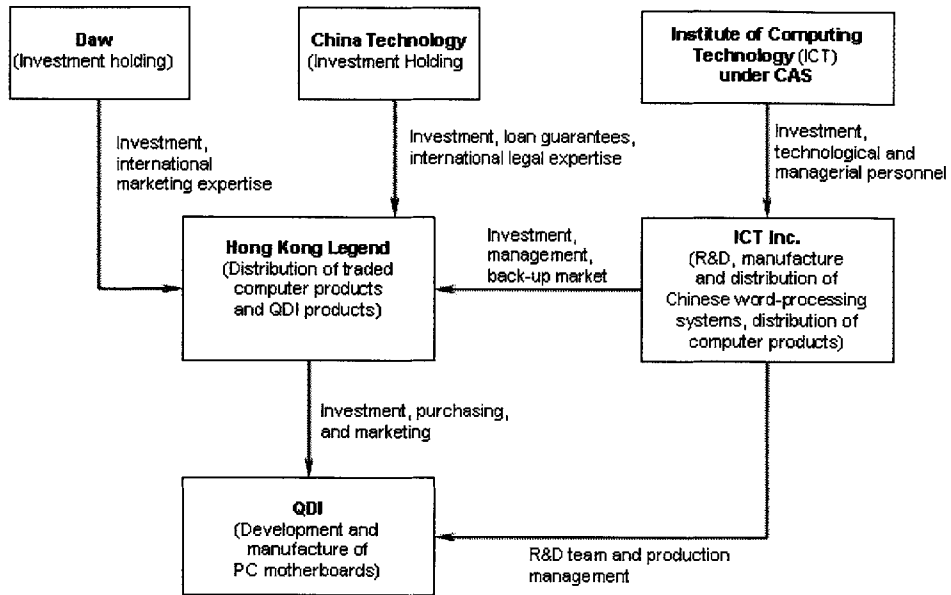
With QDI, Legend adopted the strategy of competing in the low-end of the high-tech products, rather than competing head-on with large international companies in the high-end segments. However, managing production at QDI was not an easy task, and Legend management overcame a number of problems such as high defect rate. After some intensive

⁵⁶ LXZR 1992: 186. Referenced in Lu, Qiwen (2000).

⁵⁷ Based on the financial data from April to Sept. 1988. LXZR 1992: 163. Referenced in Lu, Qiwen (2000).

reorganization effort, Hong Kong Legend finally was able to gain a foot in the world market for PC motherboards, shipping a steady volume of 3,500 per month. Figure 5-1 shows the relationship between QDI and its parent companies.

Figure 5-1 Organizational Relations between ICT Co., Hong Kong Legend, and QDI



Source: Lu, Qiwein (2000): p83

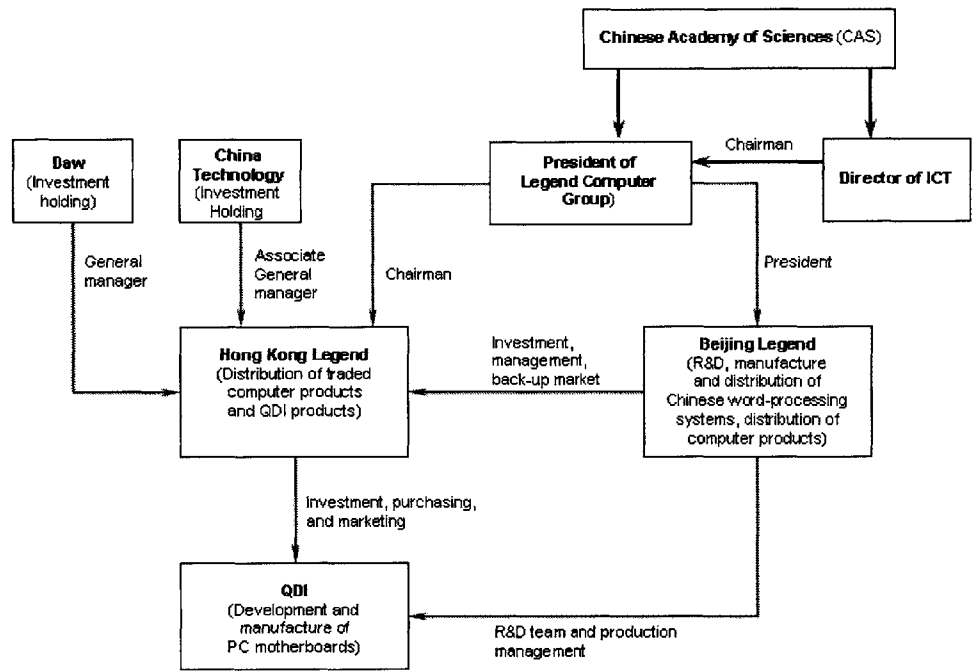
5.3.4.3 Organization Design – Integration of R&D, Trade, and Manufacturing across the Borders

In November 1989, the management decided to reorganize overseas and domestic businesses into a group – Legend Croup Co. – in order to take advantage of the complementary resources spread across the border.⁵⁸ The new organization comprised Hong Kong Legend and Beijing Legend (ICT Co.’s successor) (See Figure 5-2).

⁵⁸ The name of the new group is called Legend Group. Before November 1989, the company in mainland China was called ICT Co. For convenience, I used Legend in many cases where ICT Co. should have been used.

Table 5-3 paints the picture of spatial allocation of R&D, manufacturing, and marketing in the Legend Group. The arrangement took advantage of the complementary assets between the two entities located on two sides of the border.

Figure 5-2 Organizational and Managerial Structure of Legend Computer Group



Source: Lu, Qiwein (2000): p84

Table 5-3 Spatial Allocation of R&D, Manufacturing, and Marketing in the Legend Group

	Hong Kong	China
R&D	R&D and product development	New product testing, Chinese word-processing system and software development
Manufacturing	Pilot production	Large-scale production
Marketing	International sales and purchasing	Domestic sales and services

Source: Lu, Qiwen (2000)

5.3.4.4 From Legend PC Parts to Legend Computers

Building upon its expertise in PC motherboard development and production in Hong Kong, along with a nationwide PC distribution and service network in Mainland China, Legend Group launched its own brand named PCs in China in 1990 as an extension of the development of motherboard and add-on cards. While this move seemed to be the antithesis of international expansion, it made sense for several reasons. First, in the early 1990s, China's domestic PC market was just heating up and Legend's entry into the market injected additional boost to the domestic computer industry. Second, Legend had established its brand as a leader in computer technologies and products in Mainland China, thanks to its flagship Chinese word-processing add-on cards. The brand recognition was an invaluable source of advantage in China in that people would be more receptive to manufacturers with which they were already comfortable. Third, the nationwide sales and service network the company had built through distributing its Chinese word-processing add-on cards and AST computer systems was another asset that Legend could leverage. Fourth, Hong Kong Legend had the capability to design, produce and supply other boards and add-on cards, as well as purchasing other components and peripherals, while in the mean time Beijing Legend had assembly capacity to assemble the parts that came in a semi-knocked-down (SKD) form. In other words, the division of labor between the two Legends made possible the design, manufacturing, and marketing of Legend PCs in a streamlined fashion. Table 5-4 shows how the Chinese PC market as well as Legend's sales grew between 1990 and 1995. By 1993, Legend Group's unit sales surpassed that of Great Wall Group Computer Company, the largest state-owned computer enterprise under the MEI.

Table 5-4 Sales of Legend's PC and its Share of the Chinese Domestic Market by Volume

	1990	1991	1992	1993	1994	1995
Total units sold	85,000	100,000	250,000	450,000	718,000	1,080,000
Legend PCs	2,000	9,000	18,000	27,000	60,000	100,000
Legend's Growth Rate		350%	100%	50%	122%	67%
Legend's share	2.40%	9.00%	7.20%	6.00%	8.30%	9.30%

Source: Lu, Qinwen (*Quantity: Electronics Industry Year book, 1995p:369; Annual Report, fiscal year 1995-6:p14. Total Computers sold in China: see "New Issue prospectus" (Founder): p29. Market share: 1992: "New Issue Prospectus":p23; Annual Report 1995-6:p12.*)

Disadvantages against Large International Corporations

Despite its initial success, its disadvantages against large international corporations such as AST and Compaq were evident. First of all, leading international PC makers possessed significant cost advantage. PC manufacturing is a low margin business in which the bulk of costs go to parts and components while labor represents only a small fraction of the total costs. Because large companies had the economies of scale that enabled them to enjoy deep discounts over parts and components through volume purchases, their unit cost of finished products were lower than that of Chinese PC manufacturers. In addition, the high labor cost of the overseas companies was spread over a larger number of units, leading to lower labor cost per unit. Moreover, the technological capabilities of international PC manufacturers and the quality of their products were far superior compared with Chinese companies. Finally, these international companies had deep financial pockets which enabled them to make investment and withstand crises.

Consequently, PC imports increased at a faster rate than total domestic outputs in the early 1990s, as demand for PCs increased dramatically in China (see Table 5-5). In addition, the Chinese PC makers suffered from declining profits or losses.

Table 5-5 Domestic Production of Personal Computers and Imports in China (units)

	1985	1986	1987	1988	1989	1990	1991	1992
Total domestic outputs	35,700	39,200	47,500	53,300	69,700	80,100	93,400	82,500
Growth rate of total domestic outputs		9.80%	21.17%	12.21%	30.77%	14.92%	16.60%	-11.67%
Imports	18,700	20,400	22,500	26,700	20,300	24,900	111,300	167,500
Growth rate of imports		9.09%	10.29%	18.67%	-23.97%	22.66%	346.99%	50.49%

Source: CCID; see also *'New Issue Prospectus' of Stone: 21-2. Lu, Qiwen (2000)*

Legend "Catching-up"

In spite of Legend's disadvantages, it had a major advantage – its sales and service network – which lowered the entry barrier for the company. After entering the market, Legend gradually developed complementary capabilities in a number of areas, including technology, marketing, and production, across domestic and non-domestic businesses. As a result, it started to gain several competitive advantages. First of all, its four R&D centers in Silicon Valley, Hong Kong, Shenzhen, and Beijing enabled it to keep its product development in line with the world's latest technologies while at the same time enjoying its technological capabilities in China. Second, it used its own inexpensive motherboards and add-ons cards in manufacturing, lowering the cost of the whole system. Third, China increasingly became a major low cost supplier of computer peripherals such as power supplies, cases, and monitors, and Legend was able to source quality parts locally instead of importing them, further lowering the cost of the system.

With low costs in R&D, marketing, production, and services, Legend started enjoying a substantial advantage against its powerful international competitors. For example, in 1994, it enjoyed an above-average margin of 6% while underselling comparable models of AST and Compaq by 10 – 20%. After successfully launching its own brand computers, Legend's sales

jumped from RMB 250 million in 1990 to RMB 680 million in 1991.⁵⁹ In the meantime, Legend brand computers became the highest source of revenue for the computer.

5.3.4.5 Step Three: Going Public

By 1993, Legend had effectively built an organizational structure with the integration of R&D, manufacturing, and trade. The revenues were roughly generated half from manufacturing and half from trade in both domestic and overseas markets. To realize the management's goal of building a big business concern, Legend decided to expand further by converting Hong Kong Legend into a public company and investing the proceeds from the initial public offering (IPO) in new businesses.

In 1994, thirteen years after the twenty-two entrepreneurs from ICT founded the original Legend (ICT Co.), Legend was listed on the Hong Kong Stock Exchange. Legend Holdings Ltd, which included all existing businesses of Hong Kong Legend, authorized one billion shares with 675 million shares issued at IPO. Beijing Legend Group took firm control over the listed company with 38.8% of the stake. Other stakeholders included China Technology and the former owner-managers of Daw. The holding company issued a total of 168,750,000 shares, or 25% of the entire company, to the public at HK \$1.33 per share.

Going public on the Hong Kong Stock Exchange was a major step for Legend in that the group not only raised crucial capital (over HK \$220 million) for further expansion, it also started to enjoy an efficient financial market which was (and still is) not available to most other companies based in Mainland China.

⁵⁹ LXB 93:1. Referenced by Liu, Qiwen (2000).

5.4 Sustaining Competitive Advantage

Porter states that the sustainability of competitive advantage is dependent upon three conditions.⁶⁰ The first condition is the particular source of advantage, i.e. whether the advantage is of lower-order or higher order. Lower-order advantages, such as cheap labor or inexpensive raw materials, are relatively easy to imitate, while higher-order advantages, such as brand recognition, sophisticated supply chain management, and production differentiation based on unique products or services, are more durable. The second condition is that “higher-order advantages usually depend on a history of *sustained and cumulative investment* in physical facilities and specialized and often risky learning.” The third, and most important, condition is that sustaining competitive advantage requires *constant improvement and upgrading*.

In this section, we will discuss some of the steps Legend took to sustain its competitive advantages.

5.4.1 Expansion through Vertical Integration

As we discussed in Section 4.1, manufacturing of add-on cards and motherboards commands the lowest profit margin in the IT industry value chain. The management of Legend certainly realized this fact and decided to seize the markets of the higher margin businesses. In addition to its entry into the complete PC system market, Legend wanted to build upon the low-margin businesses in which it had successfully competed and to expand to higher-margin parts of the value chain.

⁶⁰ Porter, Michael E. *The Competitive Advantage of Nations*: p49 – p51. The Free Press, 1998.

In order to reach the goals, the company needed both a manufacturing base and a distribution channel. On the one hand, Legend's manufacturing facilities in China enjoyed low costs in both labor and raw materials and parts; other the other hand, the company had, over the years, cultivated a worldwide distribution network for large-scale manufacturing products. The two factors helped Legend build up basic resources for entering systems integration and semiconductors on two ends of the value chain in the 1990s.

Systems Integration⁶¹

On the systems integration side, the group acquired a majority stake (80%) in Expert System Solutions, Ltd., a Hong Kong-based company that aimed to offer turnkey solutions in computer information systems to major Hong Kong corporations and institutions. As Mainland China continued to open up and upgrade its IT infrastructure, the business of systems integration became more and more significant. In response to this new opportunity in China, Legend established a wholly owned subsidiary under Hong Kong Legend Holding to target the systems integration market in China. Both the Hong Kong and Mainland China companies were very successful in generating revenues starting from their initial years.

Legend was fully aware of the increasing importance of being able to provide end-to-end solutions and quality services. It responded by establishing a software development center in Shenzhen for customized software, as well as a comprehensive local support network with service centers staffed by a team of more than 250 professionals in eleven major cities across China. In addition, the local knowledge base, particularly the expertise in the development of

⁶¹ In 2001, Legend spun off its system integration business to form Digital China Co. Ltd., which is separately listed on the Hong Stock Exchange.

Chinese language software, was an important advantage that Legend possessed when competing with large international players in the Chinese market for systems integration.

Semiconductor

In order to backward integrate into semiconductor, Legend needed to build a manufacturing base with the capabilities of large-scale manufacturing products. The first step was to expand into printed circuit board (PCB) production with a minimum profit margin of 15%, compared with the industrial average of 2.5% in motherboards and add-on cards. In the past, Legend had used the so-called “reservoir method of production,” by which contract manufacturing was used to meet increasing market demand for its motherboards and add-on cards. With an increased number of clients, and with the financial resources from its IPO, the company decided to expand and upgrade its production capacity. The most notable move in this direction was the acquisition of a 71,830 square-meter industrial site and building, the Legend Science and Technology Park in Huiyang, China, as city near Shenzhen and Hong Kong, for HK \$108 million. After the acquisition, Hong Kong Legend injected HK \$15 million to upgrade and expand its production facilities. By 1995, the group had twenty-one fully automated surface mounting technology (SMT) production lines. Subsequently, Legend moved its PC motherboard and add-on card production operation from Shenzhen to the park, in order to achieve a better economy of scale and a higher level of product quality through centralized manufacturing.

PCB production requires large initial investment and is subject to market uncertainty, resulting in high barriers-to-entry. However, as the production volume of PC add-on cards and motherboards increased rapidly, the internal demand for PCBs was then large enough to consume a large portion of in-house-produced PCBs, providing a basis for the backward

integration and reducing investment risks. A new subsidiary, Huiyang Techwise Circuit Co., Ltd. Inc was set up in China in early 1994. Legend invested RMB 47 million to build the PCB manufacturing facility. The bulk of the PCB products were for in-house use while a portion of high-end, multi-layer products were sold to Legend's long-term business clients.

In addition to PCB products, the group in the mid-1990s also indicated its intention to enter the large-scale integrated circuit (LSIC) semiconductor chip business, which presented the highest level of technology in the global IT industry. It subsequently launched its self-designed ASIC semiconductor chips for multiple I/O cards and VGA cards, and forged a partnership with Valence, one of the few local semiconductor design companies in Hong Kong with ten years of experience in designing chips for international companies.

Table 5-6 lists some of the major investment activities of Hong Kong Legend Holdings, Ltd. after its IPO.

Table 5-6 Major Investment Activities of Hong Kong Legend Holdings, Ltd.

Areas of investment	Name of Business	Location	Legend's Holding (%)	Investment (millions)
Systems Integration	Expert System	Hong Kong	80	HK \$1.2
Motherboard Manufacturing	Huiyang Legend Computer Co., Ltd.	Huiyang	90	RMB 8
Industrial park	Legend Science Park	Huiyang	100	HK \$108
PCB manufacturing	Techwise Circuits Co., Ltd	Huiyang	75.5	RMB 41
Semiconductors	Valence Holding, Ltd.	Hong Kong	70	HK \$2.1

Note: The exchange rate of Chinese RMB to HK \$ was about 1.1 to 1 in 1995-6.

Source: Lu, Qiwen (2000); *Company Annual Reports 1994-5; 1995-6.*

5.4.2 Product Diversification

In addition to vertical integration in order to enter higher-margin markets in the IT value chain, Legend also expanded its product offerings horizontally. In 1997, the group launched its first multi-function laser printer. In 2002, Legend's supercomputer, the DeepComp 1800 made its debut, becoming China's first computer with 1,000 GFLOP (floating point operations per second) and China's fastest computer for civilian use and ranking 43rd in the Top 500 list of the world's fastest computers. In the same year, Legend announced the establishment of a mobile handset joint venture, marking its formal entry into the mobile handset business.⁶² Other products also include digital camera and computer monitors, among others.

5.4.3 Other Activities

In addition to its product expansions both vertically and horizontally, Legend also initiated other activities that helped it sustain its competitive advantages. To begin, it announced the birth of its new "Lenovo" logo to prepare for its expansion into the overseas market in 2003.⁶³ As we discussed before, brand recognition can be a higher-order advantage that is durable. Legend had been a high-valued brand name in China but it was not an internationally recognized one. By introducing the Lenovo brand to the overseas market, its marketing effort paid off.⁶⁴ Furthermore, the group's \$1.25 billion acquisition of IBM PCD made much buzz and effectively established the brand name internationally.

In 2004, Lenovo became an Olympic worldwide partner and it was the first Chinese company to become a computer technology equipment partner of the International Olympic

⁶² Company website. *Lenovo – About Lenovo, history and timeline.*
<http://www.pc.ibm.com/us/lenovo/about/history.html> accessed on July 16, 2005.

⁶³ Company website. *Lenovo – About Lenovo, history and timeline.*
<http://www.pc.ibm.com/us/lenovo/about/history.html> accessed on July 16, 2005.

⁶⁴ I will refer to the computer as Lenovo from this point on.

Committee.⁶⁵ This is an excellent marketing and sales opportunity which would not only help Lenovo to expand its market recognition worldwide but also potentially generate additional revenues for the company.

In 2005, Lenovo established a new Innovation Center in Research Triangle Park, N.C., to enable customers, business partners, solution providers and independent software vendors to collaborate on new personal computing solutions.⁶⁶ This investment marked a new step in the company's growth history, in that it signals the management's willingness to accept the significant importance of research and development, and innovation.

5.5 Summary

Lenovo has become one of the most successful Chinese companies since the Chinese government began its economic reform in 1978. It started as an "institution-run" company with an initial capital of RMB 200,000, and grew into a multi-billion-dollar, multi-national concern as it exists today. There are a number of success factors contributing to the growth of the company.

First of all, the company had direct access to the technologies developed at ICT, one of the top computer science technology institutions in the country. Unlike many other Chinese manufacturing companies that focused narrowly on the lower end of the value chain – low cost manufacturing, Lenovo developed its own products from the very beginning. Its dedication to research and development contributed to its leadership in the computer industry in China. By the

⁶⁵ Company website. *Lenovo – About Lenovo, history and timeline.*
<http://www.pc.ibm.com/us/lenovo/about/history.html> accessed on July 16, 2005.

⁶⁶ Company website. *Lenovo – About Lenovo, history and timeline.*
<http://www.pc.ibm.com/us/lenovo/about/history.html> accessed on July 16, 2005.

same token, this factor would be a major competing point as Leveno ventures into the league the world's top PC manufacturers with its acquisition of IBM PCD in 2005.

Unlike most of the other state-owned enterprises or institution-run companies, Lenovo enjoyed the benefit of managerial autonomy. The company management was able to make decisions such as fiscal budgeting and employee recruitment based on business and economics rather than politics. This freedom essentially cut the red tape, and more efficiently moved the company forward.

Over the years, Lenovo has built a far-reaching distribution, sales, and support network. For instance, it currently has an extensive nationwide PC distribution network that comprises about 3,600 distributions and 4,400 retail outlets.⁶⁷ This network was undoubtedly necessary for Lenovo to effectively reach out its customers and enhance the sales of its products.

As the company expanded internationally, it re-organized and integrated its domestic and overseas operations to take advantage of the complementary capabilities across the border in the late 1980s. This new structure enabled the management to allocate resources and co-ordinate various activities much more effectively with a global perspective.

Lenovo has established a manufacturing base with efficient management of various costs such as labor and raw materials, essentially increasing profit margins on its products. Today, its labor costs are \$3 per desktop PC, among the lowest anywhere, helping drive its operating

⁶⁷ Lenovo Presentation by a Vice President to MIT Sloan LFM and SDM students. Beijing, May 23, 2005.

expenses to less than 9% of revenues, half the average for the computer hardware business and about the same as Dell's.⁶⁸

The company has built itself a valuable brand name with quality products and services. It is believed to be the Number One IT brand and the Number Three most valuable brands in general in China, and it is ranked Number One in seventeen categories in an IT customer satisfaction survey in 2004.⁶⁹ In 2003, it recreated its brand in the international market, with the introduction of the name "Lenovo." A highly recognized brand is a long and lasting source of competitive advantage.

Finally, Lenovo has effectively leveraged its product design capability to roll out its PC products that exceed customer expectation (for example, integrated media PC operating system) as well as tailor-make products to target various customer segments.⁷⁰

Next Step

Despite its success, Lenovo faces several challenges. To begin, Lenovo faces tough competition from the world's leader in PC manufacturing – Dell Inc. – both domestically and internationally. Dell's success as the Number One PC maker can be attributed to its operation efficiency on two fronts: its purely direct-sales approach and build-to-order efficiency. After the acquisition of IBM PCD, Lenovo must quickly create synergies between the two and increase efficiency in supply chain management because IBM PCD traditionally had higher operating expenses than Lenovo and Dell. In addition, Lenovo should take advantage of its knowledge in

⁶⁸ Roberts, Dexter and Lee, Louise. "East Meets West, Big-Time: Lenovo's deal for IBM's PC unit led to a merger of talent – and a threat to Dell," *Business Week*, May 6, 2005. McCraw-Hill Companies, Inc.

⁶⁹ Lenovo Presentation by a Vice President to MIT Sloan LFM and SDM students. Beijing, May 23, 2005.

⁷⁰ Lenovo Presentation by a Vice President to MIT Sloan LFM and SDM students. Beijing, May 23, 2005.

developing countries to offset Dell's efficiency in direct sales, for many customers in those countries do not have credits or do not like to purchase products without seeing them. In other words, it should use its local knowledge to its advantage.

The next challenge Lenovo faces is to integrate Lenovo and IBM PCD. Integration will include a number of areas, such as supply chain, manufacturing, and distribution, among others. However, the cultural differences between the two entities are abysmal while other differences exist. JP Morgan predicts that it could be challenging for the combined company to reach the \$200 million procurement savings goal for two reasons: first, quality differences exist in component suppliers; and second, there are not meaningful savings from the notebook processors and commodities such as DRAM and TFT-LCD.⁷¹ The new management must tackle the issue of integration with highest priority, although it would be an uphill battle. Processes need to be in place to streamline the integration efforts.

Although Lenovo acquired both the technological capabilities and brand name from IBM, it would not be easy to make existing IBM PCD customers to accept Lenovo the same way as IBM. In order to keep the existing IBM customers, Lenovo must make sure that its new products would not only be of the same quality as (or exceed) the existing IBM products but also provide extra value to these customers.

In the long run, Lenovo must continue to innovate in order to stay in a leadership position in the industry. Because PC hardware is a commodity, Lenovo needs to become more than a low cost manufacturer. It should continuously innovate and roll out new ideas, new approaches, and new products in order to sustain its current competitive advantages. It should also spend more in

⁷¹ Asia Pacific Equity Research at JP Morgan. "Lenovo Limited: Big Drag from IBM PCD Acquisition despite Exciting Growth from China." June 7, 2005.

R&D bring itself on par with leading U.S. companies. The absorption of IBM's technological capabilities does provide a unique opportunity in that IBM is known to be a leader in technology and innovation. But there are other avenues to pursue. For one thing, China has consistently graduated more engineers from colleges and universities than the U.S., Japan and Germany combined every year since 1997, according to figures collected by the National Science Foundation in Washington.⁷² Lenovo could tap into these valuable human resources to further enhance its technological capabilities. In addition, it could also take advantage of the U.S. based R&D centers to stay on top of the latest technological trends and breakthroughs.

⁷² JS Online: "China Engineers its Next Leap." December 30, 2003.
<http://www.jsonline.com/bym/news/dec03/196593.asp>

6 CASE STUDY: HUAWEI TECHNOLOGIES

"With our customers and cooperators, we endeavor to bring better communication services to more people, and help them live a better life."

- Sun Yafang, Chairperson of the Board, Huawei Technologies Co., Ltd.

Established in 1988, Huawei Technologies is a privately owned high-tech enterprise which provides customized network solutions for telecom carriers worldwide. It specializes in R&D, production, and marketing of communications equipment, and its products and solutions have served 300 telecom carriers around the world in over 90 countries, including 22 of the world's top 50 operators.⁷³ In 2004, Huawei's revenues increased 42% to \$3.8 billion, and its contracted sales reached \$5.58 billion, an increase of 45% over the last year. In addition, its international sales have been doubling every year since 2000, achieving \$2.28 billion in 2004.⁷⁴ Table 6-1 shows some financial highlights between 2000 and 2004.

Table 6-1 Huawei Financial Highlights: Huawei Technologies Corporation and Subsidiary Companies.

Year Ended December 31	US\$ millions				
	2004	2003	2002	2001 (*)	2000
Revenue	3,827	2,694	2,128	2,290	1,933
Net Income	624	384	108	258	345
Cash Flow From Operations	396	385	311	204	255
Operating Profit Margin	18%	19%	10%	17%	24%
Return on Net Assets	31%	23%	7%	20%	47%

Note: (*) Excluding discontinuing operations.

Source: *Corporate Website*

⁷³ Corporate Website of Huawei Technologies. "About Huawei."

<http://www.huawei.com/about/AboutIndex.do?webColType=abouthuawei> accessed July 17, 2005.

⁷⁴ Huawei Annual Report: 2004.

Huawei currently employs 24,000 people, of which about 48% are engaged in R&D.⁷⁵ The company has six research centers across the country including Beijing, Shanghai and Nanjing, and facilities in the US, Russia, India and Sweden. It is the 6th largest electronics company in China in terms of revenue and the largest in profit.⁷⁶

The company makes a wide range of products that include fixed network, mobile network, data communications, optical network, software and services, and terminals.⁷⁷ Its major products are listed in Table 6-2. It has become a leading vendor in the industry and, in the domestic market in terms of market share, Huawei is currently Number One in digital switches and next generation network (NGN), Number Two in ADSL broadband and Number Three in optical network (RHK).⁷⁸ Internationally, it holds leading positions in areas of 3G (it is the one of the few vendors in the world to provide end-to-end 3G solutions), NGN, switching, xDSL, optical network and data communications.⁷⁹

Table 6-2 Huawei's Major Products

Product Category	Major Products
Central office	C&C08; iNET
Transmission	OptiX series (cross connect, SDH, DWDM, SMTP, multiple STM systems, flexible access and NMS)
Data communications	ATM switch; routers; VoIP series
Networking equipment	Quidway NetEngine routers (80/40/16 series); Quidway S8000/6500/5000 series
Broadband switch and access systems	DSLAM: SmartAX
Mobile systems	GSM900/1800; GPRS; CDMA (IS-95A, 2000, 450); WCDMA
3G handsets	U326; U626/636; E612/620; E600 (data card)
PHS handsets	A316, A516, A526, A528, A616, A628
Trunked Radio	GT800
Intelligent network	TE-11 IN
Wireless local loop	ETS 450 WLL
OSS	STPs; SynLock

⁷⁵ Wikipedia. <http://en.wikipedia.org/wiki/Huawei>, accessed July 17, 2005.

⁷⁶ ChinaNex. "Huawei Technologies." <http://www.chinanex.com/company/huawei.htm>, accessed July 17, 2005.

⁷⁷ Wikipedia. <http://en.wikipedia.org/wiki/Huawei> accessed July 17, 2005.

⁷⁸ Wikipedia. <http://en.wikipedia.org/wiki/Huawei>, accessed July 17, 2005.

⁷⁹ Corporate Website of Huawei Technologies. "About Huawei."

<http://www.huawei.com/about/AboutIndex.do?webColType=abouthuawei>, accessed July 17, 2005.

Call center	INtess; SMS center: INtess-SMAX-11
Videoconferencing	ViewPoint 8000

Source: ChinaNex. "Huawei Technologies." 2005.⁸⁰

6.1 Technology Strategy

6.1.1 First Product Breakthrough

Many analysts believe that Huawei's first major technological breakthrough was the launch of C&C08, a switching system used in large PBXs (communications systems that consist of switching centers and their interconnecting media), in 1994. The development of C&C08 started in 1992, the year in which Huawei's sales reached RMB 100 million for the first time with a net profit of around RMB 10 million.⁸¹ In 1992, the real estate market and the stock market had just started heating up, and many companies and individuals forayed into these markets to make a quick fortune rather than focusing on their core business fundamentals.

Ren Zhengfei, founder and CEO of Huawei, who was a former officer at the China People's Liberation Army, did not join the "gold rush." Instead, he dedicated RMB 100 million to the development of the C&C08 switching product. In an article that Ren wrote years later, he recalled his rationale behind the move that many called "outrageous."⁸² Soon after the dawn of the economic reform in China, many Chinese companies partnered with foreign corporation and formed joint ventures in order to attract foreign investment and import advanced technologies from overseas. A byproduct of this strategy, Ren said, was loss in market shares to foreign competitors. He believed that Chinese firms should invest in the development of their domestic technological capabilities and products. He set his firm's strategy from very early on that Huawei would build its business upon its own research and development, while closely

⁸⁰ ChinaNex. "Huawei Technologies." <http://www.chinanex.com/company/huawei.htm>, accessed July 17, 2005.

⁸¹ Chen, Dongshen and Liu, Lili. *The Truth of Huawei*. Dang Dai Zhong Guo Press. 2004.

⁸² Chen, Dongshen and Liu, Lili. *The Truth of Huawei*. Dang Dai Zhong Guo Press. 2004.

following the latest technological trends in the world. His goals were to dominate the domestic market, expand to the overseas markets, and compete aggressively with international players.

While developing C&C8, Huawei also developed a technology based on synchronous digital hierarchy (SDH), which used fiber optics to connect to PBX systems instead of using traditional cable. Because fiber optics had way more capacity than traditional cable, Huawei's product tremendously lowered the costs of extending telecommunications services to the rural areas, where 80% of the Chinese population lived. In addition, Huawei also designed wireless telecommunications equipment which complemented wired equipment. These products opened up its rural markets and established a basis for Huawei to expand to the urban markets.

After 15 years of development, the C&C08 switching system has been widely used as tandem exchange, gateway exchange, local exchange, and toll exchange. According to a report by Dittberner, a global telecommunications consultancy, C&C08 has been used in more than 50 countries and total worldwide application had reached 160 million ports. In 2004, Huawei deployed 20 million ports, taking 32% of the market share of globally installed ports from 2001 to and ranking Number one in the world.⁸³

6.1.2 Establishment of the Beijing Research Institute

The establishment of the Beijing Research Institute in 1994 dedicated to digital telecommunications was a major milestone in Huawei's corporate history, for it differentiated Huawei from most other privately-owned enterprises in China which mainly focused on labor-intensive industries. Huawei ventured into the technology-intensive and capital intensive

⁸³ Corporate Website. "Switching Network."
<http://www.huawei.com/products/ProductView.do?docId=D00000002022> accessed July 17, 2005.

telecommunications market with high barriers to entry which locked out many other private companies due to their lack of financial resources. Although the institute did not produce any major breakthroughs between 1995 and 1997, Ren was very supportive and invested over RMB 800 million every year in R&D. People in the industry were particularly impressed by Ren's dedication to R&D because Ren made the investment notwithstanding the financial restraints in the company.

6.1.3 From Follower to Leader

In its early years, Huawei was a technological follower which imitated and followed the existing technologies and products of international leaders. Ren elaborated in one of his writings that the difference between a follower and a leader in the technology arena is that followers jump on, and take advantage of, market opportunities while leaders create new market opportunities to induce consumer spending.⁸⁴

Determined to become a technology leader in telecommunications equipment, Ren has been consistently spending 10% of the revenue every year on R&D to bring the company on par with the multinational high-tech companies like IBM and HP. Taking advantage of the China-based cost-effective R&D, the company has, over the years, built a complete core technology system for system architecture, hardware, software and chips, and a demand-driven R&D mechanism that “translates real demands into telecom technologies and solutions.”⁸⁵

⁸⁴ Chen, Dongshen and Liu, Lili. *The Truth of Huawei*. Dang Dai Zhong Guo Press. 2004.

⁸⁵ Corporate Website: “Research and development – Welcome to Huawei.”
http://www.huawei.com/about/AboutListDoc.do?webColType=abouthuawei&root_id=ROOT|C233|C425|C442&doId=ROOT|C233|C425|C442|C956 accessed July 17, 2005.

Huawei actively involves multi-national leading players such as Motorola, IBM, Qualcomm, Microsoft, and TI in its R&D activities. The international cooperation and partnerships speed up the company's response to market change, helping it draw up advanced technologies as well management experiences from a global perspective.⁸⁶

6.1.4 Huawei R&D Management Model⁸⁷

Through the Marketing-PMT-IPMT organization operation, Huawei resolved the product planning predicament and the problems of deficient business decision-making. It shifted from relying on individual performers to the entire management to launch high-quality products. Moreover, the company has built a technical sharing system at all levels ranging from system, platform, module, and components by using Common Build Block (CBB). On the software side, the company has practiced Capability Maturity Model (CMM) for 7 years and has set up a set of mature large-scale software engineering quality management systems. It promotes standardized, modularized, and platform-specific management, and all its software development departments are CMM5-certified. In addition, Huawei has introduced the core concepts of CMM into the hardware quality management system. By simplifying the systems and organization, and with the asynchronous development method, Huawei R&D coordinates the development progress at all levels, shortens the time-to-market of products, and speeds up the response-to-market.

6.1.5 3G Ambition

⁸⁶ Corporate Website: "Research and development – Welcome to Huawei."
http://www.huawei.com/about/AboutListDoc.do?webColType=abouthuawei&root_id=ROOT|C233|C425|C442&docId=ROOT|C233|C425|C442|C956, accessed July 17, 2005.

⁸⁷ This subsection is based on Corporate Website: "Research and development – Welcome to Huawei."
http://www.huawei.com/about/AboutListDoc.do?webColType=abouthuawei&root_id=ROOT|C233|C425|C442&docId=ROOT|C233|C425|C442|C956, accessed July 17, 2005.

Forging partnerships with about 40 foreign companies including 3Com, Motorola, and Siemens, Huawei has been making inroads into the 3G mobile phone network market.⁸⁸ It not only offers 3G wireless infrastructure products, but it entered the 3G handset business in December 2004. Its ambition, backed up by its R&D spending, will potentially make Huawei a big player in the 3G space.

6.2 Marketing and Sales Strategy

6.2.1 Pricing

It is often believed by Huawei's international competitors such as Cisco that Huawei's biggest competitive advantage is its unfair pricing model that sells products at or slightly above costs and its ability and willingness to wage price wars. Huawei, like many other new entrants in a market, does engage (and has engaged) in price wars. Its principles are: Huawei would engage in a price war if (1) its product, customer relations, and brand name are similar to those of its competitors but it has weaker market power; (2) it wants to lower a competitor's profit margin in order to eliminate the newcomer; or (3) there is a significant technological breakthrough and it tries to force the industry to adopt the new technology.⁸⁹

There are two types of price wars that Huawei engages in. They can be categorized as "defensive wars" and "offensive wars." In a defensive price war, Huawei uses low price to lock new competitors out of the market. In an offensive price war, the company uses low price to aggressively cut the incumbent's profit margin, eventually finding a way into the market. In a price war, the corporate often reallocates financial resources and subsidizes the division that is engaged in the price war.

⁸⁸ Red Herring. "China's Secret Weapon." Print Issue, January 24, 2005.

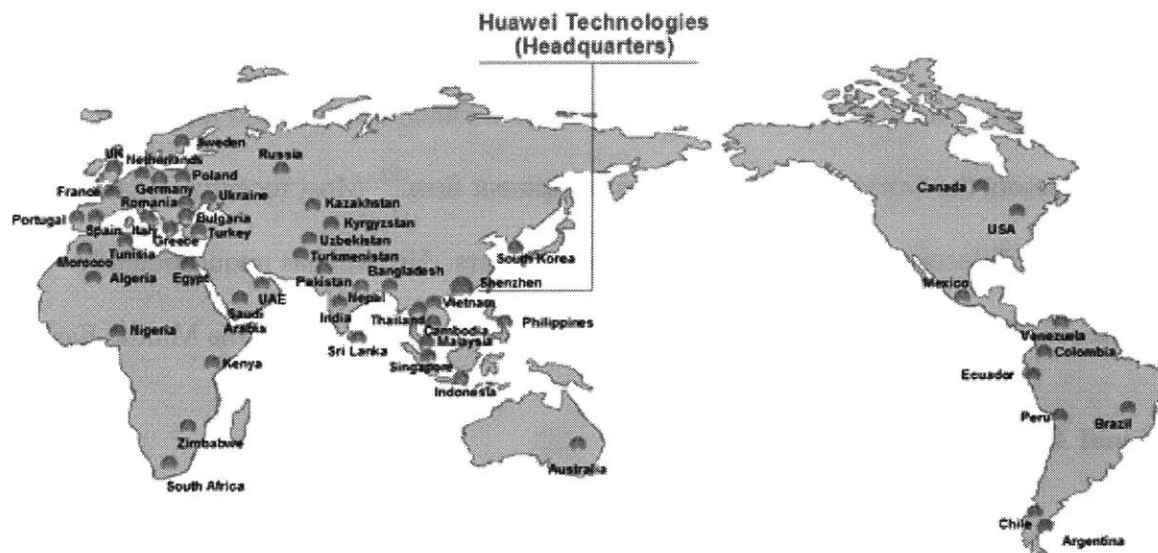
⁸⁹ Chen, Dongshen and Liu, Lili. *The Truth of Huawei*. Dang Dai Zhong Guo Press. 2004.

6.2.2 Corporate Image

It is reported that Huawei is never stingy when it comes to spending that could enhance its corporate image. For example, it has spent hundreds of millions of RMBs building facilities and renting expensive office spaces. It also outspends its competitors at trade shows and other marketing events. Its corporate principle on profit margin is not all about profit maximization; rather, the company sets profit goals that are reasonable, considering the growth needs of company. Thus, although spending millions on building corporate image cuts into the company's profit, the management believes that the spending is necessary to promote better customer relations.

6.2.3 Worldwide Sales and Services Network

Figure 6-1 Huawei Global Sales and Services Network



- 8 regional headquarters, 55 branch offices outside China.
- 3-level customer service system (HQ, regional, local).
- Products have been deployed in over 90 countries and regions.
- 22 of the world's top 50 operators are using Huawei's products and solutions.

Source: *Corporate Website*.

Huawei has built a worldwide sales and services network that includes 8 regional headquarters and 55 branch offices outside China (see Figure 6-1). Its global service platform helps the company to work closely with customers and respond faster to customer requirements.

In a report carried out by Heavy Reading, a market-research firm, based on a survey of over 100 telecoms operators worldwide, Huawei ranked 4th in service and support.⁹⁰

6.3 International Expansion

When it first entered the international market, Huawei, like many other Chinese companies, targeted low end market segments. But it almost immediately switched to high end market segments. Currently, Huawei's brand is recognized by many telecomm operators in Europe. For example, Pfalzkom and Berlicom in Germany successfully deployed Huawei's STM65 fiber system in their networks in 2000.⁹¹ In December 2004, the company won an estimated \$100 million contract to build a 3G wireless network for Telfort, a Dutch operator and long time customer of Ericsson, the world's largest telecoms equipment firm.⁹² Most recently, Huawei was selected by British Telecom as one of the eight major suppliers. Huawei has unquestionably become a telecom giant in Southwest Asia, Africa, Latin America, Russia, and the Middle East.⁹³

International Advantage

⁹⁰ The Economist. "See Huawei Run." Print Issue. March 3, 2005.

⁹¹ Chen, Dongshen and Liu, Lili. *The Truth of Huawei*. Dang Dai Zhong Guo Press. 2004.

⁹² The Economist. "See Huawei Run." Print Issue. March 3, 2005.

⁹³ Red Herring. "China's Secret Weapon." Print Issue, January 24, 2005.

The first and most obvious competitive advantage of Huawei vis-à-vis its international competitors is its low cost manufacturing and efficient supply chain management system.⁹⁴ Its products cost about 70 % of those produced by Cisco, according to Zhang Bin, who was Cisco's second-largest distributor in China between the 1990s and most recently. Zhang said that Huawei would even go out of the way to offer a deeper discount than 30% or financing to the buyer in order to sell its products.⁹⁵ In January 2005, for example, Huawei won a \$187 million order for a 3G network in Thailand, beating Ericsson and Motorola with a bid 46% lower than the operator's original estimate.⁹⁶

A perhaps more formidable advantage of Huawei is its low cost in R&D activities. During a presentation by John Morgridge, Chairman of Cisco, he was asked about the challenges presented by the competition from Huawei. Morgridge emphasized that Huawei's advantage lied in its business model, i.e. selling at or below costs.⁹⁷ However, his comments ignored a unique advantage at Huawei – low cost R&D. Huawei has over 14,000 employees in R&D and their wages are one-fifth to one-fourth of those of comparable employees at American companies. For example, a particular type of chip used to cost \$200 to import, but now it costs \$10 with Huawei's own design. In fact, Huawei's operating profit margin was 18% in 2004 and 19% in 2003, not significantly low, although it is 10 points behind Cisco whose operating margin is around 29%.

Low development costs in core technologies will be a killer strategy for Huawei to win international competition. Even though multi-national companies like Cisco move their

⁹⁴ Corporate Website. "Management Systems – Welcome to Huawei." http://www.huawei.com/about/AboutListDoc.do?webCoIType=abouthuawei&root_id=ROOT|C233|C425|C442&docId=ROOT|C233|C425|C442|C957, accessed July 30, 2005.

⁹⁵ Red Herring. "China's Secret Weapon." Print Issue, January 24, 2005.

⁹⁶ The Economist. "See Huawei Run." Print Issue. March 3, 2005.

⁹⁷ Visit to Cisco by MIT Sloan Student. MIT Sloan Silicon Valley Trek. January 4, 2005.

manufacturing operations to lower cost-countries like China, they will not likely mitigate the high cost of R&D. In addition, as Chinese companies like Huawei gain economies of scale in supply chain and manufacturing, the international incumbents will face an uphill battle in defending their existing market positions.

U.S. Expansion yet to Bear Fruit

Huawei is also ambitious in the US market. As early as 1993, Huawei established a chip research center in the Silicon Valley. In 1999, like many other large international high-tech firms, Huawei opened up a research center in Dallas, TX that is devoted to developing products targeted at the U.S. market. In 2002, Huawei set up a wholly-owned subsidiary, FutureWei, in Texas to sell broadband and digital equipment. Huawei believes that entry into the U.S. market, where competition is the strongest in the world, will mark true internationalization of the company.

However, its U.S. strategy has yet to bear fruit in that it must overcome a number of challenges. First of all, its lack of experience in marketing has hitherto prevented it from building brand recognition in the U.S. For instance, its introduction of a new name in the U.S. – FutureWei – confused its customers. In addition, the cultural gap between the local executives in Dallas and the headquarters in Shenzhen, China, is abysmal. Moreover, the company has been laden with charges of intellectual property rights violations, which has adversely affected its corporate image in the U.S.⁹⁸

⁹⁸ Wall Street Journal. Rhoads, Christopher and Buckman, Rebecca. “Trial and Error – A Chinese Telcom Powerhouse Stumbles on Road to the U.S.” July 28, 2005.

Unlike the markets in developing countries, U.S. customers look at more than just the prices for telecom equipment. For one thing, vendors in the U.S. often have long-standing ties with their clients, and leading-edge technology and product quality are just as important as a good price.⁹⁹ In some customers' eyes, such as those of Tillman Rodabough, the director of commercial networks at Telepak, Huawei's products are not yet the best in the industry.¹⁰⁰ As a result, Huawei has not secured any deals with major telcos in the U.S. such as Bellsouth and SBC Communications.

6.4 Summary

Like Lenovo, Huawei is another successful China-based company that has entered the world stage. Unlike Lenovo, Huawei is a privately-owned company and so far it has not gone public. Its success to date owes to a number of factors.

To begin, Huawei is dedicated to research and development. It spends 10% of the total annual sales on R&D, and hires 14,500, or 48% of the work force, in the R&D department. While arguably Huawei still trails leading companies like Cisco and IBM in terms of technological innovation, its cost advantage in R&D activities cannot be ignored. The implications of such advantage can be two folded. First, because low-cost advantages are mostly lower-order ones which can be easily imitated by competitors, sooner or later major players will be able to lower costs to similar levels in manufacturing and supply chain management by moving these operations offshore. As a result, R&D costs will be a major differentiator among competitors. Second, R&D activities can lead to enhanced technological capabilities and

⁹⁹ Wall Street Journal. Rhoads, Christopher and Buckman, Rebecca. "Trial and Error – A Chinese Telcom Powerhouse Stumbles on Road to the U.S." July 28, 2005.

¹⁰⁰ Wall Street Journal. Rhoads, Christopher and Buckman, Rebecca. "Trial and Error – A Chinese Telcom Powerhouse Stumbles on Road to the U.S." July 28, 2005.

innovation can create new market opportunities. Considering these two factors, it is not difficult to see the importance of the low cost advantage in R&D.

Next, not only does Huawei have an advantage in R&D costs, it has also built a flexible supply chain which provides fast, high-quality and cost-effective supply. It has flattened manufacturing organizations that can meet market demand efficiently and flexibly. These efforts help control both the costs and the quality of Huawei's products, giving the company another competitive edge.

Moreover, Huawei has been successful in playing the pricing game. It has never hesitated to wage a defensive war to keep a new entrant out of the market or an offensive one to find its way into a market. It often subsidizes a particular product engaged in a price war by reallocating financial resources at the corporate level. The strategic importance of the price wars cannot be overemphasized. Despite its competitive low prices, Huawei was able to enjoy an operating profit margin of 18% in 2004 and 19% in 2003.

Finally, Huawei successfully entered the international market with sales doubling since 2000 to reach \$2.28 billion in 2004. Now it has become a major international player and a major source of headache among top managers at its major competitors.

Next Step

In order to rise to the Number One position in the world vis-à-vis international leaders such as Cisco and Actel, Huawei must behave like a global leader. First of all, it must respect intellectual property rights (IPR) at all time. In January 2003, Cisco filed a law suit in U.S. District Court for the Eastern District of Texas, claiming that Huawei violated at least five of the

company's patents and copied Cisco's Internetwork Operating System source code.¹⁰¹ In addition, Cisco alleged that Huawei copied its technical documents, including user manuals, its command line interface and its screen displays. Although Cisco ended the lawsuit after Huawei agreed to abide by an agreement and made changes to several of its router and switch products, Huawei must make sure that it will no longer violate IPR and that all its technologies are either developed in house or obtained legally. As Huawei's R&D capabilities catch its international rivals, it will eventually find it important to protect its own IPR. Until then, it should first respect other people's rights.

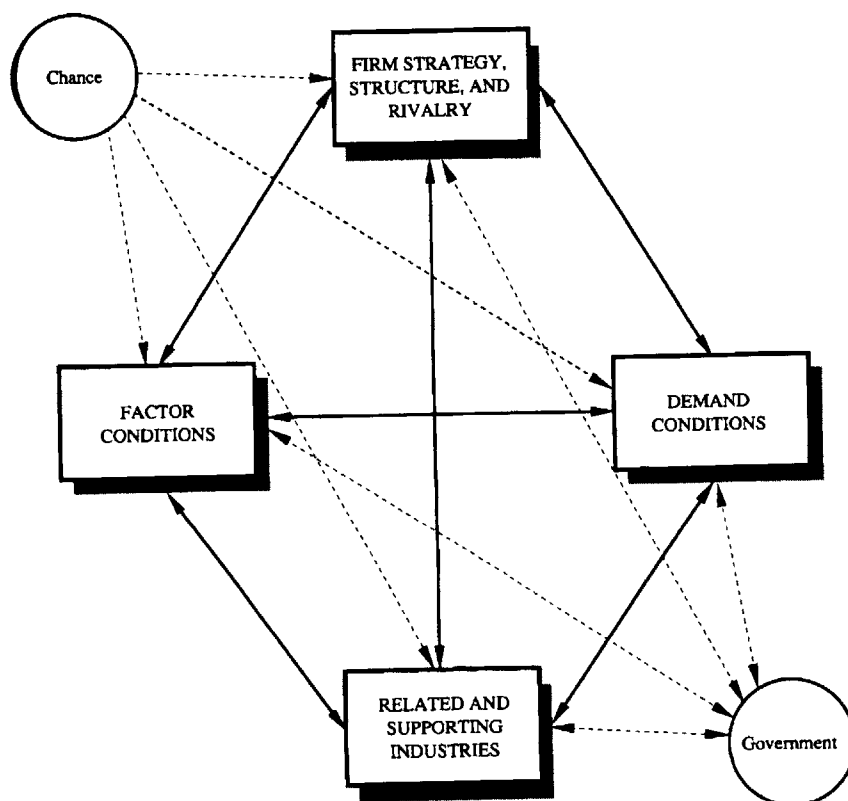
It should continue to invest in R&D and encourage innovation. As I mentioned in the Lenovo discussion, China produces more engineers than the US, Japan, and Germany combined each year. Huawei should continue to tap into this resource. Further, Huawei should hire more industry experts from outside China to design R&D processes and make innovation possible at Huawei. Innovation will not only differentiate Huawei from other Chinese players, but also make Huawei's competitive advantages sustainable. Finally, Huawei must overcome the challenges it faces in the U.S. market. It needs to not only hire more local marketing talents, but also be more open-minded and sensitive to the American culture.

¹⁰¹ Hines, Matt. "Cisco, Huawei Suspend Patent Law Suit." Cnetnews.com. October 1, 2003.

7 THE COMPETITIVE ADVANTAGE OF CHINESE HIGH-TECH INDUSTRIES

In this Chapter, I will use Porter's "diamond" framework to discuss the competitive advantage of Chinese high-tech industries. As mentioned earlier, due to the limited scope of this thesis, my discussion will be restricted to the IT industries (see Chapter 4 for more detailed explanation). Figure 7-1 is Porter's "diamond" framework.

Figure 7-1 The Complete "Diamond" System¹⁰²



Source: Porter, Michael E, *The Competitive Advantage of Nations* (1998):p127

7.1 Factor Conditions

¹⁰² Source: Porter, Michael E. *The Competitive Advantage of Nations* (Edition with Porter's Introduction). The Free Press, New York, 1998.

Unskilled and Semi-skilled Labor

Thanks to its large but under-employed population, China enjoys the abundance of low-skilled, low-cost labor. In fact, the country has become one of the largest manufacturing bases in the world. There is no doubt that China has an enormous advantage in labor costs, which has become a hot topic around the world. However, this is what Porter calls a “basic factor,” one of the factors which are inherited, not created. While basic factors are important to a nation to a certain extent, as it is in this case, these factors tend to lose their importance over time because of their diminished necessity, their widening availability, or ready access to them by global firms through foreign activities or sourcing on international markets.¹⁰³ In the long run, China will lose its advantage in its low cost labor for any or a combination of the reasons listed above, as we saw in Japan in the 1980s.

Science and Technology

Unlike many other developing countries, China has a relatively advanced science and technology infrastructure developed during China’s central planning era. Table 7-1 lists some of China’s major scientific achievements since 1949, when the Chinese Communist Party came into power.

Table 7-1 China’s Major Achievements in Science and Technology since 1949¹⁰⁴

Year	Achievement
1953	The discovery of the Daqing Oilfield
1958	The building of the first atomic reactor
1964	The successful testing of atom and hydrogen bombs
1965	The synthesis of crystalline insulin by the Biochemistry Institute under the

¹⁰³ Porter, Michael E. *The Competitive Advantage of Nations (Edition with Porter’s Introduction)*. The Free Press, New York, 1998.

¹⁰⁴ Source: China Information. Science and Technology. <http://www.asia-planet.net/china/science-technology.htm> accessed July 20, 2005.

	Chinese Academy of Sciences
1970	Satellite launching technology
1970	Nuclear power stations
1980	Carrier rockets
1988	The positron and negatron electronic collider
1999	China's first experimental manned spaceship

In addition to the traditional science and technology, since 1986, China has also been taking steps to implement the State High-Tech Research and Development Plan, a.k.a. the “863 Plan,” which was the first intermediate- and long-term plan combining military and civilian production in China. The main purpose of this plan was to develop, on a large scale, space, information, laser, biology, energy, automation, new materials, and oceanology technologies in an organized and planned way. In 1986, the government formally implemented the “Spark Program,” which was intended to rejuvenate the rural economy by relying on science and technology. In 1988, China initiated the “Torch Program,” which was designed to put results of research in new and advanced technology into use in production. In 1992, the government launched the “Scaling Heights” program to strengthen the state’s support for basic research and to give a stimulus to its sustained and steady development. In 1998, High and New Technology Development Zones were established, with 16,097 companies employing 1.74 million people.¹⁰⁵ All these activities resulted in great achievements.

The capabilities in science and technology could be classified as “advanced factors” which would be durable, and they would enable the country to innovate and move ahead along the technology curve.

Education

¹⁰⁵ China Information. Science and Technology. <http://www.asia-planet.net/china/science-technology.htm> accessed July 20, 2005.

At the start of the economic reform led by Deng Xiaoping, who set the goals of modernization for the country, in the late 1970s, the Chinese leadership recognized that to meet the goals of modernization it was necessary to develop science, technology, and intellectual resources, and to raise the education level of the population. As a result, in the early 1980s, education policy promoted expanded enrollments, with the long-term objective of achieving universal primary and secondary education.¹⁰⁶ In 1985, the government introduced plans for nine-year compulsory education and for providing good quality higher education, which reinforced its commitment to modernization.

Thanks to its education policy, China has improved its literacy rate dramatically over the years. By 1997, the adult illiteracy rate was 10% for males and 27% for females, compared with 35% and 62% in India.¹⁰⁷

What is more staggering, however, is the number of college graduates China produces every year. In 2003, China had 17 million students (both graduate and undergraduate, full-time and part-time) enrolled in its colleges and universities, up from 5 million students five years before. In comparison, the United States had 15.3 million students enrolled in public and private colleges and universities around the same time, according to the U.S. Department of Education. In the meantime, roughly 60% of the students in China majored in science and engineering, according to the China Ministry of Education. It is estimated that China graduates in excess of three times more engineers with bachelor's degrees than the U.S. In addition, China has consistently graduated more engineers than the U.S., Japan and Germany combined every year since 1997.¹⁰⁸

¹⁰⁶ Wikipedia, the free encyclopedia. "Education in Mainland China." http://en.wikipedia.org/wiki/Education_in_mainland_China accessed July 19, 2005.

¹⁰⁷ *World Development Indicators*. 1997.

¹⁰⁸ Source of key statistics: JS Online. "China Engineers its Next Great Leap." December 30, 2003. <http://www.jsonline.com/bym/news/dec03/196593> accessed July 19, 2005.

These skilled engineers will be a formidable force in research and development, and they will undoubtedly become sources of innovation.

7.2 Domestic Demand

Although China is the biggest country in the world by measure of population, estimating its domestic demand is tricky business. The Economist wrote in 2004:

“...as in imperial times, the country's scale can prove more of a hurdle than an opportunity. China has 31 provinces, 656 cities, 48,000 districts, seven major dialects and 80 spoken tongues. Climate and geography vary from the freezing northern plateaus to the semi-tropical south. There are enormous disparities in income, education and lifestyle between city dwellers and farmers, and between the wealthy east coast and the poor west and north-east. For most products, there is no such thing as a national market. China's consumers are too dispersed, too inaccessible and too different from each other.”¹⁰⁹

Despite the gloomy picture painted by the Economist, China's potential is enormous. The magazine admits in the same article that “even a single regional or urban market in China represents a big opportunity, particularly given the country's rapid growth.” As a matter of fact, the demand for IT equipment has been rising promisingly over the past two decades. In the Lenovo case, we saw that total units sold of personal computers increased from 54,400 in 1985 to 250,000 in 1992, representing a 360% increase. In Chapter 4, IDC predicted that total computer hardware sales in China would increase from \$16,840 million in 2002 to \$28,599 million in 2007, at a compounded annual growth rate of 11%. On the software front, Software

¹⁰⁹ The Economist: Behind the Mask – A Survey of Business in China. “A Billion Three, but not for Me.” March 20, 2004.

Industry Association forecasted that the software market would reach \$25.3 billion in 2004, representing an annual growth of 29%. In the semiconductor industry, the IFC report to which we alluded in Chapter 4 indicated that China's chip imports grew at 50% between 2001 and 2002, and 40% between 2002 and 2003. In other words, the demand growth for IT products is strong.

Such demand increases in all these IT industries can not be overlooked. Porter argues that both large home market size and the growth rate of home demand are important to competitive advantage because these two factors often encourage firms to invest aggressively in large-scale facilities, technology development, and productivity improvements, and to adopt new technologies faster.¹¹⁰

It is true that Chinese companies are currently unable to fulfill such rapidly growing domestic demand. For example, while China's demand for integrated circuit (chips) grows at twice the rate of the global average, 90% of the demand is fulfilled by imports. Nevertheless, with several successful companies such as Huawei Technologies and Lenovo stepping into the league of global industry leaders, I venture to predict the emergence of more and more indigenous firms that would offer competitive products and take an increasing share in the market.

We can expect two of things to happen. First, the growing demand will eventually spread to areas that are hard to reach today, resulting in more demand. Second, when coupled with a growing number of skilled workers, the strong home demand would turn into healthy competition over product features, technology, productivity, efficiency, quality, and services.

¹¹⁰ Porter, Michael E. *The Competitive Advantage of Nations with New Introduction by Porter*: p93-94. The Free Press, New York. 1998.

Through the competition, the Chinese firms will be forced to continuously improve themselves and as a result of doing so they will gradually gain more and more competitive advantages.

7.3 Rivalry

The IT industries in China do not lack domestic or international competition. As we saw in Chapter 4, there are a number of players in each of the IT industries. In addition to the indigenous players, thanks to China's FDI policy and its accession to the WTO, there are plenty of international competitors. For example, in the computer hardware industry, Lenovo competes with Great Wall domestically and Dell internationally.

Healthy competition often forces firms in the industry to innovate faster which will lead to more competitive advantages in indigenous firms.

7.4 The IT Cluster

The three major industries (hardware, software, and semiconductor) I have discussed so far are all included in the value chain of the IT industries (see Section 4.1). The software industry lies at one end of the value chain while the semiconductor industry at the other end. These industries are intrinsically related to one another. For example, when the PC industry is very competitive, it will require software products on the one hand and semiconductor products on the other hand. The growing sales of the PC industry will likely lead to the growth of software and semiconductor. On the other hand, the availability of a particular type of software, such as a Chinese operating system, could lead to increased shipments of PCs, which in turn causes the semiconductor industry to grow.

Given the relationships among the three industries, it is not difficult to see that the competitiveness of one industry could lead to the competitiveness of another. The reason for clustering is that one competitive industry helps to create another in a mutually reinforcing process and such an industry is often the most sophisticated buyer of the products and services it depends on.¹¹¹

Despite such relationships, the overall Chinese IT industries are not yet as competitive as their foreign counterparts. The good sign is that a few companies such as Lenovo and Huawei have been gaining competitive edge and they will likely lead other companies in their respective industries to improve themselves and become more competitive.

7.5 Government

As we discussed in Chapter 2 and 4, the Chinese government is generally supportive of high-tech industries. A unique feature of the China, of course, is that it is a Communist regime rather than a democracy. However, sometimes, this drawback can be turned into an advantage. In China, the government does not need the “eminent domain” clause¹¹² to demolish houses to build roads. The side effect of the practice of totalitarianism is that China has built an infrastructure that has proven to be beneficial to its economic growth, which in turn will contribute to the competitive advantage of its domestic firms.

Nevertheless, the Chinese government must overcome many of the challenges I put forth at the end of Section 2.2.2. For example, building an efficient financial market will help domestic

¹¹¹ Porter, Michael E. *The Competitive Advantage of Nations with New Introduction by Porter*: p149. The Free Press, New York. 1998.

¹¹² The “eminent domain” clause is included in the Fifth Amendment to the United States Constitution and refers to power of the state to appropriate private property for its own use without the owner's consent. The clause requires that just compensation be paid when the power of eminent domain is used, and requires that “public purpose” of the property be demonstrated.

firms to gain access to crucial financial capital that would enable them to invest in R&D and productivity improvement, among others.

7.6 Internationalization

Both of the two companies we studied in this thesis have expanded internationally. Lenovo bought IBM PCD not longer ago in order to access the markets in developed countries (the U.S. in particular), while Huawei had over two fifth of the contracted sales from international markets in 2004.

International expansion has several advantages. First, a firm would be placed directly in competition with multi-national industry leaders and it will have an excellent opportunity to improve itself to be more competitive. Second, international expansion allows a firm to develop new markets and improve sales and profits.

7.7 Summary

In conclusion, the rapid growth of the Chinese high-tech industries in recent year has been the result of two fundamental conditions – (1) creation of advanced factors backed by favorable basic factors; and (2) a large domestic market with enormous potential which has shown strong growth in IT demand. These two factors have led to the possibility of the unique top-down mode of technology learning.¹¹³

Led by pioneers such as Lenovo and Huawei Technologies, the industries are undergoing some major transformations. While it is clear that the current main competitive advantage of these industries is low cost manufacturing, more and more companies are developing their

¹¹³ Lu, Qiwen. *China's Leap into the Information Age: Innovation and organization in the computer Industry*. Oxford University Press. 2000.

competencies in areas which can create durable higher-order advantages, such as research and development, marketing, branding, sales network, organizational management, and after-sale services. A case in point is Huawei Technologies, which invests 10% of its sales each year in, and devotes 48% of its work force to, research and development activities.

Unless the U.S. high-tech firms take their Chinese competitors seriously, they might very well be overtaken by the Chinese companies. In the next chapter, I will analyze the opportunities and threats, and make recommendations to both Chinese and U.S. firms.

8 RECOMMENDATIONS

8.1 Chinese Firms

8.1.1 Opportunities

Chinese high-tech firms are currently facing unprecedented opportunities lying ahead of them, but the key question is whether they can explore the opportunities and succeed in the increasingly competitive global market. The domestic market has been growing, thanks to a rapidly growing economy. Because foreign companies still control many of the core technologies in these high-tech industries, most Chinese companies fall behind in the global competition. But this also presents an excellent opportunity for Chinese firms to catch up, for strong competition will force firms to innovate. The potentially enormous domestic market is up for grabs by the Chinese firms which have the advantage of local knowledge and expertise.

Other the other hand, with China's accession to the world trade organization (WTO), the global market has, and will, become more accessible to Chinese firms than ever before. Chinese firms will be able to leverage its low labor costs when they start to innovate and develop products. The key will be competitively priced high-quality products that will help open up international demand for Chinese high-tech products and enhance their brand recognition.

8.1.2 Threats

The biggest threat to the Chinese high-tech firms is their lack of technological capabilities, as the foreign firms are in control of major core technologies and intellectual properties. Since the beginning of the economic reform in the late 1970s, China has attracted over \$560 billion in foreign direct investment (FDI). While the upside is clear, the downside is Chinese firms have

failed to develop their own capabilities in technology and the high-tech market is essentially controlled by foreign concerns. In addition, Chinese firms often do not spend enough resources on research and development. Today, except a few companies like Huawei, most firms have become low-cost manufacturers. If they do not start to innovate quickly, the threat of foreign control of the domestic market will become even more serious, given the WTO deal.

The lack of innovation and R&D capabilities is not entirely the fault at the firm level; in fact, the Chinese government has at least as much to blame. For one thing, its tight control of the financial market, which gives entrepreneurial private firms virtually no access to financial capital, cripples these firms' ability to engage in R&D activities. A few successful firms, such as Lenovo, had access to an efficient financial market, namely, Hong Kong, but most of the other firms don't. In the meantime, the Chinese government has not crafted a solution to cure the deficient state owned enterprises. It has been throwing away money at them but the state-owned companies are inefficient and cannot withstand the competition from foreign firms.

8.1.3 Strategy Recommendation

First and foremost, the Chinese firms must start to innovate, and not just innovate to keep up with the speed of their foreign competitors, but they have to step up and innovate faster in order to catch up and surpass their rivals in the global market. They should seriously devote more resources to research and development. Possible avenues include dedicating a higher percentage of revenue to R&D activities, building closer links to universities and S&T institutions by setting up scholarships and sponsor S&T projects, and importing talents from developed countries such as the U.S. While conceivably many companies do not have the financial resources to spare on R&D, those which have the ability should start doing so quickly, for the low-cost advantage they

currently enjoy will not stay for ever. Once production costs increase too much in China, multinational companies will simply go to lower cost countries.

Next, Chinese firms should realize that their local knowledge is a great source of competitive advantage against their foreign rivals, and they should avail themselves of such expertise in a growing domestic market. In recent years, many multinational firms have become aware of the fact that, in order to be successful in China, they have to localize their products by hiring local experts. Motorola, one of the largest mobile device manufacturers, opened up R&D centers in China to design cell phone interfaces that are attractive in the Chinese market, for products that are developed in the U.S. or other countries do not sell well in China.¹¹⁴ Chinese firms should know their local markets better than any foreign companies.

Internationalization is another important step that Chinese firms with global aspiration must take in order to be competitive in the market. They can start from the domestic market, and expand into the international arena. Huawei, for example, adopted the strategy of first targeting the rural market, then the metropolitan market, developing countries such as Russian and India, and finally developed countries in Europe and America. During the process of internationalization, they could marry their low cost advantage with their increasingly high quality products. A pricing strategy which has been used by some successful firms such as Lenovo is to sell high quality products at low price points, even if it means their profits are lower. This is different from a pure price war strategy in that this strategy emphasizes on the quality of the goods. Many price wars involve low price products of low quality.

¹¹⁴ Company Visit by MIT Sloan LFM and SDM students. Motorola, Tian Jin, China. May 25, 2005.

In addition to the pricing strategy, Chinese firms must start to build their brand names. Lenovo, for example, discontinued its English brand – Legend – to switch to “Lenovo.” This was a carefully crafted strategy to reintroduce the brand to the developed markets, for the company understands the value of a well recognized brand that is associated with high quality and reliable products.

Chinese firms in general are in dire need of managerial skills and talents, besides the lack of technological capabilities and financial resources. One thing the firms could do is to import managerial talents from overseas, which many have done. In order to attract experienced managers, the Chinese firms must offer benefits that are not available overseas, such as attractive and innovative compensation schemes, and better career progression path, among others. While imports may alleviate short-term shortages of capable managers, the key is to develop domestic managerial skills through professional schools (there are many MBA programs offered at top Chinese universities), trainings, mentorship, and so on.

Business ethics and accountability is another area in which Chinese firms must improve. Statistics and reports show that corruption is a serious problem in China. Without accountability, foreign investors hesitate to invest in the Chinese stock market; instead, they prefer to open their own companies or subsidiaries in China over which they can exert managerial influence. Improvement in business ethics will encourage more investors and in turn stimulate the growth of the Chinese firms.

8.1.4 Role of Chinese Government

While it behooves the Chinese firms to step up and build durable competitive advantages, there is an important role the Chinese government must play to help the firms to reach their

goals. To begin, the China must seriously start to respect the property rights of private firms. While private companies are still a small component of the overall economy, they have been growing a at around 20% a year, more than twice as fast as the economy as a whole, and the private sector has been responsible for most of the recent job creation and for up to 60% of fixed capital investment.¹¹⁵ These firms are the great hope for China's competitive advantages and they are bound to be the dominant economic force in the near future, for the inefficient state-owned enterprises will eventually be replaced by more efficient private companies. However, even today, notwithstanding the recent constitutional amendment declaring private property "inviolable," public ownership retains its preferred status.¹¹⁶ In order to encourage the private businesses to boom and create new job opportunities for the economy, the government needs to take necessary measures to protect property rights.

The government should also change its discrimination policy in the domestic financial markets to give private firms unfettered access to financial capital such as bank loans and stock market listings. Currently private companies have virtually no access to bank loans from state-owned banks. Instead, the government banks throw away money at the ailing state-owned enterprises, creating numerous bad loans. Without financial capital, the private firms are unable to innovate or hire good talents.

In addition, the government must start to enforce the law, of which not the least is the protection of intellectual property rights. It is widely known that piracy is rampant in China and, despite the law on paper, the government hardly enforce it with full strength. Although

¹¹⁵ The Economist: Behind the Mask – A Survey of Business in China. "On the Capitalist road – Private Business are China's Great Hope for the Future." Mark 20, 2004.

¹¹⁶ The Economist: Behind the Mask – A Survey of Business in China. "On the Capitalist road – Private Business are China's Great Hope for the Future." Mark 20, 2004.

most of the pirated goods are originally created outside China, more and more intellectual properties have been created in China as well. For example, pirated CDs and DVDs include not only foreign music and films but also those made in China. Protection of intellectual property rights will undoubtedly encourage more innovation and invention in the high-tech sector in China.

8.2 U.S. Firms

8.2.1 Opportunities

The vastly available cheap labor resources, coupled with a first class infrastructure in many parts of the country which includes (but is not limited to) roads, airports, and telecommunications, have made China an attractive manufacturing base from making toys to building computer chips. Compared with their Chinese rivals, U.S. firms enjoy financial capital, brand, talents, managerial skills, and technological capabilities. Their opportunity is to take advantage of the resources in China while leveraging their existing strengths. In so doing, they will be able to accelerate their growth and make much higher returns to their shareholders.

In the meantime, the growing Chinese market presents an opportunity that international firms have been coveting for years. While most parts of the country are still not reachable or accessible by the U.S. firms, even a single regional or urban market in China represents a big opportunity. Moreover, with the rapid growth of the economy, the market will become much bigger in the years to come.

8.2.2 Threats

First of all, U.S. firms must continue to be wary of violation of intellectual property rights in China. The Chinese government has hitherto refused to fully enforce its intellectual property law. The emerging Chinese high-tech firms lack core technologies, and many have used unethical tactics to get their hands on important technologies. This trend are unlikely to wane down in the near future.

U.S. firms must also take it seriously the competition from emerging Chinese companies with global ambitions. Firms like Huawei should raise enough concern, for these Chinese competitors will be able to combine their low-cost advantage, local knowledge, and high-quality products to create sustainable competitive advantage in the long run. Most importantly, U.S. firms must realize, and acknowledge, that Chinese firms also enjoy a significantly low-cost advantage in R&D.

Finally, a totalitarian regime in China is always a threat to global firms. For example, a war against Taiwan, albeit unlikely, has the potential to paralyze the economies in the region and adversely affect U.S. firms' ability to manufacture and supply goods to international markets. In other words, too much dependency on China as a manufacturing base is a concern.

8.2.3 Strategy Recommendation

Given that Chinese firms which do invest in R&D enjoy a cost advantage, U.S. firms must take different approaches to innovation, which can be a number of forms. First, they should innovate faster, not only in products and technologies but also in other areas such as organizational design and supply chain management. In other words, they must create competitive advantages at a speed that can not be easily matched by their Chinese rivals. Next, they should explore the possibility of using lower cost labors in some of the R&D activities,

which is in and of itself a challenge because of concerns of intellectual property rights violations. However, novel ways of dividing the activities might be designed to prevent protected content from being copied. Enough pressure from the international community and possibly from some conscientious indigenous players could also force the Chinese government to be tougher on cracking down violators. Finding a low-cost country where intellectual property laws are better enforced could be another possibility.

U.S. firms should also try to improve the availability of factors of production, which in this case are engineers and scientists. As indicated in the earlier discussion, the number of American students enrolled in public and private universities and college who major in science and engineering disciplines has steadily declined since the 1980s. U.S. firms could set up more scholarship funds to support science and engineering students, sponsor more projects at universities and colleges, and increase pays for scientists and engineers who are essential to a firm's research and development activities. While this strategy seems to be contradictory to the previous strategy of moving R&D activities to lower-cost countries, there is an important distinction here. The U.S. as a nation must retain its competitive advantage in technology in order to continue to be the most advanced country in the world. The ability to make technological breakthroughs cannot be outsourced offshore. The key to this ability is the availability of innovators and people who can be engaged in R&D activities. On the other hand, certain R&D activities such as testing software do not need advanced skills and can be outsourced to places such as India.

The U.S. firms could also leverage their financial resources, managerial skills and talents to dominate the high-tech sectors in China before Chinese firms have a chance to emerge. In the semiconductor market, for example, 90% of the Chinese domestic demand has been fulfilled by

imports in recent years. U.S. firms could create barriers to entry and lock out Chinese competitors.

8.2.4 Role of U.S. Government

The U.S. government must be open-minded and not be swayed by political pressure when it comes to its relationship with China. It should continue to support open and free trade with China and take a holistic view of the global market. In particular, it should not impose any restriction on trade that could give certain U.S. firms an unfair advantage, for it will hurt the U.S. industries and firms in the long run.

In the meantime, the U.S. government should do more to improve the factor conditions in the U.S. It should use more government funding to support basic science and technology research while in the meantime revalue its immigration policy so that talented people from other countries who are willing to come to the U.S. are admitted in an expeditious way.

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