Part IV. Background and Analysis of Corporate Organizational Strategies for the IT Businesses with Case Studies

Introduction Part IV

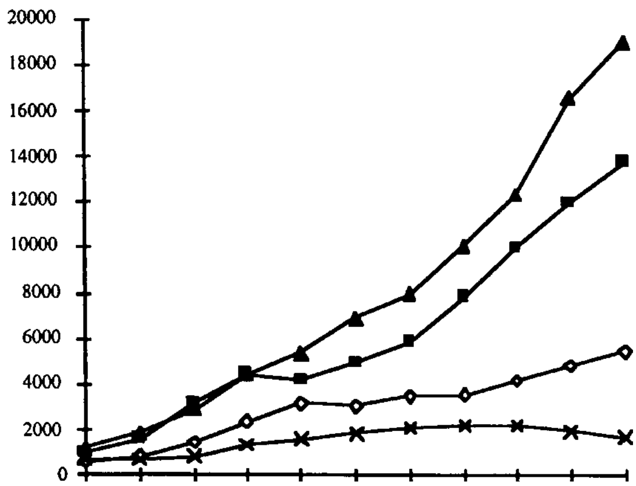
When many big computer companies started looking for low-cost suppliers and subcontractors, they offered chances for Asian companies to enter the PC industry without having to master a wide range of technologies or develop their own marketing and distribution channels through original equipment manufacturing (hereafter OEM) type opportunities. A company could produce a cable, power supply, keyboard, or monitor based on IBM's design standards and sell the components to any PC maker. It could also assemble PCs or circuit boards for major companies that preferred to outsource some parts of the production process. The barriers to entry were low, and East Asian producers flooded into the market. However, Many business scholars consider OEM as just a short term strategy or stepping stone for getting started in IT hardware because they believe that the higher profitability potential lies only in developing brand name products by getting out of the OEM business and into the international brand recognition wars. Japan, Korea and Hong Kong believed in this western strategy and all got out of the OEM business as soon as possible. By 1989 only Taiwan still believed that OEM could be a profitable long term strategy and some of the well known leaders such as Miao Fengchiang of Mitac computers and Morris Chang of the Taiwan Semiconductor manufacturing Corporation (TSMC) had actually developed full scale plans for leveraging Taiwan's OEM based business infra-structure (苗豊強 1998 pp.86-95).

The direct investment and outsourcing by multinational computer makers and efforts by local companies to become part of the supply chain combined to create a boom in computer production in East Asia. The combination of approaches was different in each situation. Singapore relied mostly on production by foreign multinationals, Taiwan and Hong Kong had a combination of foreign and domestic producers, and domestic firms dominated Korea's industry. During the 1980s, each of the four NIEs experienced high-speed growth in the manufacturing of computers and peripherals (Fig. 4-1). However, in the late 1980s and early 1990s, production levels stagnated in Korea, Japan and Hong Kong but surged in Taiwan and Singapore. This surge in Taiwan during the 1990's along with the commensurate decline of Japan, Korea and Hong Kong's market share along with a analysis of comparative organizational strategies is of primary concern in this dissertation (see Fig. A.1 below).

Table 4.01 Computer Hardware Production in Asian NIEs, 1985-1995

Taiwan = Triangular Line Singapore = Squared Line

Korea = Circled Line Hong Kong = XXX Line



1985 87 89 91 93 95 (In US $ millions per year.)

Source: 工業技術研究院 1997b p.97.

By the mid-1990s, the NIEs had developed strategies that earned them leading positions in many segments of the personal computer hardware industry (Table A.2 below). Taiwan then became the world leader in production of notebook computers, CD Rom drives, motherboards, scanners, keyboards, monitors and specialized ICs. Its companies were moving into higher technology products and providing design and distribution as well as production. Singapore led the world in production of hard disk drives and sound cards, and was fourth in PC assembly. Korea was challenging Japan's control of the DRAM market, but at the same time, its PC industry was losing its edge as global competition intensified. Hong Kong lost much of its manufacturing base, but retained a vital position in the industry by managing production in southern China. However, only Taiwan followed a strategy so radically contrary to the other Asian NIEs (the OEM strategy) and it is through looking at Taiwan's institutions that we can discover the strength of its unique organizational strategy.

Section 4.1 Vertical Division of Labor: Strategies for Taiwan's IT Hardware Industry

4.11 Dividing the Labor

The development of the IC industry in Taiwan has been a topic of great discussion and controversy. Some leaders of Taiwan's traditional industries had been questioning the viability of a local high technology industry, dismissing the multi-billion dollar investment plans of the country's IC community as mere chimera. Despite this controversy, many large producers such as UMC, TSMC and Winbond remains committed to future investment plans.

The real question people should be asking is not whether Taiwan's IC industry investment plans are unrealistic, but rather, Does Taiwan's IC industry actually have long-term competitive advantages in the global market place and why? Here is why the answer is yes. In the quarter century of development of its IC industry, Taiwan has built a unique position of global competitiveness. Furthermore, Taiwan's strategy has focused on the goal of building organizational strategies that other regions will not be able to duplicate in the foreseeable future. Three innovations have contributed greatly to the unequalled competitiveness of Taiwan's corporate organizational strategy for the IT hardware industry. They are:

Table 4.02 The Best Practices of Taiwan's Corporate Model

1. A comprehensive and dynamic vertical division of labor organizational structure.
2. Complete integration into the global supply chain.
3. A unique employee stock bonus distribution system.

The Division of Labor of the Win-Win OEM Strategy (苗豐強 1997) Has Given Birth to a Globally Competitive IC Industry in Taiwan

It is well known that the IC industry is divided into highly specialized sectors, including IC design, mask making, wafer processing, and assembly and test. One of the most significant changes in the Taiwan IC industry in recent years has been the transition from a vertically integrated model to a vertical division of labor business model. This transition has been driven by the need to constantly adapt to the rapidly changing business environments that characterize each sector of the production cycle, and by the massive investment needed to remain competitive in the global economy. The so-called IDM (integrated device manufacturer) model, in which one company is responsible for all aspects of production, is no longer competitive due to the excessive strain it places on a company's financial, research and development, and management resources. As a result, the vertical division of labor of production is becoming the mainstream business model in Taiwan.

Interestingly, as recently as ten years ago, many analysts of Taiwan's IC industry suggested Taiwan could not compete globally in technology fields because the vertical integration of its companies was not as complete as with large foreign manufacturers. (Fukuyama 1994) Nine years later, these arguments have been completely refuted by the course of industry development. In fact, to the contrary, numerous studies demonstrate the superiority of the vertical division of labor over an integrated manufacturing system (陳添枝 1994 pp.8-27, 陳競玲 1999 pp.13-44).

Table 4.03 The Advantages of the Taiwan System are Numerous

1. Because each sector of the production chain operates independently, it can develop a high level of specialization, greatly simplifying the management process.
2. Because each sector of the production chain can raise funds independently, it is easier to fund growth to reach the critical mass necessary to be competitive.
3. Increased efficiency in each sector of the production chain results in the shortest possible cycle times, allowing inventory to be kept at a minimum and dramatically reducing costs.
4. In an environment of constantly changing demand and technology, the vertical division of labor leads to much higher capacity utilization rates than in an integrated structure. Capacity utilization is the single most important factor influencing profitability in the IC industry because of the enormous investments needed in each sector of the IC production chain. In an integrated system, each sector has only one end user, i.e. the sector of the production process that precedes it within that same company. There is very little room for adjustment if a problem or change in demand arises within one sector. In contrast, in the vertical division of labor model every sector of the production chain has multiple customers. If the demand from one of these customers decreases, it is possible to supplement it with demand from another customer. This results in improved capacity utilization, and consequently higher profits (陳競玲 1999 pp.1-11).
5. Each sector in the disintegrated production chain is exposed to the harsh realities of global competition. Therefore, technology and services must continually improve for the company to survive. Consequently, each sector must develop strong competitiveness and the overall industry becomes strongly competitive.

According to a recent Donaldson, Lufkin & Jenrette research report, in 1998, the average profit margin for companies in each sector of the disintegrated production chain was 20%, while the average profit margin for integrated device manufacturers (IDM) was only 4%. Cash flow (EBITDA) at companies operating in a disintegrated environment accounted for approximately 50% of revenues, while it was only 18% for IDMs; a difference of 2.5 times. This translates into 2.5 times more potential for new investments, an undeniable competitive advantage.

For the majority of logic ICs, the disintegrated manufacturing environment is superior to the IDM business model. However, the DRAM and CPU markets continue to be dominated by integrated device manufacturers, such as Intel and Samsung. This is largely due to the fact that these products have relatively long life cycles, require extremely high production volumes and are produced in few varieties. In addition, the correlation of design and process technology for these products is relatively high, minimizing the advantages of division of labor.

4.12 Key Points on Taiwan's Unique Vertical Division of Labor for IT Hardware

Typically, these products also require the highest levels of precision engineering and process technology. In the past, lagging technology made it difficult for dedicated wafer foundries to service these sectors of the IC market. In recent years, however, dedicated wafer foundries have made astonishing progress in process technology development. TSMC, for example, began 0.18-micron technology production in March of 1999, and is already delivering advanced technology foundry services to DRAM and CPU vendors. An indication of this trend is the recent move by Japanese DRAM manufacturers to increase the percentage of their production outsourcing. This is further evidence that products like DRAM, once thought to be best suited to an IDM business model, are gradually finding it more and more difficult to resist the competitive advantages of vertical division of labor (工業技術研究院 2001). Although vertical division of labor has become the undeniable trend in electronics manufacturing worldwide, Taiwan is the only nation to develop an infrastructure with the critical mass, flexibility, comprehensiveness, depth and concentration to fully take advantage of the new disintegrated strategy OEM paradigm.

In Taiwan as of the end of 2000, there were 122 IC design houses, 5 mask manufacturers, 21 wafer manufacturers, 38 assembly houses, and 30 test companies. By the end of September 2000, the total assets of these companies had surpassed US$34 billion (NT$920 billion)(工業技術研究 2001 pp.4-11). Remarkably, despite the global trend toward specialization, Japan and Korea are so entrenched in their traditionally vertically integrated business models that they have been totally ineffective in establishing a disintegrated manufacturing environment. In contrast, the U.S. IC industry has chosen to concentrate on high value-added design services, outsourcing manufacturing to partners who are overwhelmingly located in Taiwan. Other areas, including Singapore, Malaysia, Thailand, Israel, and Mainland China, have established some facets of the infrastructure that exists in Taiwan, but are far behind in terms of scale, range of services, and depth of expertise.

Why then has Taiwan been successful in developing such a highly competitive disintegrated manufacturing environment? The following factors have been largely responsible:

1. **Strategic Clustering**. In 1976, when Taiwan's Industrial Technology Research Institute (ITRI) first transferred IC technology to Taiwan from RCA, it chose to cluster together all of the sectors that make up IC manufacturing technology, including design, mask making, wafer processing, and test. This resulted in a strong foundation for each sector of Taiwan's IC industry. ITRI's Dr. D. H. Hu led this project, and his contribution to the development of the IC industry in Taiwan should not be underestimated.
2. **Well Laid Foundation**. Even earlier, in the 1970s, Taiwan was established as an assembly center for U.S. and Japanese IC manufacturers. This infrastructure would serve as a solid foundation for the future development of the assembly industry in Taiwan.
3. **OEM Division of Labor (Win-Win Strategy).** From the very beginning many local IC manufacturers chose to outsource assembly, allowing the as assembly houses to develop their own business and technology. UMC also actively sought to outsource mask production, in order to further its specialization and promote the development of the disintegrated

manufacturing model in Taiwan. Several years later, Taiwan IC Manufacturing Corporation (TSMC) went one step further, deciding to ignore IC design altogether and concentrate on foundry manufacturing. TSMC's success with the pure foundry business model further strengthened the trend towards the vertical division of labor in Taiwan.

4. **Venture Capital Market Best Practices**. In 1986, Taiwan's stock market started a six-year term climb from a base of 800 points that was partly due to the strong venture capital markets that exist in Taiwan but not many other Asian countries. The strong bull market was an extremely important source of funding for the capital intensive IC industry in Taiwan, and it fueled explosive growth in the local IC industry. Although many people criticized the speculative nature of the stock market at the time, it is undeniable that this period laid the foundations for Taiwan's global competitiveness. On a per capita basis, Taiwan's Venture capital market is even larger than the US when seen over the long term from 1988-1998 (Tanzer 1999 pp.43-50).

5. **Geography and Vertical Division of labor.** Due to Taiwan's small size, the IC industry in Taiwan was forced, quite naturally, to develop in a concentrated geographical area. Surprisingly, the restrictions placed on the industry by geography were beneficial rather than limiting, and resulted in the ideal environment for the development of a vertical division of labor business model. Despite the fact that computer networks and telecommunications systems closely link the countries of the world, from the standpoint of manufacturing and technology development, the various sectors of an industry benefit significantly from the mutual support and cooperation that occurs with close proximity. California's Silicon Valley has enjoyed it's long reign as the envy of the high technology world due to the speed of communication and cooperation allowed by the concentration of interrelated companies and industries in a single location. Taiwan enjoys the same kind of synergy. This kind of infrastructure and environment does not develop overnight, but once it is established, it allows growth to take place at a startling rate, and it is very difficult for latecomers to close

the gap.

Section 4.2 Industry Case Study A: Taiwan's IC Foundries and Fabless ICs

4.21 Specialization, Integration, and Global Competency are Major Factors Contributing to the Competitiveness of Taiwan's IC Industry

In the business world, globalization is traditionally viewed as a single enterprise setting up distribution or manufacturing channels around the world, and marketing to each local region. This standard definition implies that an enterprise's level of globalization is measured by the extent its operations are spread out geographically. Over the last 20 years, however, the vertically integrated business model has collapsed and the ascendancy of vertical division of labor as the dominant business model has caused the concept of globalization to undergo a revolutionary change.

To better understand the new view of globalization, it is necessary to first understand the concept of integration. Hardware manufacturing today is a prime example of the process of integration. To take the IC manufacturing process as a specific example, during the construction of the fab it is necessary to integrate each facet of the project, including architectural design, construction and building engineering, and the installation of mechanical, electrical, water purification, gas and Interior water supply, and clean room systems. Furthermore, in order to develop a manufacturing process, one must integrate photolithography systems, ion implanters, diffusion furnaces, thin film deposition and cleaning equipment, etching and other apparatus. Even after the process is in place, it is further necessary to integrate the front and back-end processes of design, mask making, assembly and test in order to produce a single functional IC component(金 1994 pp.202-209)

After electronic components have been manufactured at a wide variety of sources around the world, they must then be furthered integrated into systems for computer, communication, consumer, and industrial applications by an endless number of downstream companies. From this example, it is clear that the global electronics industry is a classic example of multiple cycles of integration. If we take a close look at the manufacture of IC capital equipment, we can see another complex chain of integration. Take, for example, a single DUV Step and Scan Aligner produced by ASML. The scanning system consists of many parts, including a laser source, operator control unit, lens unit, wafer handling unit, and scanning stages. These components are produced by a variety of specialist companies such as Cymer, DEC, Zeiss, CCM and Phillips. It is only after undergoing integration by ASML that a completed system is produced.

Up until about 20 years ago, the integration process related to electronics products was basically a closed model. The major companies of each country had their own internal vertical integration process for the production of the entire range of electronic products. However, around 1980, the shape of electronic component manufacturing began to undergo massive changes. Telecommunications giant AT&T was split up into many smaller companies; the world's telecommunications enterprises underwent privatization; the personal computer industry entered a rapid growth phase; small IC companies began to display market winning technological prowess; and adoption of the internet became rapid and widespread. These changes opened up a whole new frontier of business chances, and gave birth to a seemingly endless stream of new enterprises. However, since no single enterprise could possibly have the capital or resources necessary to independently pursue all of these chances, it became necessary to divide the workload and develop close cooperation between related businesses. In the following years, the vertically integrated business model has become less and less competitive, and the vertical division of labor and multinational integration has replaced it as the mainstream in Taiwan.

As the trend for multinational integration continues, the definition of globalization has also evolved. Today, the extent of a company's globalization is judged by the nature of its integration process. Do its resources, such as equipment, staff, technology, capital, come from a broad international base? Can its products or services satisfy a broad international market? In the new definition of globalization, the major source of a company's value proposition is technical specialization, and not the geographical distribution of its operations. Only because of its specialization can it be integrated into the global supply chain. Therefore, in today's business world, the concepts of specialization, integration and globalization have become tightly intertwined. In the last 15 years, Taiwan's IC industry has smoothly adapted to the trend towards specialization, integration and globalization, with its technology advancing at an extremely rapid pace.

Many accomplishments put Taiwan at the leading edge of technology development. Such as the fields of copper interconnect and low-k dielectric technology clearly show that it leads the majority of Japanese, European, and American manufacturers in process technology. It is only a matter of time before the gap with the world's technology giants, including Intel and IBM, disappears due to the success of the disintegrated strategy. The extreme speed of technology development in Taiwan has taken domestic academics and analysts by surprise. The enormous costs of research and development in the IC field strongly suggested that it would be impossible for Taiwan to achieve technological leadership or pose any kind of challenge to the large overseas manufacturers. Fortunately, the development of IC manufacturing technology is beyond the grasp of any single manufacturer and requires widespread cooperation and global integration to be successful. For example, even the most basic process technology cannot be achieved without the appropriate processing equipment. Therefore, the industry's equipment vendors have taken the pioneering role in the development of technology, while IC manufacturers have taken over the job of integrating this equipment in a manufacturing process.

The relationship is like that of a horse trainer and a jockey. It is only through the combination of their independent skills that a horse can deliver a winning performance on the racetrack. Although it is true that specialization, integration, and globalization are trends that have moved the industry for the last twenty years, it is equally true that these trends are not unique to Taiwan. Why then have these trends led to strong competitiveness for the IC industry in Taiwan and not in other regions? A major reason is clearly the extent to which the vertical distribution of labor has developed in Taiwan. The separation of the manufacturing process into specialized sectors has made operations more manageable and simple. This simplicity, in turn, has allowed the level of expertise at each company to increase rapidly, facilitating Taiwan's integration into the global supply chain. And as local companies have been integrated into the global economy, they have been exposed to forces that have further strengthened their expertise. Over the last fifteen years, Taiwan has profited from this "learning curve strategy." And this learning curve strategy has made it possible for Taiwan's IC industry to make tremendous leaps in technology development in a very short time, becoming a global competitor.

Looking to the future, Taiwan's IC industry will not only continue to challenge the leading overseas IC companies in technology, but also in terms of capital expenditures. According to Dataquest in 1998 three of the top ten companies worldwide in terms of investment for capacity expansion were located in Taiwan. Taiwan companies like UMC surpassed industry giants such as IBM, NEC, and Toshiba to be ranked number four in the world. With this level of investment, accompanied by the strategy of specialization, integration, and globalization, Taiwan's position as an international leader in IC process technology will continue to rise, and Taiwan has a good chance to firmly establish itself as a world leader in this field.

Although Taiwan is already a global competitor in the fields of IC manufacturing, packaging and testing, most people recognize that Taiwan's IC design capabilities have yet to reach international standards. One major reason is that IC designers must closely match the demands of systems developers, and Taiwan has yet to develop any large system houses. Consequently, there are limitations related to time and distance that have restricted Taiwan's ability to meet the demands of American and European systems houses. Nevertheless, the progress of Taiwan's IC design houses is difficult to ignore. For example, Taiwan design firms are meeting almost all of the chipset requirements for today's Wintel PC systems. These companies are for the most part operated by American-educated Taiwanese engineers, and include SIS, VIA, and Acer Labs. In addition to the American-educated engineers working in the IC design industry in Taiwan, Taiwanese companies have set up operations in Silicon Valley, tapping into the rich pool of engineers and technology there. They have also cooperated with US design houses, forming numerous alliances.

4.22 Taiwan's Human Resource Competitiveness is Helped by its Unique Stock Bonus System

Article 235 of Taiwan's company law requires that a company set the ratio of earnings that should be distributed as employee bonuses. There is nothing special about this employee bonus distribution system. However, companies in the Hsinchu Science Based Industrial Park have allowed employees to receive their bonuses in the form of company shares created from the companies" retained earnings converted into capital. This practice is the so-called stock bonus system, a major factor in success of Taiwan's electronics industry. What this means is that instead of getting stock options, they get real stock.

Since its introduction in the Science Park, the stock bonus system has had a revolutionary effect on Taiwan's industrial development. It helped to overcome an obstacle that had greatly limited the development of Taiwan's industrial and academic circles in the past; the ability to attract first class international talent to come to Taiwan to work. The few that had worked overseas and returned, often boasted of the sacrifice they had made for Taiwan by abandoning high foreign salaries. After the introduction of the stock bonus system, however, there was a very significant change in Taiwan's IC industry's ability to attract first class talent from overseas. The IC industry in Taiwan has risen to the position of global competitiveness due to the contributions of a highly diverse workforce composed of first-class international talent, and is unlike traditional industry in Taiwan that has historically been relegated to low margin markets.

Why then did the stock bonus distribution system have such an incredible effect on Taiwan's high technology industry? I believe that the major reason for its success is that it allows employees to enjoy more than just the compensation of a laborer paid through a regular fixed salary. The stock bonus system also allows employees to share in the compensation of an entrepreneur.

What is the distinction between the compensation of a laborer and the compensation of an entrepreneur? In China, there is a proverb that says, "a bankrupt boss is more valuable than a self-satisfied employee." This proverb clearly reflects the extent to which society values the contribution of an entrepreneur over the contribution of the staff that the entrepreneur employs. However, there has been little research into why this phenomenon has developed. It could be that because the entrepreneur (the boss) can take advantage of the many multiplier effects offered by society to grow wealth, in much the same way a snowball grows as it rolls down a slope. In contrast, the salaried employee can only create a very limited amount of wealth based on his fixed income. This fundamental distinction has resulted in an extreme difference in their earning power.

What exactly is meant by the multiplier effect? Let's take a fictional example of a company that begins a business venture with a single dollar. If the company uses this dollar to borrow three dollars from the bank, it can use the funds to undertake an enterprise that requires a four-dollar investment. With these four dollars, the enterprise may do twenty dollars of business during the course of a year meaning the original capital has turned over five times. If the shares of this company are listed on the market, its stock price will not only represent the earnings per share of the company, but will also enjoy a valuation based on its price earnings ratio and discounted future earnings. The cumulative effect of these multipliers is that the wealth of the founder or the owner of the business has snowballed from a small initial investment to a considerable fortune. Taken to the extreme, this snowball effect may cause a financial bubble. Therefore, a healthy society is not interested in just the financial multiplier effect, but in the actual creation of value. For example, a modern jet airplane reduced to its raw materials has very little value. However, through the application of advanced technology in a process combining design, test, and assembly, an airplane is manufactured that is capable of transporting thousands of tons of cargo and flying great distances. This kind of value added innovation creates something rare and precious from plentiful raw materials with little inherent value. From this example it is obvious that the creative application of technology can create great wealth.

Therefore, it is no surprise that the pursuit of new technologies has been propelling the economies of the developed nations of the world over the last two hundred years. The first obstacle that was overcome in the early days of developing a high technology industry in Taiwan were the problems created by the disparity in compensation that exists traditionally between business owners and their employees. High technology industry requires many technical personnel; each occupying a position that calls for in-depth research and innovation. Only through the close coordination of these skilled technical staff can something of value be created. In this respect, high technology industry is quite different from traditional industries, whose success is often determined by the endeavors of a single boss or a few key managers. It was the introduction of the stock bonus distribution system in Taiwan that solved many of the problems caused by the compensation gap between employers and employees, and established a strong foundation upon which Taiwan's IC industry could develop its international competitiveness.

4.23 The Benefits of Taiwan's Stock Bonus System

A. Through the stock bonus system, employees become company shareholders. This not only eliminates the problem of conflict between management and labor, but almost erases the distinction between them.

B. By participating in the benefit of rising stock values, the employees can accept much lower base salaries than employees in other developed countries, reducing the fixed costs for Taiwan's IC industry, and resulting in a significant competitive advantage in the global IC industry. Furthermore, with this system employees receive minimum compensation when the company is unprofitable, providing motivation for employees in the same way as for the companies" founders due to a common vested interest in the success of the company.

C. Although employee fixed salaries are low, in profitable years the annual incomes of employees typically surpass those of workers in developed nations like the USA, Japan and Singapore. Therefore, Taiwan's companies are in a strong position to attract global industry talent. Furthermore, professionals attracted by this system are often highly entrepreneurial, resulting in a highly motivated, as well as highly skilled workforce.

D. The stock bonus system is extremely flexible. Profits can be retained for distribution in later years, or profits can be distributed as cash dividends. In addition, the percentage of earnings distributed is easily adjusted, and the price of shares purchased by employees does not necessarily have to be the face value of the shares, so there is great latitude in the way profits are distributed. To take UMC and TSMC as examples, bonus distributions in the early days were around 25% of profits, later this was adjusted to 12%, and recently this has been adjusted to 8%.

E. The stock bonus system contributes greatly to management efficiency. Because the stock bonus system is a win-win situation, employees working under this system are highly motivated and proactive. This greatly reduces the need for upper level management to monitor employees and results in increased management efficiency.

F. The stock bonus system can solve the problems associated with management succession. Under the stock bonus system, employees that accumulate bonus shares have the possibility of becoming major shareholders of the company. The succession of management power can therefore be passed between professional managers, contributing to the long-term viability of the enterprise.

In comparison to the stock bonus system developed in Taiwan, it is clear that the major competitors in the IC industry (USA, Japan, Korea) have a significantly less effective compensation system, Japan and Korea are particularly rigid and lacking in innovation, with employees receiving almost no profit sharing. In these countries, the employees are clearly perceived as laborers rather than partners, and the compensation system is woefully inflexible. The system in the USA is more complicated. Generally speaking, there are three characteristics of employee compensation in American high technology companies:

1. High Salaries (Relative to Taiwan)
2. Stock Options
3. Founder’s Shares

The most noticeable differences between the securities regulations in the USA and Taiwan are the ability in America to freely set the face value of founder’s shares, and the lack of regulations that limit technical shares to 15% of the total capitalization of a company. In most US high tech companies, the founder (mostly entrepreneurs with technical backgrounds) can freely set the number of shares he/she shall be issued and the price of each share. When the company lists on the stock market, the founder can quickly become incredibly wealthy. In the USA, there are many examples of this, including Microsoft’s Bill Gates and Yahoo’s Jerry Yang.

After US companies have listed on the stock market, the market determines the stock price, and it is impossible to distribute shares to employees at a token price. Therefore, the distribution of stock options has evolved as the only viable way to give employee's some kind of performance incentive. Stock options are often offered to a new employee upon joining the company. Typically, a date is set at which the employee can subscribe for shares on an annual basis at a predetermined price, typically the closing price of stock on the day he joins the company. For those employees already on the job, every few years a stock option plan is set with a starting date. The option price is determined by the stock's closing price on that date. If the stock price continues to climb after this date, the employee can profit from the difference in the actual stock price and the price of the stock options. If the stock price falls below the option price, the options are worthless.

As far as the effectiveness of the system to encourage employee performance is concerned, it seems that the US system of founder shares and stock options results in either overcompensation or not enough compensation. An example is the succession of Internet related companies that have recently gone IPO. Although these companies have no profits and inconsequential revenues, their stock prices have skyrocketed. In comparison to the stock bonus system, the speed and magnitude of wealth accumulation for employees under the stock option model is excessive.

Conversely, since the option price is set in accordance to the stock's market price it has other serious limitations. Imagine what would have happened had Taiwan's Quanta Electronics decided to adopt the US-style option system on March 25th this year. The strike price for its options would have been set at NT$572, its closing price on that day. This is 57 times the price of shares distributed through Taiwan's stock bonus system, which typically have a face value of NT$10. The extremely high price of the stock options in this scenario would have little effectiveness in motivating employees due to the slim chance of their realizing a profit on any of these options. So, regardless of the high salaries and stock options offered by leading overseas manufacturers, they are unable to stop first-class professionals from streaming to Taiwan to work for local companies. The attraction of Taiwan's stock bonus system to employees is very clear.

In light of the above analysis, we can easily grasp the superiority of Taiwan's bonus system over compensation systems in the USA, Japan and Korea, and see the competitive edge this system gives Taiwan's IT hardware industry. We have seen how Taiwan's IC industry's competitiveness comes from its vertical division of labor, globalization and employee stock bonus system. Of course, we must not forget the role that the government has played (see Part II) in providing the basic infrastructure necessary for the industry to flourish. This includes the training of a skilled labor force, the establishment of the Science Park, and the funding of industry research NPO organizations. However, the steps taken by the Taiwanese government cannot be easily replicated by governments in other areas and therefore cannot easily lead to a sustainable competitive advantage. One of the basic rules of good strategy is to not be easily duplicated by others. It can also be pointed out that the vertical division of labor, globalization and employee stock bonus system mentioned in this research have all coincided with and utilized the dynamics of the unique entrepreneurial spirit and outward character of Taiwan's small and medium sized enterprises. This spirit is not a formula that can be easily copied by other regions, and has resulted in competitive advantages unique to Taiwan.

4.24 Taiwan's IC Industry Corporations Sustaining Development

As we have seen, Taiwan's IC industry corporations have already reached the status of leading global competitors. However, the question that remains is how Taiwan will retain and further develop this competitiveness. In order to enjoy continued growth, Taiwanese industry must:

1. **Develop long-term strategies based on best practices from around the world.**

2. Know the trends, Go with the trends, and not end up against them.

3. Pay attention to the service-orientation of manufacturing and the trend towards internet-oriented services.

4. Be self-reliant for technology development.

(Compiled by author from 工業技術研究院 2001 pp.23-56)

Developing Long-term Strategies

The IC industry promises a long future. This is because the nature of the industry is not to deliver products, but rather to provide manufacturing services that facilitate the miniaturization of electronic products, making them lighter, thinner, and more compact at ever decreasing prices and ever improving performance. Anyone using a cellular phone will understand how they have become smaller, lighter, cheaper and offer richer features, and can easily understand the contribution the IC industry has made to this market.

How Can Taiwan's IC Industry Continue to Develop?

Due to its special nature, the IC industry will continue to develop well into the future, in much the same way as the pharmaceutical industry has developed over the centuries. Although the materials and techniques may change, the demand for miniaturization and increased performance in electronic products will continue. Therefore, management at IC companies must always keep an eye trained towards the future, and not be tempted to alter plans based on the short-term fluctuation of stock prices. As for investors, they must also invest for the long term. As long as investors refrain from borrowing money to buy shares and avoid a short-term investment strategy, they will profit.

Taking the latest downturn in the industry from 1997 to 1998 as an example, even though stock prices dropped sharply, the downturn was actually of great benefit to the long-term development of Taiwan's IC industry. Due to unfavorable economic conditions, the large overseas manufacturers slowed investments and cut expenses. Many of Taiwan's IC companies took this opportunity to narrow the gap with their overseas competitors. This approach resulted in increased operating costs and further cooled the performance of short-term stock prices. However, as a result many of these companies have emerged from the downturn strengthened and significantly more competitive. Therefore, investors should follow the same strategy that management has adopted by managing their investments for the long term. Any short-term losses will be rewarded greatly in the future.

Going with the Trends

Taiwan's IC industry has achieved its competitiveness by following the trends toward the vertical division of labor and global integration. Consequently, any strategy that goes against these trends is unlikely to succeed. A study of past events at UTEK IC Corporation is proof of this phenomenon. Before merging with the UMC Group as a subsidiary, UTEK was an independent IC design house listed on the Taiwan Stock Exchange as Holtek IC. After achieving some success as an IC design house, Holtek's management decided to pursue the IDM strategy by building in--house production facilities. After the completion of its 5-inch fab, Holtek started the construction of an 8-inch fab.

This resulted in two serious problems that eventually affected the company's viability. First, it was unable to fill the capacity of its production facilities with its own product needs. Secondly, it did not have the scale or technical expertise to offer its remaining capacity in the form of foundry services to external customers. In order to avert disaster, Holtek was forced to split its design and manufacturing businesses.

Table 4.04 1999 OEM Orders by Brand Name

1999 Outsourcing Orders Allocation by Global PC Firms			
	PC vendors	Beneficiary	NT$bn
U.S.	**Dell**	**Compal** (2324)	27
	(NT$80bn)	**Quanta** (2382)	36
(NT$415bn)		**Hon Hai** (2317)	5 to 10
		Others	7 to 12
	Compaq	**Inventec** (2356)	55
	(NT$170bn)	**Arima** (2381)	40
		Hon Hai (2317)	18
		Others	57
	IBM	**Acer** (2306)	45
	(NT$100bn)	Others	55
		Total	100
	HP	**Compal** (2324)	15
	(NT$65bn)	**Mitac** (2315), **FIC** (2319), **GVC** (2322), **Twinhead** (2364), **Asustek** (2357)	50
Japan	**NEC** (NT$8bn)	**FIC** (2319)	8
		Compal (2324)	3
(NT$50bn)	**Fujitsu** (NT$6bn)	**Acer** (2306)	3

	Hitachi (NT$10bn)	**Acer** (2306), **Clevo** (2362)	10
	Other Japanese firms (NT$26bn)	NA	26

Source: (Various *ITRI Statistical Yearbook* 1998-2000 compiled by author)

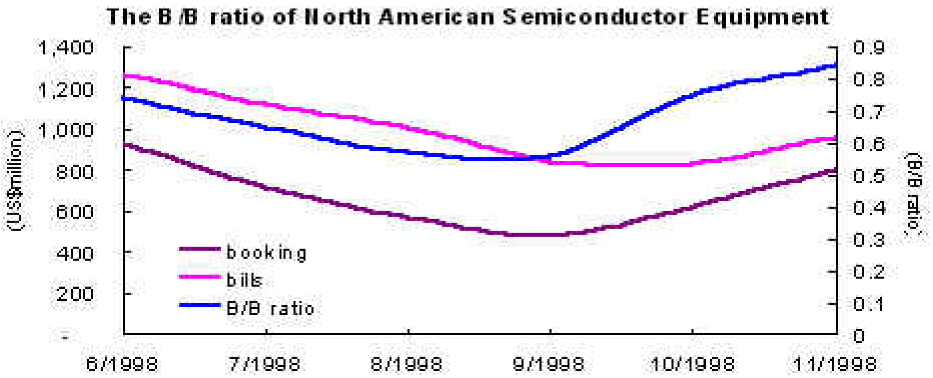
Table 4.05 Global Outsourcing

Beneficiaries of Global Outsourcing		
	Outsourcing Products	Major Beneficiaries
	Notebook	Compal, Quanta
	PC cases	Hon Hai
Dell	Power supply	Delta (2308.TW, NT$87.50)
	Notebook	Inventec, Arima
	PC cases	Hon Hai
		Mitac (2315.TW, NT$44.50)
Compaq	Desktop PC	FIC (2319.TW, NT$29.10)
	Notebook	Acer
	Motherboard	Universal Scientific (2350)
IBM	Desktop PC	Acer
HP		Compal, Quanta,
	Notebook	Twinhead (2364.TW, NT$40.60)
	Scanner	Umax (2348.TW, NT$23.30)
	Printer	Kimpo (2312.TW, NT$39.20)

Enlight (5319.TW, NT$62.50)

Sources: (Various *ITRI Statistical Yearbook* 1998-2000 compiled by author)

Table 4.06 The B/B Ratio Of IC Equipment.



Source: (2000 ITRI homepage Statistical Data www.itri.or.tw)

The situation at TSMC and Vanguard IC is another example. Both companies share the same Chairman and there is regular rotation of positions between their management teams. However, their operational results are completely different, with one company highly profitable and another suffering major losses. And why is this? The major reason is that TSMC specializes in the dedicated foundry business, allowing it to fully exploit the advantages of the vertical division of labor that exists in Taiwan's IC industry. At the same time, Vanguard is an integrated device manufacturer specializing in DRAM and is unable to benefit from the unique disintegrated infrastructure that exists in Taiwan. The difference is very simple, and clearly shows that it is easy to enjoy the fruits of success by following major trends, but very difficult going against them.

Today, there are many domestic and overseas IDMs that are struggling to buck the trend towards vertical division of labor. There may also be some IC design houses that are concerned that their product lines will have trouble expanding. Perhaps they are considering pursuing the IDM model as a short-term strategy to bolster their business results. However, this type of strategy will not solve their problems. The real challenge for these IC design houses is how to build market share by realizing better system integration and taking advantage of related products and services, such as EDA tools, IP cells, design services, and foundry services. If they can use the principles of specialization, integration, and globalization to their advantage, further their use of the internet, and better utilize the benefits of software to strengthen their physical designs, they will have no need to enter the manufacturing business and will be positioned for rapid growth (陳添枝 1994 pp.18-29; 苗豊強 1997 pp.34-66, 工業技術研究院 2001 pp.48-63) They should Pay attention to the service-orientation of manufacturing and the trend towards internet-oriented services. As a result of the vertical division of labor, Taiwan's electronics manufacturing industry long ago developed into a service industry. In the future, it must continue to make strides in developing its service orientation and internet-related services.

The IC sector is no exception. We can imagine in the future that IC manufacturing services will resemble today's airline industry, with every process the equivalent of an airline route, and every production lot resembling a flight along a particular route. Foundry customers will be similar to today's airline passengers, able to access information on each route and every flight over the Internet. They will even be able to place their orders on-line and track the progress of the wafers in real time. To remain competitive, IC manufacturers will have to continually offer new processes, providing greater miniaturization and increased performance for their IC design house customers. This vision of the future is exciting and well worth the wait.

Recently, people have warned that if Taiwan does not develop a software industry soon, today's manufacturing industries will vanish within four to five years. This may be true for traditional low technology manufacturing. However, if the manufacturing industries of the future can combine service orientation with high technology and the emerging capabilities of the internet, a whole new manufacturing model will be born. This new model will have the vitality necessary to ensure strong future growth and development. Therefore, if Taiwan's IC companies of the future are service-oriented, develop strong network services and have superior research and development capabilities, they will have a bright future. If they fail to do so, the future is not so sure.

Independent Technology Development

Taiwan's IC companies must continue to develop in line with the trends towards vertical division of labor, global integration, and Internet commerce in order to achieve sustained growth. However, there is one other basic condition: they must be self reliant for technology development. In Taiwan today, there are many companies whose technology is completely purchased from outside sources. In fact, the main thrust of their business is to provide low-cost labor to the providers of their technology. Although these companies have taken a shortcut to produce competitive products, they will surely face severe difficulties in the long-term. In fact, they are often paying a high price for technology used to make products that they are forced to sell at a low price. (see Part I 1.3) Therefore, even when business is good their profits are low, and when business takes a turn for the worse their losses are huge.

Of course, if the purchase of technology is just a first step to becoming self-reliant in technology development, this may not be such a faulty strategy. However, based on recent examples, once a company purchases its technology from an outside source it is set on the path to permanent reliance on outside technology. It seems that once a company has become dependent on outside technology, it loses the ability to make judgments independently. It is no longer in a position to profit from the learning curve strategy created by integration and specialization in the global economy. Furthermore, it has spent the funds necessary for the research and development of its own independent technology on the purchase of outside technology. These companies are doomed to a life of technology servitude. Therefore, a company's ability to achieve self-reliance in technology development is a strong indicator of its future potential.

4.25 Introduction to Company Case Studies

The Division of Labor of the Win-Win OEM Strategy (苗豐強 1997pp.34-67) Has Given Birth to a Globally Competitive IC Industry in Taiwan. It is well known that the IC industry is divided into highly specialized sectors, including IC design, mask making, wafer processing, and assembly and test. One of the most significant changes in the Taiwan IC industry in recent years has been the transition from a vertically integrated model to a vertical division of labor business model. These case studies show the diversity of strategy in action and ability to constantly adapt to the rapidly changing business environments that characterize each sector of the production cycle, and by the massive investment needed to remain competitive in the global economy. The so-called IDM (integrated device manufacturer) model, in which one company is responsible for all aspects of production, is no longer competitive due to the excessive strain it places on a company's financial, research and development, and management resources. As a result, the vertical division of labor of production is becoming the mainstream business model in Taiwan.

Interestingly, as recently as ten years ago, many analysts of Taiwan's IC industry suggested Taiwan could not compete globally in technology fields because the vertical integration of its companies was not as complete as with large foreign manufacturers. (Fukuyama 1994) Nine years later, these arguments have been completely refuted by the course of industry development. In fact, to the contrary, numerous studies demonstrate the superiority of the vertical division of labor over an integrated manufacturing system (陳添枝 1994 pp.8-27, 陳競玲 1999 pp.13-44). We will see in these case studies that because each sector of the production chain operates independently, it can develop a high level of specialization, greatly simplifying the management process. Also, because each sector of the production chain can raise funds independently, it is easier to fund growth to reach the critical mass necessary to be competitive. Increased efficiency in each sector of the production chain results in the shortest possible cycle times, allowing inventory to be kept at a minimum and dramatically reducing costs.

In an environment of constantly changing demand and technology, the vertical division of labor leads to much higher capacity utilization rates than in an integrated structure. Capacity utilization is the single most important factor influencing profitability in the IC industry because of the enormous investments needed in each sector of the IC production chain. In an integrated system, each sector has only one end user, i.e. the sector of the production process that precedes it within that same company. There is very little room for adjustment if a problem or change in demand arises within one sector. In contrast, in the vertical division of labor model every sector of the production chain has multiple customers. If the demand from one of these customers decreases, it is possible to supplement it with demand from another customer. This results in improved capacity utilization, and consequently higher profits (陳競玲 1999 pp.1-11).

Each sector in the disintegrated production chain is exposed to the harsh realities of global competition. Therefore, technology and services must continually improve for the company to survive. Consequently, each sector must develop strong competitiveness and the overall industry becomes strongly competitive.

Case Study 1: UMC United Micro Electronics*

Company Description

United Micro Electronics Corporation. The Group's principal activities are designing, producing and selling integrated circuits and related electronics products. Other activities include wafer foundry services, including embedded IC design, mask tooling, wafer production and testing. The Group operates in Taiwan, USA and other.

Background and History

United Microelectronics Corporation (UMC) was Taiwan's first semiconductor fabrication company, launched as a spin-off from ERSO in 1980. Since then it has flourished as a private concern, developing a sophisticated range of chip products, and expanding its revenue to top US$ 100 million by 1990, and reaching $565 million in 1994. This made it Taiwan's second most significant semiconductor revenue earner, after TSMC. In its first 15 years of operation, UMC developed a broad range of ICs used in commercial products, telecoms, computers and peripherals, and consumer products. This range encompasses logic, linear and analog chips, as well as assorted memory chips and customized products (ASICs). In the 1990s it has taken tentative steps towards becoming a producer of high value-added microprocessors (MPUs), particularly to Asian electronics and computer suppliers. It is producing both clones of Intel MPUs (without permission or licensing from Intel, and therefore running the risk of a major legal confrontation) as well as of the PowerPC (with full permission and support from the chip's developers, IBM and Motorola).

* All case study charts and data are collected directly from company quarterly and Annual Reports issued by each respective PR Division.

UMC has however held back from any involvement with DRAM production, watching others like TI-Acer joint venture enter this field, as well as ERSO / ITRI with its submicron project. When the pilot plant developed by the submicron project was auctioned off, in 1994, UMC eventually made no bid (allowing TSMC to become the major shareholder in the company formed to enter DRAM production, via Vanguard Semiconductor Corporation).

Origins

UMC is unusual amongst modern semiconductor companies in that it was entirely a creation of the public agency, ERSO; it began its commercial life with an endowment of products, technologies, equipment and staff all provided by ERSO. The capital of $NT 500 million (around US$ 20 million) was also raised by public agencies, notably the Ministry of Economic Affairs, drawing together a consortium of public and private investors. UMC was spun off from Taiwan's first chip fabrication effort, organized by the government through its research agency ERSO, and in collaboration with RCA. The initial president was Mr. Robert Tsao, a senior officer at ERSO and one of the "Taiwan 40" group trained at RCA from the very beginning. UMC was the first Taiwan company to apply for permission to establish itself in the new Hsinchu Science-based Industry Park. This was an important initiative, for it led to every other major semiconductor company in Taiwan locating at Hsinchu as well. This has generated enormous strategic clustering benefits for all the companies concerned. In keeping with its origins, UMC's early production efforts were simple chips oriented towards consumer applications such as calculators, watches and toys. It commenced pilot runs in April 1982 and had reached break-even point by November 1982 (Chang, Shih and Hsu 1994 p.166). It has turned a profit every year since 1982. UMC's sales were exceeding NT$ 100 million per month by mid-1983, and the company was marketing its products in East Asia (Hong Kong, Korea and Taiwan) and the USA. Subsequently, the USA has become a lesser market for UMC's products.

Since its launch, UMC has been progressively privatized. There was an initial public stock offering in 1985, which turned out to be most successful; UMC became a Taipei stock market darling. In 1993 the State-owned Bank of Communications (now the Chiao Tung Bank) still owned 7.3% of the stock, and the Ministry of Economic Affairs owned 8.1 % on behalf of the government; private interests held the rest. In 1984, UMC acquired a small chip design house in the US, named Unicorn. Through this, and other research contracts entered into with foreign firms, Mosel and Quasel, UMC leveraged itself into VLSI technology capability during the 1980s.

Production Facilities

UMC acquired Taiwan's first chip-making facility, with capacity of 20,000 wafers per month. It opened its second fab, embodying VLSI technology, in June 1989. This timing was fortuitous, for demand was soaring as the plant opened for business. UMC began construction of its third fab in early 1994. This 200mm wafer fab had a capacity of 30,000 wafers per month and operated in the range 0.5 to 0.35 microns, eventually going down to 0.25 micron. Investment of around $930 million was collected.

Foundry service has been important for UMC. In 1993 about 30 percent of its fab capacity was provided to OEM foundry customers, up from 10% in 1992. In 1994, the proportion grew to 40 percent, or $226 million. (This makes UMC the second largest foundry operation in the world, exceeding the revenue of $160 million earned in 1994 by the OEM Chartered in Singapore.) Foundry customers started to invest in equity positions in UMC. For example the US fabless company Alliance Semiconductor Corporation (San Jose, CA) invested $15 million in 1994 in UMC to make the Taiwanese company its manufacturing partner and in April 1995 Alliance increased the investment by $35 million to secure more wafer fabrication capacity. In addition to its $50 million invested in UMC, Alliance has also taken a similar $50 million stake in Singapore's Chartered Semiconductor, guaranteeing it capacity in Chartered's Fab 2, that began production in the second half of 1995. In the mid-1990s, it appeared that UMC was heading in a new strategic direction to become more of a foundry company than one developing its own product range.

Table 4.06 UMC's Early Years: Sales, Expenditures, R&D and Staff

UMC: Financial Data by Year (millions of US$)							
	1988	1989	1990	1991	1992	1993	1994'
Sales $mill.	120	117	149	215	255	372	565
Capital exp			10	19	20	80	130
R&D exp			18	19	35	55	83
Staff		1700	1800	1805	1810	1900	2100

Source: (Compiled by author from 工業技術研究院 1997 pp.31-119).

The company has made a profit every year except in 1990 (the year of the Gulf War). Profit levels have been in excess of 20 per cent.

Product Range

UMC started with chip sets for computers and linear ICs for consumer electronics. It is now an important supplier of a range of computer products, memory chips, chips for communications products, for consumer electronics, and starting in 1994, microprocessors and personal entertainment ICs (e.g. video games).

Table 4.07 UMC: Sales Analysis, by Product 1989-1993 (by percent).

(By %)	1989	1990	1991	1992	1993	2000
Computing ICs	38	25	23	23	25	15
Memory ICs	16	29	33	28	26	28
Comm ICs	13	7	1	2	7	14
Misc ICs	24	31	32	23	14	7
Wafer Foundry	9	8	11	24	28	36

Source: (Compiled by author from *工業技術研究院 1997-2000* pp.59-169).

UMC is never involved in standardized commodity products, but rather chooses profitable niche products such as I/Os for PCs, LAN for Ethernet, high-speed SRAMs etc. Note how wafer foundry operations have grown in significance, so that by 1994 they were accounting for nearly 40 percent of revenues. Sales by region reveal how UMC has targeted its sales efforts mainly in Taiwan itself and East Asia. Unlike all other East Asian IC firms, it has steered clear entirely of the US market. (This is not unconnected with its strategy of cloning Intel microprocessors.) UMC will broaden its involvement in semiconductors with a move into the rapidly expanding Liquid Crystal Display product market. It is constructing a fab for 10-inch LCDs. The existing Fab one now houses a pilot plant for 5-inch LCDs.

Operations

UMC wafer fabs operate 24 hours per day, 7 days per week. They are totally automated, including manufacturing and testing (auto probe). The fabs include central monitors for the environment. Particle counts are custom-checked and recorded. Quality and reliability get the highest priority. The fabs are certified by IECQ, providing international recognition. UMC employs automated design for its high-speed SRAMs and ROMs. UMC's perspective is to focus on design and flexibility, rather than on long production runs, as is the case with Korean producers. UMC stays at the leading edge of technology. In July 1992 it released 0.6-micron design rules to its customers; in 1994 it was introducing 0.5-micron design rules.

Microprocessor Initiatives

In May 1994, UMC introduced its long-awaited U5S 'Green Chip' (so-named because of its low power consumption), the first microprocessor compatible with Intel's 486-series chips to be manufactured outside the US. Since Intel is likely to take strong legal action against UMC, just as it has against other cloners, UMC has taken pre-emptive legal action, applying in both France as well as Taiwan to have Intel's so-called '338' patent invalidated. This patent has been invoked by Intel to try to stop competitors from manufacturing chips compatible with its own. UMC stated that it intends to follow the same legal course everywhere, probably next in Germany, seeking to have Intel's 338 patent invalidated.

In the US, Intel's competitors, AMD and Cyrix, have worked out licensing arrangements with Intel, or have secured court rulings, which enable them to use Intel's circuit patents. Intel was forced to drop a suit it launched against Cyrix in Texas earlier in 1994. But Intel fights the patent war vigorously; in 1993 it filed a complaint with the US International Trade Commission against the Taiwanese computer maker Twinhead International Corp, alleging that it was using chips made 'illegally' by Intel's competitors. US semiconductor manufacturers, particularly Intel, are using patent protection increasingly as a competitive weapon. Its action can be interpreted as a move signaling to the Taiwanese that they should seek licenses from Intel, thus paying royalties on products they sell. Note too that lntel is under investigation by the US Justice Department on anti-monopoly grounds, so it cannot afford to press its suits too hard. The main beneficiaries of UMC's new Intel clone MPU have been Taiwanese and Asian PC manufacturers, who are able to purchase a much cheaper version of the chip that others have to buy from Intel. At the press conference announcing the U5S chip and the legal moves UMC intends to make, UMC signed orders worth $6 million from small PC-manufacturers Aquarius Systems Inc, and Chaintech Computer Co. UMC's new chip is 'compatible with Intel's 486 SX chip, which has now been surpassed in performance by Intel's 486 DX chip, and of course more recently by the Pentium. UMC produced a chip compatible with Intel's 486 DX early in 1995.

There must be severe question marks posed to a strategy that pits a small global player like UMC against the best and biggest in the semiconductor world. Late in 1995, it appeared that UMC's microprocessor strategy was in some disarray. The joint venture to develop new products with the US firm Meridian, did not appear to be working well. The major competitor to Intel's dominance of the microprocessor market is the PowerPC, developed jointly by IBM and Motorola, and utilized in all Apple's products. A 'New PC' consortium has been formed in Taiwan, to develop products based on the PowerPC microprocessor. UMC joined this consortium in its early stages, to give it access to the basic PowerPC platform. This gives UMC a bet each way in the microprocessor stakes. Since the consortium is supported by IBM and Motorola, and coordinated by CCL/ITRI, there is no danger of intellectual property rights issues arising if and when UMC starts producing versions of the PowerPC for the PC consortium. However UMC dropped out of the PowerPC consortium in its third phase, and its commitment to producing PowerPC products must be in doubt.

UMC involvement in ERSO and CCL Sponsored Consortia

UMC has three principal involvements in ITRI-sponsored collaborative development projects.

SPARC Workstations

In this case, UMC collaborates in the development of SPARC workstations, providing chip sets under authorization from CCL. UMC is developing chipsets based on the IBM-Motorola-Apple PowerPC, for a new PowerPC-based personal computer produced by a CCL-sponsored consortium in Taiwan. But as noted above, UMC has now dropped out of this consortium. HDTV UMC is developing digital signal processing chips for use by the Taiwan HDTV consortium.

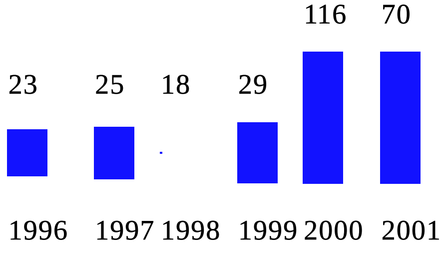
Thus UMC emerges as a highly competent semiconductor firm that has maintained a very profitable focus on high-value adding products, eschewing the large mass-production items that have powered Korean success. The company is well aware of current trends and is situating itself to take advantage of the future expected demand for microprocessors in the Asian region. It is adopting a two-pronged strategy, involving both the Power PC and its own clones of Intel chips. The latter course is risky, and UMC has to pay a high price in foregoing sales in the US market in order to pursue it. The big question mark hanging over UMC's product strategy is its reluctance to get involved in standardized products, particularly DRAMs. It has been reported that UMC and Intel explored the possibility of Intel transferring its flash memory manufacturing technology across to UMC, but that eventually this possibility was discounted, after both sides found it not to their liking. So although UMC continues to keep the option of DRAM manufacture 'under review', there appear to be no plans currently to become involved. The most recent shift in strategic direction, towards offering foundry services as the major 'product' line of UMC, pits it directly as a competitor against TSMC in Taiwan and Chartered Semiconductor of Singapore. UMC clearly sees the foundry market as one of continuing growth in revenue and profits.

Competitor Analysis

United Micro Electronics Corporation operates within the Semiconductors and related devices sector. This analysis compares United Micro Electronics with three other companies in this sector in Taiwan: Advanced Semiconductor Engineering, Inc (2001 sales of 38.37 billion Taiwanese Dollars [US$1.11 billion] of which 75% was Installation department), Via Technologies (33.81 billion Taiwanese Dollars [US$978.40 million]), and World Peace Industrial Company (42.51 billion Taiwanese Dollars [US$1.23 billion]).

Sales Analysis During the year ended December of 2001, sales at United Micro Electronics were 69.82 billion Taiwanese Dollars (US$2.02 billion). This is a sharp decrease of 39.6% versus 2000, when the company's sales were 115.61 billion Taiwanese Dollars.

Table 4.08 Recent Sales at United Micro Electronics



(Figures in Billions of Taiwanese Dollars)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

The company derives most of its revenues in its home market of Taiwan: in 2001, this region's sales were 37.42 billion Taiwanese Dollars, which is equivalent to 53.6% of total sales. On a geographical basis, contributing to the decline in the company's sales in 2001 were the declines in others, where sales dropped 53.2% to 4.67 billion Taiwanese Dollars. Sales in Taiwan were also lower, falling 39.8% (to 37.42 billion Taiwanese Dollars). The company currently employs 9,373. With sales of 69.82 billion Taiwanese Dollars (US$2.02 billion) , this equates to sales of US$215,566 per employee.

Table 4.09 Sales Comparisons for UMC (Fiscal Year Ending 2001)

Company	Sales (blns)	Sales Growth	Sales/ Emp (US$)	Largest Region
United Micro Electronics	69.817	-39.6%	215,566	Taiwan (53.6%)
Advanced Semiconductor Engineering, Inc	38.368	-24.6%	N/A	Taiwan (76.2%)
Via Technologies	33.808	10.4%	1,583,167	N/A
World Peace Industrial Company	42.512	39.5%	7,237,109	Asia (57.4%)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Profitability Analysis

On the 69.82 billion Taiwanese Dollars in sales reported by the company in 2001, the cost of goods sold totaled 24.72 billion Taiwanese Dollars, or 35.4% of sales (i.e., the gross profit was 64.6% of sales). This gross profit margin is lower than the company achieved in 2000, when cost of goods sold totaled 27.2% of sales. United Micro Electronics' 2001 gross profit margin of 64.6% was better than all three comparable companies (which had gross profits in 2001 between 5.3% and 40.9% of sales).

The company's earnings before interest, taxes, depreciation and amortization (EBITDA) were 29.44 billion Taiwanese Dollars, or 42.2% of sales. This EBITDA margin is worse than the company achieved in 2000, when the EBITDA margin was equal to 63.6% of sales. The three comparable companies had EBITDA margins that were all less (between -1.2% and 21.3%) than that achieved by United Micro Electronics.

Although sales at United Micro Electronics fell 39.6% in 2001, the company actually increased it's selling, general and administrative expenses 5.01 billion Taiwanese Dollars (approximately 47.0%). In 2001, earnings before extraordinary items at United Micro Electronics were -3.16 billion Taiwanese Dollars, or -4.5% of sales. This profit margin is lower than the level the company achieved in 2000, when the profit margin was 43.9% of sales. The company's return on equity in 2001 was -1.4%. This was significantly worse than the already high 42.6% return the company achieved in 2000. (Extraordinary items have been excluded).

Table 4.10 Profitability Comparison for UMC

Company	Year	Gross Profit Margin	EBITDA Margin	Earns bef. extra
United Micro Electronics	2001		42.2%	-4.5%
United Micro Electronics	2000	72.8%	63.6%	43.9%
Advanced Semiconductor Engineering, Inc	2001	14.1%	-1.2%	-5.2%
Via Technologies	2001	40.9%	21.3%	15.7%
World Peace Industrial Company	2001	5.3%	2.3%	0.5%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Inventory Analysis

The value of the company's inventory totaled 5.72 billion Taiwanese Dollars. Since the cost of goods sold was 24.72 billion Taiwanese Dollars for the year, the company had 84 days of inventory on hand (another way to look at this is to say that the company turned over its inventory 4.3 times per year). In terms of inventory turnover, this is a significant improvement over , when the company's inventory was 10.79 billion Taiwanese Dollars, equivalent to 125 days in inventory. The 84 days in inventory is higher than the three comparable companies, which had inventories between 31 and 72 days sales at the end of 2001.

Research and Development

Research and Development Expenses at United Micro Electronics in 2001 were 8.96 billion Taiwanese Dollars, which is equivalent to 12.8% of sales. In 2001 R&D expenditures increased both as a percentage of sales and in actual amounts: In 2000, United Micro Electronics spent 6.31 billion Taiwanese Dollars on R&D, which was 5.5% of sales. During each of the previous 4 years, the company has increased the amount of money it has spent on Research and Development (in 1997, United Micro Electronics spent 1.76 billion Taiwanese Dollars versus 8.96 billion Taiwanese Dollars in 2001).

Financial Position

The company's long-term debt was 54.70 billion Taiwanese Dollars and total liabilities (i.e., all monies owed) were 87.41 billion Taiwanese Dollars. The long-term debt to equity ratio of the company is 0.24. The accounts receivable for the company were 12.13 billion Taiwanese Dollars, which is equivalent to 63 days of sales. This is an improvement over the end of 2000, when United Micro Electronics had 69 days of sales in accounts receivable.

Table 4.11 Financial Positions for UMC

Company	Year	LT Debt/ Equity	Days AR	Days Inv.	R&D/ Sales
United Micro Electronics	2001	0.24	63	84	12.8%
Advanced Semiconductor Engineering, Inc	2001	0.73	68	31	3.9%
Via Technologies	2001	0.18	51	72	0.0%
World Peace Industrial Company	2001	0.37	65	52	0.0%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.12 Analysis Summary: United Micro Electronics Corporation

Note: All figures are in U.S. Dollars

		Ratios		Equity Capital					Dividends	
Year	Last Price	P/E	P/Bk	Earned Growth %	Profit Rate %	Book Value Begin Yr	Earnings Per Share	% Chg	Divs Per Share	Avg Yield
1993	0.24	21.6	n/c	n/c	n/c	n/a	D 0.011	n/c	A 0.00	0.0
1994	0.41	15.6	8.6	50.2	55.4	0.05	D 0.026	133	A 0.00	0.6
1995	0.34	6.8	4.5	65.2	65.2	0.08	D 0.049	86	A 0.00	0.0
1996	0.37	14.4	3.1	21.6	21.6	0.12	D 0.026	-48	A 0.00	0.0
1997	0.79	28.4	5.2	18.3	18.3	0.15	D	8	A	0.0

							0.028		0.00	
1998	0.64	49.8	3.2	6.5	6.5	0.20	D 0.013	-54	A 0.00	0.0
1999	2.04	71.0	9.3	13.3	13.3	0.22	D 0.029	127	A 0.00	0.0
2000 C	1.05	10.2	3.2	31.6	31.6	0.33	BD 0.103	254	A 0.00	0.0
2001	1.28	n/c	3.1	-1.5	-1.5	0.42	D -0.006	n/c	A 0.00	0.0
2002	0.61	n/c	1.5	n/c	n/c	0.40	n/a	n/c	A 0.00	0.0
3/7/03	0.56	n/c	1.4	n/a	n/a	0.40	-0.006	n/c	A 0.00	0.0

The data included in the notes have not been converted to U.S. Dollars. To convert the data in the notes use a factor of: 0.028940

(A): ALL ITEMS ADJUSTED FOR STOCK SPLITS OR DIVIDENDS - 15% IN 2002, 15% IN 2001, 20% IN 2000, 15% IN 1999, 29% IN 1998, 30% IN 97, 93% IN 96, 50% IN 95, 25% IN 94, 15% IN 93

(B): INCLUDES THE EFFECTS OF A CHANGE IN ACCOUNTING POLICIES OR TAX LAWS - - ADOPTED THE STRAIGHT-LINE METHOD OF ACCOUNTING FOR THE DEPRECIATION OF FIXED ASSETS IN 2000, EARNINGS IMPACT IMMATERIAL

(C): ACQ'D - UMC CAPITAL CORPN & 51.95% OF UMCI PTE LTD IN 2001

(D): BASED ON AVERAGE SHARES OUTSTANDING

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.13 Sales & Profitability Summary: United Micro Electronics Corporation

Figures expressed in billions of U.S. Dollars

Year	Sales	Sales Growth<	EBITDA	% of sales	Inc. bef Extra	% of sales	Emps	Sales/Empl
1993	0.296	n/c	0.115	39.0%	0.071	24.0%	1,974	149,999
1994	0.448	51.4%	0.238	53.2%	0.188	41.9%	2,285	196,134
1995	0.713	59.1%	0.428	60.0%	0.389	54.6%	2,982	239,100
1996	0.654	-8.2%	0.277	42.4%	0.221	33.8%	n/a	n/a
1997	0.726	11.0%	0.221	30.4%	0.282	38.8%	n/a	n/a
1998	0.533	-26.5%	0.151	28.2%	0.128	23.9%	n/a	n/a
1999	0.844	58.1%	0.328	38.8%	0.304	36.0%	n/a	n/a
2000	3.346	296.6%	2.126	63.6%	1.470	43.9%	9,373	356,954
2001	2.020	-39.6%	0.852	42.2%	-0.091	-4.5%	n/a	n/a

Earnings and Dividend Analysis: United Micro Electronics Corporation

Figures in U.S. Dollars

Quarters are Calendar Quarters (4th quarter ends in December)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Case Study 2: Taiwan Semiconductor Manufacturing Company (TSMC)

Company Description

The Group's principal activities are the manufacture, sale, packaging, testing and design of integrated circuits and other semiconductor devices. Other activities of the Group include the manufacturing of masks, foundry business and investing in affairs that focused on the design, manufacture, and other related business of semiconductors. Operations of the Group are carried out in Taiwan and overseas countries such as North America, Japan and Europe.

Background and History

The Taiwan Semiconductor Manufacturing Company (TSMC) has long been the leader as Taiwan’s largest and most successful semiconductor project to date. Founded only in 1986, as the first silicon foundry in the world, its sales revenues have soared, from US$466 million in 1993 and $720 million in 1994 to an amazing US$5.12 billion in 2000 (see charts inside this case study. Profits have also been substantial, for that TSMC is reputed to be the most profitable semiconductor company in the world averaging around 38% profit on sales and 28% return on equity during the 1994-2000 period. TSMC has thus been a resounding success in its own right as a profitable company. But its impact on the Taiwanese semiconductor industry has been much greater than this. It was created by ITRI, as a joint venture involving the Dutch multinational Philips, to act as a technology transfer vehicle, offering OEM foundry facilities to existing semiconductor firms and to the design firms whose formation it was intended to stimulate. In this it has been quite remarkably successful. Funding of $145m was provided by the NGO called the Taiwan Development Fund (47.5%), Philips N.V. (27.5%) and 25% from a group of Taiwanese firms.

TSMC was set up to concentrate on OEM manufacturing for other companies, and not competing with them in selling chips. The first president was James Dykes, formerly of General

Electric's Semiconductor Business Division until its merger with RCA; he described the concept as 'unique' and likely to be very effective. Semiconductor companies can utilize these resources without fear that TSMC will take their technology and run to the market. The formation of TSMC represented a radical departure for Taiwan, and above all a break from the emphasis on building pilot operations at ITRI. The move away from continued R&D in a pilot VLSI plant, towards a full commercial operation established as a joint venture with a major multinational, was very much a strategy associated with Dr Morris Chang upon his arrival at ITRI in 1985. He met some resistance from ERSO but overcame this, winning government support for his proposal to establish a foundry. The switch in policy came as something of a surprise to many ITRI/ERSO people (王羽 2001-07 interview).

Philips already had a close relationship with Taiwan; it acted as the European distributor of Taiwanese semiconductor products. Under the agreement to form TSMC, Philips supplied 2.0-micron technology for producing VLSI devices, at no charge; but it is to collect a technical assistance fee of 3% of net sales of certain products for ten years, from January 1 1988. This agreement will automatically continue for successive periods of five years, unless either party terminates it. Philips was given the option of purchasing up to 51 % of the ownership during the fourth and tenth year after establishment of TSMC. In 1992, Philips in fact increased its stake to 40%, and this was then declared to be the maximum the company could have.

Even more important than the technology supplied by Philips has been its intellectual property rights protection. Philips has cross-licensing agreements with most of the world's IT giants, including IBM, Intel, Motorola etc, and because of its ownership stake, these carry over to TSMC, at least informally. As a result, TSMC has been untroubled by intellectual property litigation, or any other form of litigation for that matter. TSMC remains as the only Taiwanese semiconductor venture in which a major non-Taiwanese multinational has played an important role (Electronics, March 5, 1997 p.35). Mr. Dykes stayed with TSMC during its first 18 months, and then moved in 1989 to take over as President of Signetics, the California-based US subsidiary of Philips. The company's first chairman was Morris Chang, formerly CEO of General Instrument Corp and a senior VP at Texas Instruments and he was also the Chairman of ITRI. The President of TSMC then was Mr. Donald Brooks, a former VP at Texas Instruments in charge of memory devices, and a veteran of the US-Japan DRAM wars. TSMC began operations in early 1987 by leasing fabrication facilities from ITRI. The fab (called Fab 1) had a capacity of 12,000 6-inch wafers per month, using double-metal and double-poly processes to 1.0-micron design rules. The major initial local customers included Quasel and UMC, while foreign customers included MNCs located in Taiwan, such as NEC, Toshiba and Apple; Philips absorbed 35 percent of the output.

The capacity of Fab one was not sufficient to allow TSMC to become a significant player in the international foundry business, so planning began immediately for a more advanced Fab 2. (It was in any case the intention of the Taiwanese government to use TSMC as a fast learning vehicle.) The Fab 2 was designed from the ground up as a fully SMIF-integrated operation - the first in the world (Shu and Tu 1992 pp.25-33). This would give it unrivalled flexibility. Fab 2 was designed for output capacity of 40,000 6-inch wafers per month in two modules of 20,000 wafers each, operating at submicron design level. TSMC selected the Asyst Technologies SMIF-system and smart-traveler system for the new facilities, which came on stream in 1989. This was a first for Taiwan, and the system has been a great success for TSMC, offering enhanced flexibility, as well as the possibility of automating much of its work-in-progress monitoring and control - a big and potentially disastrous issue for a foundry like TSMC having to put a wide variety of lots through repeated wafer processing steps. The high quality and yield levels achieved at TSMC attest to the success of its control system, which in turn is linked to its SMIF technology developed through its diversity strategy with Phillips.

TSMC broke ground in late 1993 for Fab III, a 0.6-micron; 200mm wafer fab with a capacity of 25,000 wafers per month. It was completed in 1996. A fourth foundry fab, started operations in 1997. This employed CMOS technology with line widths down 0.25 micron, for 8-inch wafer production. The company also constructed a foundry facility in the US, which is where most of its major customers are located. TSMC has its own mask generation capability, in addition to its ownership of a 10% stake in Taiwan Mask Corporation - another ERSO spin-off. In addition, TSMC offers test support (wafer probe and final testing) as well as assembly services, thus offering customers a completely integrated service. TSMC has been so successful in fact that it has had trouble in keeping up with demand. To provide itself with extra capacity until Fab III was ready, TSMC leased an undisclosed portion of fab space from fellow Taiwanese company Macronix, in October 1993. Under the agreement, worth $80 million, Macronix installed equipment for 150mm wafer production, supplying TSMC with a total of 252,000 wafers over the three years May 1994 to June 1997.

Sales Revenues and Costs

The sales revenue history for TSMC is given in Chart A-1. Revenues were only US$ 4.4 million in 1987, the year the company started operations.

Table 4.14 TSMC's Early Period & 2000: Sales, Investment and Employment

US$ millions	1988	1989	1990	1991	1992	1993	1994	2000
Sales	33	71	82	167	258	475	720	5120
Net Income			8	13	18	46	140	2230
R&D					3	5	7	210
Capital Invested				160	100	140	300	1630
Staff	586	809	1187	1501	1893	2294	2557	8238

Source: (Compiled by author from 工業技術研究院 2001 pp.31-119)

Sales revenues have shown steady growth, without any hiccups. In fact, TSMC's sales belie their significance; as a foundry, its costs are considerably less than those of a dedicated producer. Its pattern of investment is characteristic bf a foundry - high capital spending, but low R&D expenditure. This reflects the absence of product development expenses. TSMC now has over 100 customers worldwide, including of course Philips, its major equity holder, as well as AMD and Analog Devices, and a host of small Taiwanese design houses. Its US sales accounted for 55% of revenue in 1993, with Taiwanese sales shrinking to only 25-30%, and European sales to 15-20% (primarily Philips which maintains very close relations). It has no Japanese customers.

TSMC, like other Taiwanese semiconductor concerns, draws substantial benefits from being located on the Hsinchu Science-based Industrial Park. The company has been entitled to tax holidays on a number of investment projects.

These Include:

1. First manufacturing plant: Jan 1 1989 to Dec 31 1989;
2. Module A of Fab 2: Jan 1 1992 to Dec 31 1995;
3. Module B of Fab 2: Jan 1 1993 to Dec 31 1996;
4. Computer-aided design: Jan 1 1994 to Dec 31 1996;
5. Extensions to Fabs 1 and 2: Jan 1 1994 to Dec 31 1997.

Foundry Service

TSMC is a full service house, the largest and in many ways most advanced silicon foundry in the world. It has no packaging or test operations. It maintains an extensive cell library. TSMC's principal OEM competitor is Chartered Semiconductor of Singapore. The key to foundry success is flexibility. In this sense, TSMC provides the model, with its multiple processes all compatible with each other through SMIF boxes and a sophisticated CIM system operating a SMART traveler system for each box. TSMC's mini-environment manufacturing system (i.e. wafer isolation technology) allows it to add capacity with a machine set up next to one that is already operational. This flexible capacity varies widely from the Japanese-style dedicated fab.

TSMC offers three entry points for customers. They can take advantage of a full ASIC service; encompassing design, mask making and VLSI wafer fabrication; or the mask making service and wafer fabrication (as done by many of the fabless companies at Hsinchu such as Weltrend); or the wafer fabrication service alone. Most customers are interested in the wafer fabrication service, although revenue from the ASIC and mask options is growing. Exit points are with an untested wafer, a probed wafer, or with a fully assembled, packaged and tested chip (where TSMC subcontracts the final packaging). TSMC's charter prevents it from offering any products under its own brand; it works exclusively as an OEM manufacturing service organization for those who have a product they wish to have produced.

In addition to standard foundry contracts, TSMC seeks long-term win-win OEM cooperative relations with customers through offering them guaranteed capacity and sales; through encouraging equity investments by customers (notably Philips); and by offering customers seats on the Board. These are all examples of international "best practice" in organizational structures and processes. TSMC has focused its technology on CMOS Logic and Mixed analog/digital IC fabrication, while dedicating some its capacity for memory products such as SRAMs and non-volatile memory. (Flash memory is planned, but is not available yet.) This has given it enormous flexibility in meeting demand for a wide variety of products from its customers.

Apart from its initial technology transfer from ERSO and Philips, TSMC has not been involved in many significant technology transfer deals. In 1994, TSMC and AMD reached a significant foundry agreement under which AMD doubled its production capacity for its Am486 microprocessors by the end of 1995. Under the agreement, AMD transferred 0.5-micron technology to TSMC in 1996. TSMC continues to recognize its debt to ITRI, and pays royalty fees on account of technology received at its start-up. Altogether, royalty payments add up to only 2% of TSMC's total costs - a far lower rate than the 20% or so faced by the technology borrowing

Korean companies.

Ownership

TSMC has been a public company since October 1992, and its shares were listed on the Taiwan stock exchange in early 1994. Its major shareholders are the Development Fund of the Executive Yuan (representing the government) and Philips, together with smaller shareholders such as Swanson Plastics Corp. Under an agreement reached at the time of TSMC's formation, Philips was given the option to increase its shareholding from 27.5% to 51%. In November 1992, Philips and one of its affiliates increased their combined shareholding to 40%; Philips has made a commitment, reported to the Taiwan Stock Exchange, not to increase its shareholding beyond this level, thus waiving its 51% option. Philips holds five seats out of 13 on the Board.

In 1994, TSMC embarked on a new chapter in its history and became a major shareholder in the new DRAM manufacturing venture, Vanguard Semiconductor Corporation, launched by ERSO as a spin-off from its Sub-micron ULSI project. This carried TSMC into the world's Big League of memory chip fabrication. This venture was kept quite separate from TSMC's continuing foundry operations. Overall, then, TSMC must be counted as Taiwan's greatest success to date in the semiconductor industry. Its founding as a joint venture with Philips gave an important amount of diversity to Taiwan's cooperation strategy of technology absorption, leveraging it into the Big League of VLSI fabrication. Its main success results from its overall human resource diversity strategy and knowledge mobility utilization. Its charter as a foundry has proven to be a brilliant success, offering not only a very profitable business, but also a stimulus to the development of dozens of small, fabless design houses and chip suppliers who can use its services with confidence.

This is a highly original approach to the use of public sector facilities to encourage industry development. By 1994 it was fully privatized and TSMC continued its expansion through process technology transfers such as that recently agreed with AMD, and entered new ventures such as a major DRAM production operation. With turnover in 1995 in excess of US$1 billion, the company had committed itself to future investment of nearly $3 billion by the year 2000 for building new 8-inch wafer fabrication facilities. By the year 2000, TSMC was Taiwan's number 3 largest industrial companies after the Mitac Computer Group and Acer, with turnover of around US$5.2 billion. Having leveraged itself abreast of the world's best, the issue now facing TSMC is whether it can sustain a capability in innovation to match its proven capabilities in expansion.

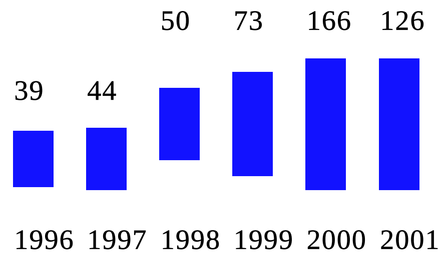
Competitor Analysis

Taiwan Semiconductor Manufacturing Corp. operates within the Semiconductors and related devices sector. This analysis compares Taiwan Semiconductor Manufacturing Corporation with three other companies in this sector in Taiwan: United Micro Electronics Corporation (2001 sales of 69.82 billion Taiwanese Dollars [US$2.02 billion] of which 96% was Semi-conductor products), Advanced Semiconductor Engineering, Inc (38.37 billion Taiwanese Dollars [US$1.11 billion] of which 75% was Installation department), and World Peace Industrial Company (42.51 billion Taiwanese Dollars [US$1.23 billion]).

Sales Analysis

During the year ended December of 2001, sales at Taiwan Semiconductor Manufacturing Corp. were 125.88 billion Taiwanese Dollars (US$3.64 billion). This is a sharp decrease of 24.3% versus 2000, when the company's sales were 166.20 billion Taiwanese Dollars.

Table 4.15 Recent Sales at Taiwan Semiconductor Manufacturing Company



(Figures in Billions of Taiwanese Dollars)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

The company currently employs 14,636. With sales of 125.88 billion Taiwanese Dollars (US$3.64 billion), this equates to sales of US$248,914 per employee.

Table 4.16 Sales Comparisons for TSMC (Fiscal Year ending 2001)

Company	Sales (blns)	Sales Growth	Sales/ Emp (US$)	Largest Region
Taiwan Semiconductor Manufacturing Corp.	125.885	-24.3%	248,914	Taiwan (100.0%)
United Micro Electronics Corporation	69.817	-39.6%	215,566	Taiwan (53.6%)
Advanced Semiconductor Engineering, Inc	38.368	-24.6%	N/A	Taiwan (76.2%)
World Peace Industrial Company	42.512	39.5%	7,237,109	Asia (57.4%)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.17 Summary of Company Valuations for TSMC (as of 3/7/03)

Company	P/E	Price/ Book	Price/ Sales	52 Wk Pr Chg
Taiwan Semiconductor Manufacturing Corp.	50.1	2.65	6.14	-54.50%
United Micro Electronics Corporation	N/A	1.38	4.05	-57.13%
Advanced Semiconductor Engineering, Inc	N/A	1.37	1.42	-48.39%
World Peace Industrial Company	28.7	1.24	0.17	-49.41%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

The market capitalization of this company is 772.96 billion Taiwanese Dollars (US$22.37 billion). Closely held shares (i.e., those held by officers, directors, pension and benefit plans and those shareholders who own more than 5% of the stock) amount to over 50% of the total shares outstanding: thus, it is impossible for an outsider to acquire a majority of the shares without the consent of management and other insiders. The capitalization of the floating stock (i.e., that which is not closely held) is 241.19 billion Taiwanese Dollars (US$6.98 billion).

Profitability Analysis

On the 125.88 billion Taiwanese Dollars in sales reported by the company in 2001, the cost of goods sold totaled 36.91 billion Taiwanese Dollars, or 29.3% of sales (i.e., the gross profit was 70.7% of sales). This gross profit margin is slightly lower than the company achieved in 2000, when cost of goods sold totaled 29.0% of sales. Taiwan Semiconductor Manufacturing Corporation’s 2001 gross profit margin of 70.7% was better than all three comparable companies (which had gross profits in 2001 between 5.3% and 64.6% of sales). The company's earnings before interest, taxes, depreciation and amortization (EBITDA) were 68.10 billion Taiwanese Dollars, or 54.1% of sales. This EBITDA margin is worse than the company achieved in 2000, when the

EBITDA margin was equal to 61.8% of sales. The three comparable companies had EBITDA margins that were all less (between -1.2% and 42.2%) than that achieved by Taiwan Semiconductor Manufacturing Company. Although sales at Taiwan Semiconductor Manufacturing Company fell 24.3% in 2001, the company actually increased it's selling, general and administrative expenses 5.66 billion Taiwanese Dollars (approximately 37.2%).

In 2001, earnings before extraordinary items at Taiwan Semiconductor Manufacturing Corp were 14.48 billion Taiwanese Dollars, or 11.5% of sales. This profit margin is lower than the level the company achieved in 2000, when the profit margin was 39.2% of sales. The company's return on equity in 2001 was 5.8%. This was significantly worse than the already high 53.9% return the company achieved in 2000. (Extraordinary items have been excluded).

Table 4.18 Profitability Comparison for TSMC

Company	Year	Gross Profit Margin	EBITDA Margin	Earns bef. extra
Taiwan Semiconductor Manufacturing Corp.	2001		54.1%	11.5%
Taiwan Semiconductor Manufacturing Corp.	2000	71.0%	61.8%	39.2%
United Micro Electronics Corporation	2001	64.6%	42.2%	-4.5%
Advanced Semiconductor Engineering, Inc	2001	14.1%	-1.2%	-5.2%
World Peace Industrial Company	2001	5.3%	2.3%	0.5%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Inventory Analysis

The value of the company's inventory totaled 9.83 billion Taiwanese Dollars. Since the cost of goods sold was 36.91 billion Taiwanese Dollars for the year, the company had 97 days of inventory on hand (another way to look at this is to say that the company turned over its inventory 3.8 times per year). Although the inventory level dropped by 2.96 billion Taiwanese Dollars during FY2001, there was an almost insignificant increase in days in inventory from, when the company had 12.79 billion Taiwanese Dollars, which was 97 days of sales in inventory. The 97 days in inventory is higher than the three comparable companies, which had inventories between 31 and 84 days sales at the end of 2001.

Research and Development

Research and Development Expenses at Taiwan Semiconductor Manufacturing Corp in 2001 were 10.65 billion Taiwanese Dollars, which is equivalent to 8.5% of sales. In 2001 R&D expenditures increased both as a percentage of sales and in actual amounts: In 2000, Taiwan Semiconductor Manufacturing Company spent 5.13 billion Taiwanese Dollars on R&D, which was 3.1% of sales. Taiwan Semiconductor Manufacturing Company increased its R&D spending in 2001 by 5.52 billion Taiwanese Dollars. If it had kept its R&D expenditures level with 2000, then the ordinary earnings before taxes would have been approximately 51% higher.

Financial Position

The company's long-term debt was 46.40 billion Taiwanese Dollars and total liabilities (i.e., all monies owed) were 72.96 billion Taiwanese Dollars. The long-term debt to equity ratio of the company is 0.17. the accounts receivable for the company were 16.95 billion Taiwanese Dollars, which is equivalent to 49 days of sales. This is an improvement over the end of 2000, when Taiwan Semiconductor Manufacturing Corporation had 67 days of sales in accounts receivable. The 49 days of accounts receivable at Taiwan Semiconductor Manufacturing Corporation are lower than all three comparable companies: United Micro Electronics Corporation had 63 days, Advanced Semiconductor Engineering, Inc had 68 days, while World Peace Industrial Company had 65 days outstanding at the end of the fiscal year 2001.

Table 4.19 Financial Positions for TSMC

Company	Year	LT Debt/ Equity	Days AR	Days Inv.	R&D/ Sales
Taiwan Semiconductor Manufacturing Corp.	2001	0.17	49	97	8.5%
United Micro Electronics Corporation	2001	0.26	63	84	12.8%
Advanced Semiconductor Engineering, Inc	2001	0.73	68	31	3.9%
World Peace Industrial Company	2001	0.37	65	52	0.0%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.20 Analysis Summary: Taiwan Semiconductor Manufacturing Corporation

Note: All figures are in U.S. Dollars

		Ratios		Equity Capital					Dividends	
Year	Last Price	P/E	P/Bk	Earned Growth %	Profit Rate %	Book Value Begin Yr	Earnings Per Share	% Chg	Divs Per Share	Avg Yield
1994	0.29	14.4	n/c	n/c	n/c	n/a	B 0.020	n/c	0.00	0.0
1995	0.29	8.2	6.4	78.1	78.1	0.04	B 0.035	74	0.00	0.0
1996	0.34	7.7	4.4	56.4	56.4	0.08	B 0.044	26	A 0.00	0.0
1997	1.01	25.5	8.6	33.6	33.6	0.12	B	-10	A	0.0

							0.040		0.00	
1998	0.93	28.0	6.1	21.7	21.7	0.15	B 0.033	-16	A 0.00	0.0
1999	2.70	53.2	14.8	28.7	28.7	0.18	0.051	57	A 0.00	0.0
2000	1.64	13.9	6.5	46.4	46.4	0.25	B 0.118	126	A 0.00	0.0
2001	2.53	105.4	5.8	5.5	5.5	0.44	B 0.024	-80	A 0.00	0.0
2002	1.23	n/c	2.7	n/c	n/c	0.45	n/a	n/c	0.00	0.0
3/7/03	1.20	50.1	2.7	n/a	n/a	0.45	0.024	n/c	0.00	0.0

The data included in the notes have not been converted to U.S. Dollars. To convert the data in the notes use a factor of: 0.028940

(A): ALL ITEMS ADJUSTED FOR STOCK SPLITS OR DIVIDENDS - 40% IN 2001, 28% IN 2000, 23% IN 1999, 45% IN 1998, 50% IN 97, 80% IN 96

(B): BASED ON AVERAGE SHARES OUTSTANDING

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.21 Sales & Profitability Summary: Taiwan Semiconductor Manufacturing Corporation

Figures expressed in billions of U.S. Dollars

Year	Sales	Sales Growth<	EBITDA	% of sales	Inc. bef Extra	% of sales	Emps	Sales/Empl
1994	0.560	n/c	0.333	59.5%	0.245	43.8%	2,681	208,723
1995	0.832	48.8%	0.521	62.6%	0.436	52.4%	3,412	243,988
1996	1.140	37.0%	0.717	62.9%	0.561	49.2%	4,117	276,959
1997	1.271	11.5%	0.731	57.5%	0.520	40.9%	5,593	227,337
1998	1.454	14.3%	0.891	61.3%	0.444	30.5%	5,908	246,064
1999	2.116	45.6%	1.272	60.1%	0.711	33.6%	n/a	n/a
2000	4.810	127.3%	2.973	61.8%	1.884	39.2%	14,636	328,626
2001	3.643	-24.3%	1.971	54.1%	0.419	11.5%	n/a	n/a

Earnings and Dividend Analysis: Taiwan Semiconductor Manufacturing Corporation

Figures in U.S. Dollars

Quarters are Calendar Quarters (4th quarter ends in December)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Case Study 3: Winbond Electronics Corporation

Company Description

The Group's principal activities are designing, developing, manufacturing and selling of integrated circuits (ICs) and other related components and devices. The Group has honed its skills in research, development, design, process, manufacturing, marketing and customer service, focusing on digital consumer, multimedia, communication, non-flash memory and computer logic ICs as well as SRAM and DRAM products. The main IC products are: Consumer & speech ICs, Data Communications ICs, Foundry Services, Memory ICs, Microcontroller ICs, Multimedia ICs, Peripheral Devices ICs, Personal Computer ICs, Telephony ICs and Visual Communication ICs. The Group has expanded its strategic market positions in the United States of America, Hong Kong, Singapore, Europe and Japan.

Background and History

Winbond, founded as a spin-off from ERSO, is now emerging as the third major force in semiconductors in Taiwan. Indeed, as UMC winds back its own product line in favor of foundry operations, becoming more and more like TSMC, Winbond is likely soon to emerge as Taiwan's premier 'own product' semiconductor company. Yet the company is still only very young. It was founded in 1987, and began operations in 1989. It has grown extremely rapidly, notching up sales of $48 million in 1990, $96m in 1991, $123m in 1992, $215m in 1993, growing to $326m in 1994 and an astonishing $700 million-plus in 1995. These are annual rates of growth of 52 percent in 1994, 74 percent in 1993 and 28 percent in 1992 - very large even for the high-growth semiconductor industry. Winbond became a listed company in October 1995. Its recent profit performance as a public company has been remarkable. Indeed profits leapt by 270 percent in 1994/95, to reach $260 million. Winbond's staff numbers have expanded from 900 in 1990, to 2,300 in 1994.

Winbond is a particularly interesting semiconductor company, because it captures perhaps more than any other in Taiwan the spirit of high-technology capitalism being 'managed' to generate wealth. Winbond is the product of pure entrepreneurial spirit. It was founded by a former ERSO high official who took with him from the public agency a set of ideas, competencies and people. He found investment capital in the form of the Wahlsin Lihwa Electric Wire and Cable Co. Ltd, i.e. capital that was looking for ventures beyond the scope of its existing industry. It has been guided by a philosophy of seeking appropriate scale, a balanced portfolio of products, and driven by an unsurpassed knowledge of the process and product technology of semiconductors. Winbond has in fact grown very rapidly, and after achieving its initial, mobilizing input of capital, has not had to seek outside for further replenishment. By the mid-1990s, Winbond was in fact the most profitable venture in the Wahlsin Lihwa group.

Dr Yang Ding-Yuan founded Winbond in 1987, one of the 'RCA 40' trained at RCA, and subsequently a senior official with ERSO. He left ERSO with a large number of personnel to found the new company. Thus Winbond can be counted as andunofficial' ERSO spin-off. Dr Ding-Yuan Yang has a PhD in engineering from Princeton; his classmates there included Dr Shin-Tai Shih, the first director of the IC Demonstration Lab at ERSO in 1977, and now the President of ITRI, and Dr C. C. Chang, former Director of ERSO and now Executive Vice-President of Winbond. Such are the links that oil the wheels of the IC industry in Taiwan. Dr Yang joined ERSO in 1976, and has been associated with the IC industry in Taiwan ever since. He led the group of engineers to RCA in 1977, and worked with Dr Shin-Tai Shi on the first Demonstration Lab at ERSO. He led the IC Design Lab at ERSO (which was not actually as successful as the Manufacturing lab) and then in 1985/86 was sent by ERSO to complete a Master of Management Science at Stanford Business School. From 1978 to 1986, Dr Yang was head of the Computer Technology Development Operation (CTDO) of ERSO, which laid the groundwork for Taiwan's phenomenal success in personal computers. After his return from Stanford, he became the head of the Office of Planning and Marketing at ITRI, and president of ITIC, the ITRI fully owned venture capital fund. During his last year at ITRI, he was head of the Industrial Economic Research Center, where he conducted studies into what made some ITRI projects succeed (such as semiconductors and personal computers) and why others got nowhere, i.e. he conducted an internal review of success and failure factors of ITRI projects.

The circumstances were as follows. In 1987, the ERSO Pilot plant (Demonstration plant) had been functioning for 10 years, and was starting to lose its way. UMC had been established, and TSMC was shortly to take over the operations of the VLSI project. People were starting to leave. At this point, Dr Yang elected to leave and in effect 'privatized' the ERSO Lab through his own initiative. He found an investor, Walsin Lihwa Corporation, which had been one of the original investors in UMC, and which was keen to get more deeply involved in semiconductors. Walsin Lihwa Corporation is now a very significant investor in the Taiwanese semiconductor industry. It invested originally in UMC, in 1980; in Mosel, then a Silicon Valley start-up, in the early 1980s; then in Winbond in 1987; and finally in 1994 Pacific Wire and Cable (Walsin Wire) emerged as the second most significant investor in the new DRAM manufacturing business spun off from ERSO, Vanguard Semiconductor Corp. It is probably the largest external investor in the Taiwanese semiconductor industry.

Dr Yang then formed Winbond as an independent company, and with the capital contributed by his investors, hired most of the ERSO staff working on the now defunct Demonstration Lab. Thus things renew themselves in Taiwan. The name Winbond itself is highly significant. Its Chinese characters are 'Hwa' (Chinese kingdom) and 'Bang' (city state); their combination implies a Chinese self-governing community of professionals. The 'in' was added in English to denote 'intelligence' (as in the name of the US firm, Intel). The sense conveyed is thus that this is a company that will grow through the application of intelligence. So far the dream has borne fruit. Winbond became a US$3 billion company in the year 2000, under the astute leadership of Dr Yang.

The ownership structure of Winbond is also interesting. At the foundation of the company, Dr Yang secured an agreement from Walsin Lihwa that employees could be given shares in the company (even before it is listed on the Taiwan Stock Exchange). Thus Walsin Lihwa holds 35% of the equity, a variety of smaller investors hold 55%, and employees hold 10%. [In Taiwan there is a 'grey market' for the trading of shares of unlisted companies.] As of August 1993, Winbond's capital had grown to NT$ 3.5 billion (more than US$ 130 million), with actual paid-in capital of NT$ 6.6 billion (US$ 250 million). Winbond never intended to be a fabless IC company. From the outset, it intended to operate at a scale that would support the operation of a state-of-the-art fabrication facility. With the initial capital, facilities and equipment were bought. This fab, built in 1988, has been the prime asset of the company. It operates at 1.0-micron level, and has a capacity of 20,000 5-inch wafers per month; at one stage 500 personnel staffed it.

With growth came the need for expansion. A new Fab II was commissioned in 1991, and went on-line in October 1992. It has a capacity of 30,000 6-inch wafers per month, and incorporated the very latest in sub-micron technology. The funds to build Fab II were not raised externally. They had to be generated internally and through capital drawings on the existing investors. This is characteristic of Taiwan's cautious approach to expansion. (It also reflects the reluctance of the founding investors to dilute their shareholdings with further equity issues.) In fact, the building of Fab II plunged Winbond into negative cash flow for a time; it was a big morsel to swallow.

Product Strategy

Winbond began as a memory- and PC-chip maker, and has since moved on to ASICs, imaging chips, and embedded MPUs. In general, Winbond is targeting the multimedia market.

Its product areas include:

- Microcomputer and peripherals ICs
- Memory ICs
- Telecommunications ICs
- Consumer product ICs
- Application specific ICs, and
- Foundry service.

In the microcomputer ICs area, Winbond is a leading supplier of chip sets, incorporating 286, 386 and 486 Intel microprocessors (with full respect of Intellectual Property rights, i.e. paying all due royalties). These chipsets, rather than individual ICs, are becoming the real engines of PCs - so they represent strategically an exceedingly important product area. Hsinchu's Innovative Product Award honored the WINBUS 80486 DX/SX chipset product in 1992. In the memory ICs area, Winbond is becoming a leading supplier of high-speed SRAMs and a large supplier of memory for cache RAMs. These are emerging product areas that will eventually become as important as mainstream DRAMs.

In consumer product ICs, Winbond has targeted applications in the multi-media area, such as speech synthesizers, speech controllers and video compressors. In conjunction with C-Cube (see below), it has pioneered the development of chips that can 'squeeze' sound and visual data for packaging in a CD-ROM. Its development of chips incorporating the MPEC one standard for image and voice compression, will allow a full-length film to be squeezed onto a CD ROM, for example; it is now working on incorporating MPEC 2 standard for HDTV into multimedia chips. Winbond was awarded the coveted Gold National Award for Excellence for its W9900 Multimedia Chip Set product in 1994. This product, the first of its kind in Asia, consists of three highly integrated ICs, covering audio decoding, video decoding and image coding decoding. The chipset can be used as the basis for multimedia add-on cards for a variety of PC-based products, eliminating the need for external logic circuitry and thus reducing system complexity and cost. Winbond is also collaborating in the production of a videophone chip. In telecoms ICs, Winbond produces LAN products and tone generators. HSIP is the world's largest concentration of LAN products producers, such as D-Link, an important customer for Winbond's ICs. This is the 'clustering effect' of Hsinchu, which enhances its wealth generating capacity.

Table 4.22 Sales Chart Winbond: Sales and Employment, 1988-94

	1989	1990	1991	1992	1993	1994
Sales	33	47	95	120	185	320
R&D	3	4	5	10	12	15
Staff	900	1200	1600	2100		

Source: (Compiled by author from 工業技術研究院 1997 pp.59-169).

Profit figures were not publicly available before 1997. However it is known that there were losses in 1989 and 1990 while the company got on its feet; profits were generated in 1991; then went into loss again with the construction of Fab 2; then went into profit again in 1992 and 1993. A good profit was secured in 1994 -just over NT$ 2 billion, out of revenues of NT$ 8.6 billion. Winbond has sought to achieve a good balance of sales, with major focus on the expanding Asian markets. In 1993, 70% of its $200m sales were in Asia ($110m in Taiwan alone), with Europe and the US each accounting for a further 15%.

What is quite remarkable is that 80 percent of Winbond's sales are through its own brand name. Thus Winbond has leapt past the OEM stage of manufacturing, directly to 'Own Brand Manufacture' (OBM). These own-brand efforts are backed by a worldwide sales and distribution system, with major sales offices in Hong Kong and Silicon Valley, California. The balance of its sales are made up not from OEM but mainly from foundry services. These account for around 20% of revenue. Its Fab one operates CMOS and BiCMOS technology at 1.0 to 5.0

micron resolution; its Fab 2 does the same with resolution down to 0.6 micron and wafer size of 150mm. Its customers for foundry services come from all over the world; they are assured of absolute privacy and confidentiality. Winbond guards its reputation for probity very jealously.

R&D: Technological Collaboration

Winbond is also unique amongst Taiwan's semiconductor industry in that it takes R&D very seriously, allocating over 10 percent of its considerable sales revenue to innovation. By the mid-1990s, it was employing 270 staff in R&D functions, or 20 percent of its entire professional staff. It operates five product development divisions and two technology development divisions in Taiwan (at Hsinchu) and one technology centre in Silicon Valley, California. Winbond has now leveraged itself abreast of world technology developments through technology tie-ups and alliances, enabling it to collaborate in the development of advanced products.

- Winbond acquired flash memory technology from Silicon Storage Technology, and the two companies are jointly developing low-voltage EPROM chips, i.e. advanced memory chips. SST provides the non-volatile memory products, and Winbond makes them manufacturable. A 1 M flash memory product was recently released resulting from this collaboration.
- Winbond and NCR-MPD have entered a comprehensive agreement, covering mutual distribution of their products, joint development, and with Winbond providing manufacturing services. The two have formed a joint venture ASIC design centre in Taipei; under the agreement, NCR transferred its library of 10,000 gate array designs to Winbond as well as its 1.5-micron CMOS production process. (Since then Hyundai has taken over NCR's semiconductor operations, to form the autonomous entity Symbios Logic; this brings Winbond into an interesting relationship with the Korean giant.)
- Winbond has licensed Hewlett-Packard's PA-RISC microprocessor technology, and in April 1994 offered sample copies of the chips designed exclusively for printers, X-Windows terminals and other 'embedded controller' applications. Embedded controllers - i.e. chips

that perform a dedicated function with control built in, rather than applied from an external source - promise to be a leading product area off the future. There are substantial intangible benefits from this alliance. Winbond joins a select few companies, including Oki, Hitachi, Hughes Aircraft and Hewlett Packard - and possibly Intel - in the international PA-RISC consortium, which pools ideas as to how the PA-RISC architecture may be put to good use. In particular, with the announced alliance between HP and Intel, the new Intel product line is likely to incorporate PA-RISC architecture, placing Winbond in a superb position to benefit from its inside knowledge.

- Winbond has an equity stake in C-Cube Microsystems (San Jose, CA), and acts as a second source for C-Cube's image-compression ICs used in multi-media applications. C-Cube is recognized as one of the most innovative companies in Silicon Valley in the multimedia sector.
- Winbond has a 70% equity stake in the US design house, Symphony Lab, to boost its capacity in chipset production.
- Winbond purchased a stake, and now has 100% ownership, of Winbic, which is now its US Design Center. Winbond did use this company as a technology acquisition gateway in the US.
- Winbond has joined a local consortium promoting the PowerPC, developing chip sets, SRAMs and other ICs to complement the PowerPC microprocessor. This gives Winbond a stake in what could become the standard-setting microprocessor of the later 1990s.
- Winbond has entered technology-licensing arrangements with a number of firms, such as SMC for its floppy disc controller, and SGS-Thomson for its telephone dialing ICs. It has purchased product designs outright from firms such as Opus (2.88M floppy disc controller); Topnotch and SPECOM (16-bit digital signal processor).

These collaborations appear to have been carefully chosen to give Winbond access to the best available intelligence concerning new product developments and shifts in such intangibles as 'architecture'. It is significant that all the collaborations are with US companies, which Winbond sees as technical leaders in the multimedia and microprocessor area. As a result of licenses acquired under these agreements, and an original agreement entered into with ERSO to cover technology implicitly transferred with the movement of staff (entered voluntarily by Winbond two years after its foundation) royalty fees now amount to 1.5% of Winbond's revenue, i.e. $4.8 million in 1994. Dr Yang was at that time of the view that it was an inevitable trend in the 1990s as companies enter alliances and seek licenses from each other; firms that try to avoid any royalty payments at all are sailing 'close to the wind' and could end up with unpleasant lawsuits on their hands. Dr Yang was firmly of the view that Winbond has been able to attract high caliber partners for its product development efforts, and high caliber customers for its foundry services, because of its reputation for probity. This was an important intangible asset in the IC world.

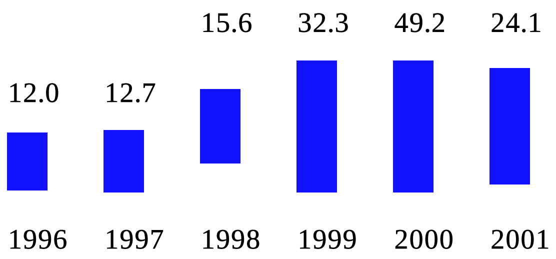
The latest shift in Winbond's strategy involves a projected move upwards into DRAM manufacture. As of the end of 1995, Winbond was involved in discussions with a number of Japanese firms, such as Toshiba, over a DRAM technology transfer arrangement. Acceptable terms were agreed and Winbond was catapulted into DRAM manufacture in 1996. Presumably the interest of a Japanese partner would be to secure access to the Taiwan DRAM market, engage a competent Taiwanese firm such as Winbond as a 'second source', and receive some cash royalties for a superseded 1M and 4M-DRAM technology. The interest of Winbond would lie in achieving access to a sector of the semiconductor business that has so far been beyond it. With its existing R&D strengths, it rapidly became a leading DRAM player in Taiwan.

Competitor Analysis Winbond Electronics Corporation operates in the Semiconductors and related devices sector. This analysis compares Winbond Electronics with three other companies in this sector in Taiwan: Lite-On It Corporation (2001 sales of 25.98 billion Taiwanese Dollars [US$751.10 million]), Siliconware Precision Industries Company (16.53 billion Taiwanese Dollars [US$477.88 million]), and Macronix International Company Limited (21.36 billion Taiwanese Dollars [US$617.55 million]).

Sales Analysis

Winbond Electronics reported sales of 24.13 billion Taiwanese Dollars (US$697.66 million) for the year ending December of 2001. This represents a sharp decrease of 50.9% versus 2000, when the company's sales were 49.16 billion Taiwanese Dollars.

Table 4.23 Recent Sales at Winbond Electronics



(Figures in Billions of Taiwanese Dollars)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Winbond Electronics currently has 4,477 employees. With sales of 24.13 billion Taiwanese Dollars (US$697.66 million), this equates to sales of US$155,831 per employee. This is lower than the three comparable companies, which had sales between US$167,092 and US$2,030,010 per employee.

Table 4.24 Sales Comparisons for Winbond (Fiscal Year ending 2001)

Company	Sales (blns)	Sales Growth	Sales/ Emp (US$)	Largest Region
Winbond Electronics	24.132	-50.9%	155,831	N/A
Lite-On It Corporation	25.981	59.2%	2,030,010	Domestic (99.5%)
Silicon ware Precision Industries Company	16.530	-12.3%	167,092	N/A
Macronix International Company Limited	21.361	-33.7%	215,173	N/A

The market capitalization of this company is 55.63 billion Taiwanese Dollars (US$1.61 billion).

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Profitability Analysis

On the 24.13 billion Taiwanese Dollars in sales reported by the company in 2001, the cost of goods sold totaled 12.74 billion Taiwanese Dollars, or 52.8% of sales (i.e., the gross profit was 47.2% of sales). This gross profit margin is lower than the company achieved in 2000, when cost of goods sold totaled 35.6% of sales. There was a wide variation in the gross profit margins at the three comparable companies, from 25.0% of sales to 83.3% of sales. The company's earnings before interest, taxes, depreciation and amortization (EBITDA) were 134.00 million Taiwanese Dollars, or 0.6% of sales. This EBITDA margin is worse than the company achieved in 2000, when the EBITDA margin was equal to 42.3% of sales. The three comparable companies had EBITDA margins that were all higher (between 12.4% and 45.4%) than that achieved by Winbond Electronics.

Although sales at Winbond Electronics fell 50.9% in 2001, the company actually increased its selling, general and administrative expenses 394.00 million Taiwanese Dollars (approximately 3.6%). In 2001, earnings before extraordinary items at Winbond Electronics were -10.66 billion Taiwanese Dollars, or -44.2% of sales. This profit margin is lower than the level the company achieved in 2000, when the profit margin was 20.5% of sales. The company's return on equity in 2001 was -13.6%. This was significantly worse than the 16.1% return the company achieved in 2000. (Extraordinary items have been excluded).

Table 4.25 Profitability Comparison for Winbond

Company	Year	Gross Profit Margin	EBITDA Margin	Earns bef. extra
Winbond Electronics	2001	47.2%	0.6%	-44.2%
Winbond Electronics	2000	64.4%	42.3%	20.5%
Lite-On It Corporation	2001	25.0%	12.4%	9.8%
Silicon ware Precision Industries Company	2001	34.7%	26.1%	-7.2%
Macronix International Company Limited	2001	83.3%	45.4%	-4.1%

In the first quarter of 2001, Winbond Electronics reported a loss per share of 0.10 Taiwanese Dollars. Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Inventory Analysis

As of December 2001, the value of the company's inventory totaled 5.76 billion Taiwanese Dollars. Since the cost of goods sold was 12.74 billion Taiwanese Dollars for the year, the company had 165 days of inventory on hand (another way to look at this is to say that the company turned over its inventory 2.2 times per year). Although the inventory level dropped by 1.40 billion Taiwanese Dollars during FY2001, there was an increase in days in inventory from December 2000, when the company had 7.16 billion Taiwanese Dollars, which was only 149 days of sales in inventory.

Research and Development

Research and Development Expenses at Winbond Electronics in 2001 were 7.89 billion

Taiwanese Dollars, which is equivalent to 32.7% of sales. In 2001 R&D expenditures increased both as a percentage of sales and in actual amounts: In 2000, Winbond Electronics spent 7.47 billion Taiwanese Dollars on R&D, which was 15.2% of sales. During each of the previous 4 years, the company has increased the amount of money it has spent on Research and Development (in 1997, Winbond Electronics spent 1.67 billion Taiwanese Dollars versus 7.89 billion Taiwanese Dollars in 2001).

Financial Position

As of December 2001, the company's long-term debt was 14.01 billion Taiwanese Dollars and total liabilities (i.e., all monies owed) were 21.98 billion Taiwanese Dollars. The long-term debt to equity ratio of the company is 0.21. As of December 2001, the accounts receivable for the company were 3.25 billion Taiwanese Dollars, which is equivalent to 49 days of sales. This is slightly higher than at the end of 2000, when Winbond Electronics had 43 days of sales in accounts receivable.

Table 4.26 Financial Positions for Winbond

Company	Year	LT Debt/ Equity	Days AR	Days Inv.	R&D/ Sales
Winbond Electronics	2001	0.21	49	165	32.7%
Lite-On It Corporation	2001	0.00	57	74	N/A
Silicon ware Precision Industries Company	2001	0.41	86	48	N/A
Macronix International Company Limited	2001	0.45	42	735	N/A

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002

Table 4.27 Stock Performance Indicators (All Figures are in U.S. Dollars)

		Ratios		Equity Capital					Dividends	
Year	Last Price	P/E	P/Bk	Earned Growth %	Profit Rate %	Book Value Begin Yr	Earnings Per Share	% Chg	Divs Per Share	Avg Yield
1995	0.55	4.9	n/c	n/c	n/c	n/a	B 0.112	n/c	0.00	0.0
1996	0.37	13.9	1.8	12.6	12.6	0.21	B 0.027	-76	A 0.00	0.0
1997	0.68	18.1	2.6	14.2	14.2	0.26	B 0.037	38	A 0.00	0.0
1998	0.74	n/c	2.3	-1.0	-1.0	0.32	B -0.003	n/c	A 0.00	0.0
1999	1.62	n/c	4.8	9.9	9.9	0.34	n/a	n/c	0.00	0.0
2000	0.77	n/c	1.7	15.0	15.5	0.44	n/a	105	A 0.00	0.3
2001	0.73	n/c	1.4	-13.3	-13.3	0.52	n/a	n/c	A 0.00	0.0
2002	0.43	n/c	1.0	n/c	n/c	0.44	n/a	n/c	0.00	0.0
3/7/03	0.37	n/a	0.8	n/a	n/a	0.44	n/a	n/c	0.00	0.0

The data included in the notes have not been converted to U.S. Dollars. To convert the data in the notes a use a factor of: 0.028910

(A): ALL ITEMS ADJUSTED FOR STOCK SPLITS OR DIVIDENDS - 19.5% IN 2001, 11% IN 2000, 25% & 106.3:100 RIGHTS ISSUE (1.5% DIV) IN 1998, 30% IN 1997, 100% IN 1996

(B): BASED ON AVERAGE SHARES OUTSTANDING

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.28 Cash Flow and Sales in Billions of U.S. Dollars

Year	Sales	Sales Growth	EBITDA	% of sales	Inc. bef Extra	% of sales	Emps	Sales/ Empl
1995	0.527	n/c	0.299	56.7%	0.266	50.6%	n/a	n/a
1996	0.347	-34.2%	0.117	33.8%	0.076	22.0%	n/a	n/a
1997	0.368	6.1%	0.076	20.8%	0.113	30.8%	n/a	n/a
1998	0.450	22.3%	0.128	28.4%	-0.011	-2.5%	8,501	52,908
1999	0.935	107.9%	0.374	40.0%	0.129	13.7%	4,093	228,473
2000	1.421	52.0%	0.601	42.3%	0.292	20.5%	n/a	n/a
2001	0.698	-50.9%	0.004	0.6%	-0.308	-44.2%	n/a	n/a

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Case Study 4 : Weltrend Semiconductor Incorporated

Company Description

Weltrend Semiconductor Incorporated. The Group's principal activities are planning, designing and testing of application development and distribution of IC products. The product lines encompass IC's for various PC Peripherals, Consumer Electronics and Power Management.

Background and History

Founded as a small start-up in July 1989, Weltrend was an interesting example of the flourishing IC design houses that have clustered on the Hsinchu science park around TSMC's silicon foundry. Weltrend was better designated as a 'fabless' chip producer, since it delivers finished chips to customers, rather than designs on paper; it contracts out the mask making, wafer fabrication and packaging stages of the production process, reserving to itself the design of the chips, and the testing of the finished products.

Weltrend produces Application-specific standard products (ASSPs) for computers and peripherals, as well as a range of simpler but very profitable chips for consumer applications such as greetings cards and 'talking watches'. It also has a flourishing custom-design business. Weltrend was started by its current president, Mr. Sam Lin, who worked for ten years as a director of strategic planning at ERSO, and completed an MBA at Taiwan National University (writing his graduation thesis on the Taiwan semiconductor industry). When the time came to start his own company, he was therefore well prepared. He formulated his business plan and gained clearance from HSIP Administration to let space on the Hsinchu Park; with this in hand, he found it relatively easy to raise funds from venture capital firms such as H&Q Taiwan, as well as from partners, in the cash-rich days of 1989. Initial capital was US$ 5 million.

The product strategy was the key to whether a start-up company did survive. Mr. Lin followed a well thought out strategy of identifying the electronics products in which Taiwan held a world dominant position, such as scanners, monitors and simple consumer products like Christmas lights, and identifying ways in which application specific ICs could be introduced to improve the performance and reduce the costs of these products. These ideas could then be turned into customized chips for selected electronics firms. This turned out to be a good strategy, quickly yielding some profitable work in producing light control ICs for Christmas lights (these are cheap chips, at $0.60 or 0.70 each, but produced in huge numbers generate a good profit), as well as more complex longer-term work such as sync signal discriminators for multisync monitors; these latter took two to three years to develop. Thus Mr. Lin formulated the view that a good product mix was the key to successful operation of a fabless company, combining some low-end products with high-end products; this ensures both good cash flow for the present and sound prospects for growth in the future.

Weltrend now positions itself as a manufacturing partner for customers, both those wishing to have chips produced entirely to their own specification, and those willing to purchase ASSPs. Weltrend develops specifications (usually in consultation with the customer), produces and tests the circuit design and then the circuit layout, using its own in-house array of SUN Microsystems SPARC 2 workstations using state-of-the-art software such as ECS, PC-Silos and Cadence. It then sub-contracts the mask-making to another firm on HSIP, such as TMC or Innova, supplying them with its own computer tapes; the wafer fabrication was then sub-contracted to TSMC or another Hsinchu-based foundry operation provided by UMC, Winbond, HMC or Holtek, or even an overseas foundry such as SGS Thomson in France, or Seiko in Japan, or AWA in Australia. The printed wafers are then transferred back to Weltrend, where they are tested, using test equipment at Weltrend's premises, and using customized techniques that are built into the design of each circuit. (This was an important feature of chip design, optimizing not just performance but test procedures as well.) The wafers are then passed on to a sub-contracted packaging company, such as Taiwanese firms Taicera, CET, Chantek, Talent, More Power, Silicon ware or Chinko, or to an overseas operation. The packaged and assembled chips are then returned to Weltrend, where they are tested once again before being delivered to the customer.

Weltrend's revenues have grown in healthy fashion as a result of the comprehensive service it provides, growing at a compound rate of 97% a year, and reaching US$ 7.2 million in 1993, and $12 million in 1994. It employs 45 staff; most of them highly qualified engineers. It was seeking listing on the 'over-the-counter' stock exchange in Taipei in 1994, to facilitate the raising of further capital, and to be able to offer stock option schemes to attract high-caliber staff.

Competitor Analysis

Weltrend Semiconductor Incorporated operates within the Electronic components sector. This analysis compares Weltrend Semiconductor Incorporated with three other companies in this sector in Taiwan: Myson-Century Technology Incorporated (2001 sales of 1.52 billion Taiwanese Dollars [US$44.03 million]), G-Shank Enterprise (1.36 billion Taiwanese Dollars [US$39.31 million] of which 100% was Spare parts), and Sintek Photronics Corporation (1.58 billion Taiwanese Dollars [US$45.54 million]).

Sales Analysis

During the year ended December of 2001, sales at Weltrend Semiconductor Incorporated were 1.48 billion Taiwanese Dollars (US$42.89 million). This is a decrease of 14.5% versus 2000, when the company's sales were 1.74 billion Taiwanese Dollars. On a geographical basis, contributing to the decline in the company's sales in 2001 were the declines in North America, where sales dropped 47.0% to 1.42 million Taiwanese Dollars. Sales in Domestic were also lower, falling 14.5% (to 1.48 billion Taiwanese Dollars).

Table 4.29 Sales Comparisons for WSI (Fiscal Year ending 2001)

Company	Sales (blns)	Sales Growth	Sales/ Emp (US$)	Largest Region
Weltrend Semiconductor Incorporated	1.484	-14.5%	N/A	Domestic (99.9%)
Myson-Century Technology Incorporated	1.523	4.1%	314,500	Taiwan (64.2%)
G-Shank Enterprise	1.360	-21.3%	170,908	Taiwan (56.4%)
Sintek Photronics Corporation	1.575	N/A	53,261	N/A

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.30 Recent Stock Performance for WSI

Company	P/E	Price/ Book	Price/ Sales	52 Wk Pr Chg
Weltrend Semiconductor Incorporated	13.6	2.07	3.52	-43.90%
Myson-Century Technology Incorporated	N/A	1.36	1.86	-62.24%
G-Shank Enterprise	12.3	1.23	1.85	-45.90%
Sintek Photronics Corporation	27.0	1.28	4.80	N/A

The market capitalization of this company is 5.23 billion Taiwanese Dollars (US$151.12 million).

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Profitability Analysis

On the 1.48 billion Taiwanese Dollars in sales reported by the company in 2001, the cost of goods sold totaled 832.50 million Taiwanese Dollars, or 56.1% of sales (i.e., the gross profit was 43.9% of sales). This gross profit margin is better than the company achieved in 2000, when cost of goods sold totaled 57.7% of sales. Weltrend Semiconductor Incorporated's 2001 gross profit margin of 43.9% was better than all three comparable companies (which had gross profits in 2001 between 23.0% and 36.1% of sales). The company's earnings before interest, taxes, depreciation and amortization (EBITDA) were 293.91 million Taiwanese Dollars, or 19.8% of sales. This EBITDA margin is worse than the company achieved in 2000, when the EBITDA margin was equal to 24.0% of sales. Although sales at Weltrend Semiconductor Incorporated fell 14.5% in 2001, the company actually increased it's selling, general and administrative expenses 38.94 million Taiwanese Dollars (approximately 12.2%).

In 2001, earnings before extraordinary items at Weltrend Semiconductor Incorporated were 379.52 million Taiwanese Dollars, or 25.6% of sales. This profit margin is lower than the level the company achieved in 2000, when the profit margin was 33.0% of sales. The company's return on equity in 2001 was 17.2%. This was significantly worse than the already high 37.1% return the company achieved in 2000. (Extraordinary items have been excluded).

Table 4.31 Profitability Comparison for WSI

Company	Year	Gross Profit Margin	EBITDA Margin	Earns bef. extra
Weltrend Semiconductor Incorporated	2001	43.9%	19.8%	25.6%
Weltrend Semiconductor Incorporated	2000	42.3%	24.0%	33.0%
Myson-Century Technology Incorporated	2001	36.1%	6.4%	-13.2%
G-Shank Enterprise	2001	33.7%	21.1%	16.6%
Sintek Photronics Corporation	2001	23.0%	11.8%	16.2%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Inventory Analysis As of December 2001, the value of the company's inventory totaled 145.22 million Taiwanese Dollars. Since the cost of goods sold was 832.50 million Taiwanese Dollars for the year, the company had 64 days of inventory on hand (another way to look at this is to say that the company turned over its inventory 5.7 times per year). In terms of inventory turnover, this is a significant improvement over December 2000, when the company's inventory was 207.61 million Taiwanese Dollars, equivalent to 76 days in inventory. The 64 days in inventory is lower than the three comparable companies, which had inventories between 80 and 117 days at the end of 2001.

Research and Development

Research and Development Expenses at Weltrend Semiconductor Incorporated in 2001 were 216.69 mill. Taiwanese Dollars, equivalent to 14.6% of sales. In 2001 R&D expenditures increased both as a percentage of sales and in actual amounts: In 2000, Weltrend Semiconductor Incorporated spent 171.53 million Taiwanese Dollars on R&D, which was 9.9% of sales.

Financial Position

As of December 2001, the accounts receivable for the company were 447.85 million Taiwanese Dollars, which is equivalent to 110 days of sales. This is slightly higher than at the end of 2000, when Weltrend Semiconductor Incorporated had 104 days of sales in accounts receivable.

Table 4.32 Financial Positions for WSI

Company	Year	Days AR	Days Inv.	R&D/ Sales
Weltrend Semiconductor Incorporated	2001	110	64	14.6%
Myson-Century Technology Incorporated	2001	115	104	16.8%
G-Shank Enterprise	2001	87	80	0.0%
Sintek Photronics Corporation	2001	209	117	4.2%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.33 Stock Performance Indicators (All Figures are in U.S. Dollars)

		Ratios		Equity Capital					Dividends	
Year	Last Price	P/E	P/Bk	Earned Growth %	Profit Rate %	Book Value Begin Yr	Earnings Per Share	% Chg	Divs Per Share	Avg Yield
1999	1.49	30.6	n/c	n/c	n/c	n/a	C 0.049	n/c	0.00	0.0
2000	0.91	9.8	3.4	29.1	35.0	0.27	BC 0.093	91	A 0.02	1.7
2001	1.34	22.8	3.8	12.3	16.5	0.36	C 0.059	-36	A 0.02	1.1
2002	0.91	n/c	2.3	n/c	n/c	0.39	n/a	n/c	0.00	0.0
3/7/03	0.80	13.6	2.1	n/a	n/a	0.39	0.059	n/c	0.02	1.9

The data included in the notes have not been converted to U.S. Dollars. To convert the data in the notes a use a factor of: 0.028910

(A): ALL ITEMS ADJUSTED FOR STOCK SPLITS OR DIVIDENDS - 28% IN 2001, 30% IN 2000 (B): INCLUDES OR EXCLUDES EXTRAORDINARY CHARGE OR CREDIT - INCLS 1.89 PRETAX CR IN 2000 (C): BASED ON AVERAGE SHARES OUTSTANDING

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.34 Cash Flow and Sales in Millions of U.S. Dollars

Year	Sales	Sales Growth	EBITDA	% of sales	Inc. bef Extra	% of sales	Emps	Sales/ Empl
1999	29.802	n/c	5.455	18.3%	8.190	27.5%	n/a	n/a
2000	50.172	68.3%	12.032	24.0%	16.563	33.0%	n/a	n/a
2001	42.894	-14.5%	8.497	19.8%	10.972	25.6%	n/a	n/a

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Case Study 5 : Macronix International Company

Company Description

The Group's principal activities are the manufacturing and developing of integrated microcircuits and memory chips and provision of consultation services on the design of products.

Background and History

Founded in 1989, Macronix Inter. Co (MXIC) was one of the fastest growing and most technically sophisticated of Taiwan's new crop of semiconductor companies. Sales in 1994 reached US$ 221 million, after growing at around 50% per year from $6.5m in 1990, $30m in 1991, $65m in 1992, $147m in 1993, $230m in 1994 and $390m in 1995. Its ambition to be a US$1 billion company by the year 2000 was attained in 1999 one year early. The number of employees jumped from 980 in 1993 to 1,440 in 1994. Macronix was founded by two of Taiwan's most experienced semiconductor engineer-technologists. The President, and promoter of the company, was Mr. Miin Wu, who had 16 years experience working at the highest levels in US semiconductor companies, such as Intel and VLSI Technology. The chairman was Dr Hu, Ding-Hua. In the mid-1970s, Dr Hu, then working for RCA, was responsible for taking a group of Taiwanese engineers to RCA to semiconductor training and technology transfer. He has since been involved in each major phase of Taiwan's emergence as a leading semiconductor power.

MXIC was founded in Taiwan in 1989 with venture capital raised by Mr. Wu, using as vehicle the small IC marketing company, Macronix Inc, that he had founded with partners in the USA in 1983. Initial capital was US$ 80 million. From the start, the business strategy pursued by MXIC was one of new product development, rather than technology importing or foundry work. Sufficient funds were raised to establish a VLSI fab in Hsinchu Science-based Industry Park, equipped with some of the most advanced processing technology in the world. This fabrication facility, with a Class 1 clean room for the submicron chip fabrication areas, achieved 0.8-micron geometry in 1992 and 0.6-micron capability in 1993, with a capacity of 30,000 wafers per month. Funds were also spent in hiring an extremely high caliber technical staff, including around 40 Chinese Americans with lengthy experience in the US semiconductor industry.

The initial product strategy was one of developing a range of technically demanding memory products, to develop in-house expertise and to maintain cash flow during the company's early years. Initial product offerings were Mask ROM (4M to 16M), graduating to the more technically demanding EPROM (256K to IM) within a year of the company's establishment. Flash memory products, which are recognized as providing ideal memory ICs for the next generation of PCs, were targeted as the next major product offering. A 4M Flash EPROM was released in October 1992. MXIC has joined with the Japanese steelmaker, NKK, to jointly develop the technology needed for these products. (NKK was one of the most recent of the Japanese steelmakers to enter the semiconductor fabrication field.) This was the first of several major strategic alliances entered into by MXIC.

Meanwhile the Logic Product group at MXIC was targeting a range of niche products needed by next generation PCs and communication products. The product groups selected were digital signal processors; microcontrollers; and analogue ICs (for interfacing electronics products with the real world). In each case, the emphasis was to be on 'total system' solutions to be contained in the chip, with low power requirements and maximum portability. Early examples of this strategy at work are such products as 386 and 486 chipsets; graphics controllers; digital answering machine (DAM) chip; and 64-bit accelerator chip for graphical user interface. These are innovative, state-of the-art ICs.

The latest and most significant step in the company's evolution has been its development of a 32-bit RISC microprocessor (developed in conjunction with US based firm MIPS (now part of Silicon Graphics). This product potentially takes MXIC into the big league of the semiconductor industry. MXIC has built up from the start a global marketing presence, with sales and distribution channels in Taiwan, USA, Japan, Korea, Hong Kong, Singapore, The Netherlands, Germany, Italy, Denmark, Sweden and the UK. Its business did increasingly be focused on Japan, North America and Europe as well as Asia. Sales in 1994 were distributed as follows: Japan 36 per cent, Taiwan 35 percent, the USA 17 percent, and 12 percent elsewhere.

In 1993, sales of Mask ROM reached US$ 65 million, and of EPROM just under $60 million, with sales of logic devices accounting for just under $13m. Flash memory sales began in a small way in 1994. In 1993, MXIC emerged as world number 7 supplier of Mask ROM (i.e. three years after start-up) and number 9 supplier of EPROM. In 1994 it expected to move to number 6 position in both categories, behind Samsung and Hitachi. Cash flow in the early years had been enhanced through securing OEM contracts with some of the leading companies in the USA, Japan and Korea, for such products as Mask ROM and EPROMs. The list of customers for these OEM accounts with MXIC reads like a Who's Who of the IC industry.

The company was able to break even in its first two years, then slipped back into a loss of $23m in its third year (during the ramp-up of the VLSI fab), before establishing a profit of $18m in 1993 (15% net profit) and a $42m profit in 1994 (18% net). In early 1994, MXIC was approved for listing on the Taipei Stock Exchange as a 'Category C' high-tech company (in fact the first such company listed in this category). Its listing would allow MXIC to raise its future capital requirements through share offerings, and to attract bright engineers by offering them share options in the company. The proceeds of the public listing of MXIC did go towards building a new fabrication facility, also on Hsinchu Park, for 8-inch wafers. Costing $1.13 billion, this new fab came on stream in two stages in 1996, with a monthly capacity of 40,000 wafers, and an eventual line width capability of 0.2 micron. Thus MXIC was set upon a path of expansion.

Strategic Alliances

MXIC has fostered strategic partnerships from the outset. With the Japanese steel maker NKK, it has jointly developed Mask ROM and EPROM products, transferring technology along the way to the Japanese company. (And claiming to be the only Taiwanese company to have done so!) With TSMC, it has had a production cooperation agreement, offering part of its fab capacity for TSMC's foundry operations. It has transferred technology from MIPS Computer Systems for the 32-bit RISC microprocessor. As at mid-1994, MXIC was negotiating a major joint project with a US semiconductor company, involving product development, business and production capacity.

Thus MXIC was evolving into one of the most intelligent and diversified of the advanced semiconductor companies in Taiwan. Like UMC, it has chosen its product range carefully, and has pursued high value-adding products at the cutting edge of technological development. It provides yet another example of how latecomer status can be turned to advantage in the high technology field, if intelligent strategies are pursued.

Competitor Analysis

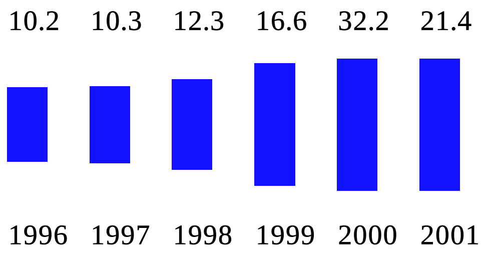
Macronix International Company Limited operates within the Semiconductors and related devices sector. This analysis compares Macronix International Company Limited with three other companies in this sector in Taiwan: Winbond Electronics Corporation (2001 sales of 24.13 billion Taiwanese Dollars [US$697.66 million]), Siliconware Precision Industries Company (16.53 billion Taiwanese Dollars [US$477.88 million]), and Lite-On It Corporation (25.98 billion Taiwanese Dollars [US$751.10 million]).

Sales Analysis

During the year ended December of 2001, sales at Macronix International Company

Limited were 21.36 billion Taiwanese Dollars (US$617.55 million). This is a sharp decrease of 33.7% versus 2000, when the company's sales were 32.24 billion Taiwanese Dollars.

Table 4.35 Recent Sales at Macronix International Company Limited



(Figures in Billions of Taiwanese Dollars)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

The company currently employs 2,870. With sales of 21.36 billion Taiwanese Dollars (US$617.55 million) , this equates to sales of US$215,173 per employee. The sales per employee levels at the three comparable companies vary greatly, from US$155,831 to US$2,030,010, as shown in the following table. Some of the variation may be due to the way each of these companies counts employees (and if they count subcontractors, independent contractors, etc).

Table 4.36 Sales Comparisons for MICL (Fiscal Year ending 2001)

Company	Sales (blns)	Sales Growth	Sales/ Emp (US$)	Largest Region
Macronix International Company Limited	21.361	-33.7%	215,173	N/A
Winbond Electronics Corporation	24.132	-50.9%	155,831	N/A
Silicon ware Precision Industries Company	16.530	-12.3%	167,092	N/A

Lite-On It Corporation	25.981	59.2%	2,030,010	Domestic (99.5%)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.37 Recent Stock Performance for MICL

Company	P/E	Price/ Book	Price/ Sales	52 Wk Pr Chg
Macronix International Company Limited	N/A	0.82	1.64	-65.50%
Winbond Electronics Corporation	N/A	0.85	2.31	-55.07%
Silicon ware Precision Industries Company	N/A	1.18	1.83	-53.11%
Lite-On It Corporation	14.2	4.46	1.43	-42.96%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

The market capitalization of this company is 34.99 billion Taiwanese Dollars (US$1.01 billion) . The capitalization of the floating stock (i.e., that which is not closely held) is 31.22 billion Taiwanese Dollars (US$902.69 million) .

Profitability Analysis

On the 21.36 billion Taiwanese Dollars in sales reported by the company in 2001, the cost of goods sold totaled 3.57 billion Taiwanese Dollars, or 16.7% of sales (i.e., the gross profit was 83.3% of sales). This gross profit margin is significantly better than the company achieved in 2000, when cost of goods sold totaled 26.8% of sales. Macronix International Company Limited's 2001 gross profit margin of 83.3% was better than all three comparable companies (which had gross profits in 2001 between 25.0% and 47.2% of sales). The company's earnings before interest, taxes, depreciation and amortization (EBITDA) were 9.70 billion Taiwanese Dollars, or 45.4% of sales. This EBITDA margin is worse than the company achieved in 2000, when the EBITDA margin was equal to 57.4% of sales. The three comparable companies had EBITDA margins that were all less (between 0.6% and 26.1%) than that achieved by Macronix International Company Limited.

Although sales at Macronix International Company Limited fell 33.7% in 2001, the company actually increased it's selling, general and administrative expenses 552.00 million Taiwanese Dollars (approximately 11.1%). In 2001, earnings before extraordinary items at Macronix International Company Limited were -866.00 million Taiwanese Dollars, or -4.1% of sales. This profit margin is lower than the level the company achieved in 2000, when the profit margin was 32.9% of sales. The company's return on equity in 2001 was -1.9%. This was significantly worse than the already high 40.2% return the company achieved in 2000. (Extraordinary items have been excluded).

Table 4.38 Profitability Comparison for MICL

Company	Year	Gross Profit Margin	EBITDA Margin	Earns bef. extra
Macronix International Company Limited	2001	83.3%	45.4%	-4.1%
Macronix International Company Limited	2000	73.2%	57.4%	32.9%
Winbond Electronics Corporation	2001	47.2%	0.6%	-44.2%
Silicon ware Precision Industries Company	2001	34.7%	26.1%	-7.2%
Lite-On It Corporation	2001	25.0%	12.4%	9.8%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Inventory Analysis

This company has more than two year's of sales in inventory. As of December 2001, the value of the company's inventory totaled 7.19 billion Taiwanese Dollars. Since the cost of goods sold was 3.57 billion Taiwanese Dollars for the year, the company had 735 days of inventory on hand (another way to look at this is to say that the company turned over its inventory 0.5 times per year). This is an increase in days in inventory from December 2000, when the company had 5.14 billion Taiwanese Dollars, which was only 217 days of sales in inventory. The 735 days in inventory is higher than the three comparable companies, which had inventories between 48 and 165 days sales at the end of 2001.

Research and Development

Research and Development Expenses at Macronix International Company Limited in 2001 were 3.82 billion Taiwanese Dollars, which is equivalent to 17.9% of sales. In 2001 R&D expenditures increased both as a percentage of sales and in actual amounts: In 2000, Macronix International Company Limited spent 3.14 billion Taiwanese Dollars on R&D, which was 9.7% of sales. Macronix International Company Limited increased its R&D spending in 2001 by 682.00 million Taiwanese Dollars. If it had kept its R&D expenditures level with 2000, then the company would have reported a profit instead of a loss in 2001: ordinary earnings before taxes would have been 733.00 million Taiwanese Dollars instead of 51.00 million Taiwanese Dollars.

Financial Position

As of December 2001, the company's long-term debt was 19.51 billion Taiwanese Dollars and total liabilities (i.e., all monies owed) were 26.21 billion Taiwanese Dollars. The long-term debt to equity ratio of the company is 0.45. As of December 2001, the accounts receivable for the company were 2.46 billion Taiwanese Dollars, which is equivalent to 42 days of sales. This is an improvement over the end of 2000, when Macronix International Company Limited had 61 days of sales in accounts receivable. The 42 days of accounts receivable at Macronix International Company Limited are lower than all three comparable companies: Winbond Electronics Corporation had 49 days, Silicon ware Precision Industries Company had 86 days, while Lite-On It Corporation had 57 days outstanding at the end of the fiscal year 2001.

Table 4.39 Financial Positions for MICL

Company	Year	LT Debt/ Equity	Days AR	Days Inv.	R&D/ Sales
Macronix International Company Limited	2001	0.45	42	735	17.9%
Winbond Electronics Corporation	2001	0.21	49	165	32.7%
Silicon ware Precision Industries Company	2001	0.41	86	48	3.1%
Lite-On It Corporation	2001	0.00	57	74	0.0%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.40 Stock Performance Indicators (All Figures are in U.S. Dollars)

		Ratios		Equity Capital					Dividends	
Year	Last Price	P/E	P/Bk	Earned Growth %	Profit Rate %	Book Value Begin Yr	Earnings Per Share	% Chg	Divs Per Share	Avg Yield
1995	0.34	6.9	n/c	n/c	n/c	n/a	B 0.049	n/c	0.00	0.0
1996	0.37	9.4	2.5	26.2	26.2	0.15	B 0.039	-20	A 0.00	0.0
1997	0.60	30.9	2.9	9.5	9.5	0.20	B 0.019	-51	A 0.00	0.0
1998	0.42	n/c	1.7	-5.7	-5.7	0.24	B -0.014	n/c	A 0.00	0.0
1999	1.09	123.0	4.8	3.7	3.7	0.23	B 0.009	n/c	A 0.00	0.0
2000	0.80	9.1	3.3	36.8	36.8	0.24	B 0.088	973	A 0.00	0.0

2001	0.71	n/c	1.9	-1.9	-1.9	0.36	n/a	n/c	A 0.00	0.0
2002	0.31	n/c	0.9	n/c	n/c	0.34	n/a	n/c	A 0.00	0.0
3/7/03	0.28	n/a	0.8	n/a	n/a	0.34	n/a	n/c	A 0.00	0.0

The data included in the notes have not been converted to U.S. Dollars. To convert the data in the notes a use a factor of: 0.028910

(A): ALL ITEMS ADJUSTED FOR STOCK SPLITS OR DIVIDENDS - 10% IN 2002, 30% IN 2001, 13% IN 2000, 10% & 105.2:100 RIGHTS ISSUE (1.30% DIV) IN 1999, 22% IN 1998, 30% IN 97, 50% IN 96

(B): BASED ON AVERAGE SHARES OUTSTANDING, FULLY DILUTED EARNINGS FOR THE 12 MOS ENDED DEC 2000 WERE 4.23

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.41 Cash Flow and Sales in Millions of U.S. Dollars

Year	Sales	Sales Growth	EBITDA	% of sales	Inc. bef Extra	% of sales	Emps	Sales/ Empl
1995	256.318	n/c	107.572	42.0%	89.250	34.8%	n/a	n/a
1996	294.726	15.0%	132.871	45.1%	97.155	33.0%	n/a	n/a
1997	297.608	1.0%	110.988	37.3%	56.115	18.9%	n/a	n/a
1998	356.130	19.7%	108.647	30.5%	-44.728	-12.6%	n/a	n/a
1999	480.242	34.9%	184.809	38.5%	26.210	5.5%	n/a	n/a
2000	932.001	94.1%	535.153	57.4%	306.822	32.9%	2,870	324,739
2001	617.547	-33.7%	280.427	45.4%	-25.036	-4.1%	n/a	n/a

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Case Study 6 : Mosel Vitelic Inc.

Company Description

Mosel Vitelic Inc. The Group's principal activities are the design, manufacture and marketing of dynamic RAM's (DRAM's), Flash and slow, low power static RAM's (SRAM's) for worldwide markets. The Group provides DRAM's for specific applications, such as PC graphics, with attributes that include fast access time and memory organization. Operations of the Group are carried out in Taiwan and North America.

Background and History of Mosel-Vitelic

Mosel-Vitelic is currently Taiwan's largest general supplier of DRAMs and associated memory chips (apart from the TI-Acer joint venture, which currently is tied exclusively to TI's product line). In addition, it designs, manufactures and markets high-performance ASICs, consumer chips and logic devices. Mosel and Vitelic, two start-ups founded in Silicon Valley by Chinese Americans in the 1980s, shifted the bulk of their operations to Taiwan; at first separately, and then as a combined force, have sought to become big players with their own fabrication facilities. But it has been a long, hard road for these companies. Mosel and Vitelic merged in 1991. Their combined revenue in that year was $165 million. Since then it has grown to $238 million in 1993, and $285 million in 1994. Revenues in 1995 were over $500 million, with profits at a very healthy $250 million. The number of employees also grew remarkably from 880 in 1993 to 1,411 in 1994. Unlike other chip firms in Taiwan, Mosel-Vitelic secures 90 percent of its sales revenues from DRAMs. Its performance in 1994 and 1995 shows that the company was riding the DRAM wave very well indeed.

Chinese-American Mr. Alex Au founded Vitelic as a US company in 1983, with the idea of harnessing US design skills to Asian production capacities. He had worked with Fairchild in the late 1960s and '70s on such early products as the 256-bit memories. Just after its formation, Vitelic landed a plum job as research contractor for ITRI in Taiwan's VLSI project, with a view to developing VLSI technology for 1M-DRAM production. This design was completed in 1986. (As it turned out, the chip was never built in Taiwan, but was sold to the Koreans; this was one of the factors involved in hastening Taiwan's acquisition of DRAM fabrication capability.) An early attempt by Vitelic to build a plant in Taiwan in 1984 fell through, forcing the company to depend on foundries in Japan, Korea and the US for its manufacturing. In 1986, Vitelic licensed its 64K DRAM design to Korea's Hyundai, and other designs to Japanese and Korean producers. Early on it developed a design for a 16K SRAM, licensed to Fujitsu; for a 64K SRAM, licensed to Hyundai; and for a 256K SRAM, licensed to Sharp. Schive (1990) reported that about half of Vitelic's revenue in 1987 of $30m came from royalties. In 1989, the San Jose-based chipmaker was reported to be planning a $100m fab in Hsinchu Science Park, to act as a major DRAM facility. The bulk of the first $40m would come from the company's customers, all of who were anxious for secure supplies of DRAMs.

Mosel was another small chipmaker founded in California by a Chinese American, operating as MOS Electronics Taiwan, Inc. Its main investor was the Taiwan multinational, Pacific Wire and Cable (Walsin Lihwa). Mosel too quickly built up a large design business in Taiwan. In 1991 Vitelic merged with Mosel, to form Mosel-Vitelic Inc. Combined sales in 1991 were $165m (Mosel $78m, Vitelic $87m). Sales grew to $213m in 1992, and $238m in 1993, by which time the company employed 880 staff at Hsinchu Science Based Industrial Park. These staff were employed in Mosel-Vitelic's design, testing and QC operations at Hsinchu; from 1994 the company has also been involved directly in wafer fabrication, which explains the big increase in staff numbers in 1994. It also operates a fab for consumer IC production in Hong Kong.

Over 90 percent of Mosel-Vitelic's output consists of memory chips: 78 percent DRAMs, 10 percent SRAMs and 3 percent VRAMs. The balance was made up of chips for consumer products. One percent of revenue comes from foundry contracts. About 70 percent of the company's production was exported, with the US taking 60 percent, followed by Korea, Hong Kong and Singapore. (These are where the DRAM markets are.) Most of Mosel-Vitelic's sales are to original equipment manufacturers. Reflecting its strength in IC design, Mosel-Vitelic has been dependent for production expertise on technology transfer. In 1993, Mosel/Vitelic Inc signed a comprehensive technology transfer agreement with Japan's Oki Electric Industry Co., Ltd, covering transfer of 0.6 and 0.45-micron technology to Mosel/Vitelic. The agreement also covers assistance in the making of 4M DRAMs. In October 1994 the agreement was extended to cover 16M-DRAM process technology as well.

With technical assistance from Oki, Mosel/Vitelic has constructed Taiwan's 'most advanced' wafer fabrication facility at Hsinchu. It opened in August 1994. This plant incorporates 0.6-micron resolution technology, and did build up to capacity of 30,000 6-inch wafers per month by 1995. Pilot production started in November 1994. Staff numbers grew dramatically in consequence, from 880 in 1993 to 1,411 in 1994. At the end of 1994, Mosel-Vitelic's future was clouded after the departure of its founder and chief executive, Mr. Alex Wu. The test of his achievement was the capacity of his creation to sustain its growth and become one of the world's top memory chip producers.

Competitor Analysis

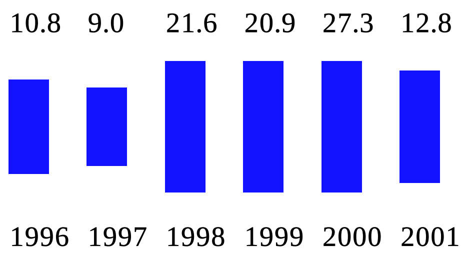
Mosel Vitelic Inc. operates in the Semiconductors and related devices sector. This analysis compares Mosel Vitelic Inc. with three other companies in this sector in Taiwan: Powerchip Semiconductor Corp (2001 sales of 11.16 billion Taiwanese Dollars [US$322.55 million]), Silicon Integrated Systems Corporation (9.99 billion Taiwanese Dollars [US$288.75

million]), and Nanya Technology Company Limited (12.83 billion Taiwanese Dollars [US$370.92 million]).

Sales Analysis

Mosel Vitelic Inc. reported sales of 12.76 billion Taiwanese Dollars (US$369.01 million) for the year ending December of 2001. This represents a sharp decrease of 53.2% versus 2000, when the company's sales were 27.29 billion Taiwanese Dollars.

Table 4.42 Recent Sales at Mosel Vitelic Inc.



(Figures in Billions of Taiwanese Dollars)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Almost all of the company's 2001 sales were in its home market of Taiwan: in 2001, this region's sales were 11.75 billion Taiwanese Dollars, which is equivalent to 92.0% of total sales. Mosel Vitelic Inc. currently has 1,230 employees. With sales of 12.76 billion Taiwanese Dollars (US$369.01 million) , this equates to sales of US$300,006 per employee.

Table 4.43 Sales Comparisons for MVI (Fiscal Year ending 2001)

Company	Sales (blns)	Sales Growth	Sales/ Emp (US$)	Largest Region
Mosel Vitelic Inc.	12.764	-53.2%	300,006	Taiwan (92.0%)
Powerchip Semiconductor Corp	11.157	-41.4%	N/A	N/A
Silicon Integrated Systems Corporation	9.988	27.5%	N/A	Domestic (99.9%)

Nanya Technology Company Limited	12.830	-9.6%	309,096	Taiwan (77.4%)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.44 Recent Stock Performance for MVI

Company	P/E	Price/ Book	Price/ Sales	52 Wk Pr Chg
Mosel Vitelic Inc.	N/A	0.64	1.23	-73.10%
Powerchip Semiconductor Corp	N/A	0.79	2.01	-67.88%
Silicon Integrated Systems Corporation	N/A	1.60	2.96	-47.69%
Nanya Technology Company Limited	N/A	1.62	4.64	-58.18%

The market capitalization of this company is 15.71 billion Taiwanese Dollars (US$454.08 million) .

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Dividend Analysis

This company has paid no dividends during the last 12 months. The company also reported losses during the previous 12 months. The company has not paid any dividends during the previous 6 fiscal years.

Profitability Analysis

On the 12.76 billion Taiwanese Dollars in sales reported by the company in 2001, the cost of goods sold totaled 10.30 billion Taiwanese Dollars, or 80.7% of sales (i.e., the gross profit was 19.3% of sales). This gross profit margin is lower than the company achieved in 2000, when cost of goods sold totaled 69.7% of sales. The gross margin in 2001 was the lowest of the previous five years (in 1997, the gross margin had been as high as 49.5%). There was a wide variation in the gross profit margins at the three comparable companies, from 5.4% of sales to 66.4% of sales. The company's earnings before interest, taxes, depreciation and amortization (EBITDA) were -4.07 billion Taiwanese Dollars, or -31.9% of sales. This EBITDA margin is worse than the company achieved in 2000, when the EBITDA margin was equal to 9.0% of sales. The three comparable companies had EBITDA margins that were all higher (between -7.4% and 35.9%) than that achieved by Mosel Vitelic Inc. Although sales at Mosel Vitelic Inc. fell 53.2% in 2001, the company actually increased its selling, general and administrative expenses 2.10 billion Taiwanese Dollars (approximately 47.4%). In 2001, earnings before extraordinary items at Mosel Vitelic Inc. were -19.76 billion Taiwanese Dollars, or -154.8% of sales. This profit margin is lower than the level the company achieved in 2000, when the profit margin was 7.7% of sales. The company's return on equity in 2001 was -43.7%. This was significantly worse than the 5.3% return the company achieved in 2000. (Extraordinary items have been excluded).

Table 4.45 Profitability Comparison for MVI

Company	Year	Gross Profit Margin	EBITDA Margin	Earns bef. extra
Mosel Vitelic Inc.	2001	19.3%	-31.9%	-154.8%
Mosel Vitelic Inc.	2000	30.3%	9.0%	7.7%
Powerchip Semiconductor Corp	2001	34.3%	12.2%	-57.6%
Silicon Integrated Systems Corporation	2001	66.4%	35.9%	-6.1%
Nanya Technology Company Limited	2001	5.4%	-7.4%	-74.7%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Inventory Analysis

As of December 2001, the value of the company's inventory totaled 1.85 billion Taiwanese Dollars. Since the cost of goods sold was 10.30 billion Taiwanese Dollars for the year, the company had 65 days of inventory on hand (another way to look at this is to say that the company turned over its inventory 5.6 times per year). In terms of inventory turnover, this is a significant improvement over December 2000, when the company's inventory was 4.51 billion Taiwanese Dollars, equivalent to 87 days in inventory. The 65 days in inventory is lower than the three comparable companies, which had inventories between 66 and 414 days at the end of 2001.

Research and Development

Research and Development Expenses at Mosel Vitelic Inc. in 2001 were 5.33 billion Taiwanese Dollars, which is equivalent to 41.8% of sales. In 2001 R&D expenditures increased both as a percentage of sales and in actual amounts: In 2000, Mosel Vitelic Inc. spent 3.38 billion Taiwanese Dollars on R&D, which was 12.4% of sales. The company's expenditures on R&D in 2001 were higher than all three comparable companies (as a percentage of sales): Powerchip Semiconductor Corp spent 14.3% of its sales on R&D, Silicon Integrated Systems Corporation spent 18.9%, and Nanya Technology Company Limited spent 6.2%. This company's expenditure of 5.33 billion Taiwanese Dollars were higher than at all three comparable companies combined. During each of the previous 5 years, the company has increased the amount of money it has spent on Research and Development (in 1996, Mosel Vitelic Inc. spent 738.52 million Taiwanese Dollars versus 5.33 billion Taiwanese Dollars in 2001).

Financial Position

As of December 2001, the company's long-term debt was 14.96 billion Taiwanese Dollars and total liabilities (i.e., all monies owed) were 31.92 billion Taiwanese Dollars. The long-term debt to equity ratio of the company is 0.48. As of December 2001, the accounts receivable for the company were 3.06 billion Taiwanese Dollars, which is equivalent to 88 days of sales. This is higher than at the end of 2000, when Mosel Vitelic Inc. had 59 days of sales in accounts receivable. The 88 days of accounts receivable at Mosel Vitelic Inc. are higher than all three comparable companies: Powerchip Semiconductor Corp had 59 days, Silicon Integrated Systems Corporation had 83 days, while Nanya Technology Company Limited had 48 days outstanding at the end of the fiscal year 2001.

Table 4.46 Financial Positions for MVI

Company	Year	LT Debt/ Equity	Days AR	Days Inv.	R&D/ Sales
Mosel Vitelic Inc.	2001	0.48	88	65	41.8%
Powerchip Semiconductor Corp	2001	0.27	59	66	14.3%
Silicon Integrated Systems Corporation	2001	0.55	83	414	18.9%
Nanya Technology Company Limited	2001	0.87	48	190	6.2%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.47 Cash Flow and Sales in Taiwanese Dollars

		Ratios		Equity Capital					Dividends	
Year	Last Price	P/E	P/Bk	Earned Growth %	Profit Rate %	Book Value Begin Yr	Earnings Per Share	% Chg	Divs Per Share	Avg Yield
1995	22.13	6.7	n/c	n/c	n/c	n/a	D 3.304	n/c	0.00	0.0
1996	18.30	12.7	2.0	15.7	15.7	9.16	D 1.440	-56	A 0.00	0.0
1997	27.84	50.4	2.7	5.5	5.5	10.13	D 0.553	-62	A 0.00	0.0
1998 C	24.72	n/c	2.3	-6.5	-6.5	10.75	D -0.697	n/c	A 0.00	0.0
1999	40.52	29.9	4.0	13.5	13.5	10.06	BD 1.353	n/c	0.00	0.0

2000	16.61	25.1	1.3	5.1	5.1	12.87	BD 0.663	-51	A 0.00	0.0
2001	16.97	n/c	1.2	-43.4	-43.4	14.03	D -6.090	n/c	A 0.00	0.0
2002	5.10	n/c	0.7	n/c	n/c	7.83	n/a	n/c	A 0.00	0.0
3/7/03	4.99	n/c	0.6	n/a	n/a	7.83	-6.090	n/c	A 0.00	0.0

(A): ALL ITEMS ADJUSTED FOR STOCK SPLITS OR DIVIDENDS - 1098.80:1000 RIGHTS ISSUE (.17% DIV) IN 2002, 10% IN 2001, 12% IN 2000, 24.6% IN 1998, 40% IN 97, 70% IN 96

(B): INCLUDES OR EXCLUDES EXTRAORDINARY CHARGE OR CREDIT - INCLS 0.24 PRETAX CR, INCLS 2.75 PRETAX CR IN 1999

(C): CHANGE FROM UNCONSOLIDATED TO CONSOLIDATED REPORTS

(D): BASED ON AVERAGE SHARES OUTSTANDING, FULLY DILUTED EARNINGS FOR THE 12 MOS ENDED 1999 WERE 1.57

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Case Study 7 : TI-Acer (Texas Instruments – Acer Joint Venture)

In May 1989, the US semiconductor giant Texas Instruments and the Taiwanese computer firm Acer, announced a joint venture to produce DRAMs. This joint venture was Taiwan's first large-scale, privately owned memory chip fabrication facility. In 1991, the joint venture was consummated with the opening of a plant located on the Hsinchu Science-based Industry Park, geared for the production of TI's 4M DRAMs. Sales revenues increased rapidly, from US$ 67.5 million in 1992 to $231 in 1993, to $300 million in 1994, and $480 million in 1995. This placed TI-Acer just behind Mosel-Vitelic in terms of revenues. Ti-Acer does not sell its product on the open market, reserving its output for the joint venture partners; even so, it was rumored to be a substantial source of profit for both companies.

The joint venture needs to be seen in the context of Texas Instruments' global DRAM strategy. To avoid the shocking losses it suffered in the mid 1980s and early 1990s downturns, TI was pursuing a strategy of sharing DRAM production activities, in a series of virtually identical plants located around the world, in Avezzano (Italy), in Singapore, in Taiwan, in Portugal, and of course in its home base of Dallas, Texas. Most of these are joint ventures: in Singapore, TI has joined forces with Canon, Hewlett-Packard and the Singapore Economic Development Board; in Portugal with Samsung; and in Taiwan with Acer. In this way, TI distributes the capital costs of building the latest DRAM fabrication facilities, bringing its customers in as partners, and meanwhile allying with its top competitors like Hitachi in development efforts directed at the next generation DRAM products. TI has learnt much from its bruising encounters with the Japanese and Koreans; its risk-sharing DRAM strategy commands high respect in East Asia.

For its part, Acer stands to gain much from its sharing in this joint venture, albeit as junior partner. Prior to 1989 Acer had no experience whatever of the semiconductor industry - although it was Taiwan's fastest growing PC and general IT-products manufacturer. Through the link with TI, Acer gains an apprenticeship in the semiconductor industry with one of the world's outstanding companies; this began in production methods, and was extending to encompass product development and design. It would not be entirely unexpected if sometime in the late 1990s Acer were to branch out and form its own semiconductor business, based on the skills and know-how acquired in its joint venture with TI.

Acer Computer

Acer, founded by Mr. Stan Shih, was Taiwan's leading computer and IT firm. Its total revenue amounted to US$ 1.9b in 1993, with target sales of $2.8b in 1994. It became one of the world's Top Six PC and monitor manufacturers by 1995, with the number one market share in SE Asia. Acer was evolving through a series of technology alliances with the world's leading companies; it has already entered into strategic links with such US firms as Intel, Microsoft, and Novell. Acer was founded by a small group of Taiwanese engineers in 1976. Acer developed the first Chinese operating system for computers, and manufactured its own 4-bit, 8-bit and 16-bit microcomputers. Its 32-bit microcomputer, launched in 1986, was the second in the world (behind Compaq but ahead of IBM). (The Economist 1991: 19). In 1988, the year of the company's public flotation in Taiwan, Acer announced the world's first PC86 chip designed for PS/2 model 30 PCs. Since then it has maintained a strong innovation capacity, through its central research hub, Acer Laboratories Inc. By 1992, Acer was producing 32-bit PCs, notebook computers and laser printers in Taiwan and in offshore plants in Malaysia and The Netherlands.

Acer was floated as a public company in Taiwan in 1988. In the second half of 1994, Acer Peripherals, and the computer components distributor, Acer Sere Inc, were also floated in

Taiwan. Acer Peripherals has plants in Taiwan and Malaysia where it manufactures keyboards, monitors and fax machines on both an OEM and branded product basis. (It opened a further keyboard and monitor plant in Sushi, China, in 1995.) In Acer's Vision 2000, prepared by Mr. Shih as the company's long-range plan, the company aimed to have a core technology hub in Taiwan linked to a network of regional sales, marketing, product integration and service operations around the world. Acer did finally evolve into a federation of 21 firms with global sales of over $8 billion by the end of the decade. The organizational model driving this transnational federation of firms was that of the 'client-server' computer network. According to Mr. Shih, 'server' business units did supply products to 'client' business units, which may also take on server roles. This organizational model was designed to maximize efficiency of information exchange. In terms of ownership, Acer did maintain an equity stake in all 21 firms, which was publicly floated in a series of operations through the late 1990s.

Joint Venture

Acer was determined to find a way to provide itself with a DRAM source in Taiwan. In the absence of public or private sector willingness to develop DRAM capability, Acer chairman Stan Shih approached TI in July 1988, with a view to developing technology transfer through a joint venture. With strong support from the government, a deal was concluded and signed on May 12 1989 for joint investments of $250 million in a DRAM fabrication joint venture. The 1989 agreement provided for an initial capital of $250m, shared between Acer (58%), the China Development Corporation (16%) and TI (26%). Acer planned to raise $140m through a new stock issue. Of TI's share, 10% would come in the form of technology transferred, and 20% in the form of equipment. TI was to have the option to raise its share to 51% within five years. Thus TI was able to shift to Acer most of the burden of raising cash for the joint venture.

The TI-Acer venture was an enormous step for Acer, then still a relatively small computer maker, and for Taiwan. The Taiwan President, Mr. Lee Tang-Hui, took a personal interest in the project. The Taiwan government facilitated things by changing the investment law, allowing Acer to make an investment that was worth more than 40% of its book value. The joint venture did not have an easy birth. In 1991, it threatened to collapse, as cash problems mounted at Acer (the majority shareholder) and plummeting prices for DRAMs threatened its viability. A pick-up in the market came just in time, and construction of the production facility proceeded. Finally, TI-Acer swung into full production in April 1992. The joint venture President Mr. Alex Cheng claims that the TI-Acer plant, located on a hill in Hsinchu Science Park, has the highest yield of any of TI's production facilities. He stated that the plant was breaking even (on a monthly basis) by November 1992; only seven months after mass production began. It reached balance sheet break-even point by September 1993.

The TI-Acer facility located in the HSIP was the first submicron memory IC wafer fab in Taiwan. The advanced wafer fab was on a par with other TI initiatives: it has Class one clean room, supported by ultra-clean chemicals, DI water and gases. The first product in 1992 was the 4M-DRAM. In addition, TI-Acer plans to supply Acer with high performance ASICs using 0.8 micron CMOS technology. The facility was being expanded to produce 16M DRAMs using 200mm wafers by Q3 1995, adding a further 20,000 wafers per month capacity. TI-Acer had an output of 3 million 4M DRAMs per month, which was 40% of TI's worldwide supply at that time. Under the agreement, TI-Acer transfers all the output to TI, with Acer retaining a right to buy back up to 50% for its own purposes. Currently, Acer purchases 30% of the output, and gets its DRAMs from other sources as well, such as Korea.

TI-Acer also has offered foundry services for Logic devices and ASICs. It became a publicly listed company, in 1997. By agreement, TI provided full technical support for the venture. Having obtained approval from the National Science Council and the HSIP Administration, groundbreaking at the plant site took place in March 1990. Groups of engineers had been sent to

TI in USA and Japan for technical training of 9 months to one year. Plant construction was completed on schedule, in July 1991 - only three years after the initial approach to TI. This must be a record for such a substantial international technological collaboration. In July 1991 TI-Acer began pilot runs with 4M DRAMs. TI-Acer entered volume production in early 1992; its capacity was one million 4M DRAMs per month. The plant was officially inaugurated in September 1991, receiving its 500 hours early release qualification in January 1992, its 1000 hours full qualification in March '92, and ramp-up to peak wafer start in April '92. This was an extraordinary record for a new company.

By July 1993 the monthly output was exceeding 2 million chips (exceeding the designed capacity of 1.45 million chips per month). The whole project had broken even by September 1993; after that, it was into profitable production. (In fact, the year 1993 recorded a net profit of NT$ 1.69b.) The 0.5-micron process volume production began in March 1994, and by August 1994, monthly output was exceeding 3 million chips. TI-Acer was at the time a production-only plant. However in 1994 a fledgling R&D department had been formed, all of whose members were away in the US at TI receiving training. The TI-Acer technology roadmap, reflecting TI's global strategy, was as follows. In 1992, the venture started with 4M-DRAM production, with geometry of 0.8 micron. In 1994, it moved on to first generation 16M DRAM [production, at a geometry of 0.6 micron. In 1995, it was involved in producing second generation 16M DRAMs, at geometry of 0.5 micron. It was soon also involved in experimental work on the 64M DRAM, for which production of first generation devices was started in 1997, at a geometry of 0.35 micron. By the year 2000, the TI-Acer joint venture did produce 256M-DRAM chips, at a geometry of 0.25 micron.

Thus TI-Acer has emerged as a significant DRAM producer in Taiwan. It was perhaps a little premature, and certainly caught ERSO and the semiconductor leaders in Taiwan by surprise. But the determination of the Acer chairman to have his own supply of DRAMs, and to gain a foothold in the semiconductor industry generally, was recognized by the government, which offered him full support. Nevertheless it was a precarious undertaking, nearly collapsing in 1991 due to funding difficulties. It was riding a wave of worldwide demand for DRAMs, and was offering Acer an unrivalled learning experience in the big league of DRAM manufacturing.

Conclusions to Case Studies for Taiwan's IC Industry

There was a downturn in the IC industry from 1995-1998. At the end of 1998, the total production value of the global IC industry had fallen from US$150 billion dollars in 1995 to US$120 billion in 1998. But from the beginning of 1999, the economic conditions did recover, and then had two good years but so far 2001 was bad and now 2002 is even worse. However, Taiwan has done comparatively better than Japan, the US and Korea by loosing less market share and still staying more profitable even in these hard times.

In 1998, the total production value of the global IC design community was US$6.2 billion, and the total market for wafer foundry services was US$5 billion. These figures represent a small percentage of the total market for ICs. However, the growth rate of these two sectors has already far surpassed the growth rate of the IC industry in general between 1998 and 2002. This is because the shift from vertical integration to the vertical division of labor is accelerating. The weakness of the vertical division of labor companies in the past was their lack of financial strength, small size, and lagging technology. However, the three-year downturn in the IC industry (1996-1998) caused technology development and capacity expansion at most of the leading IDMs (integrated device manufacturers) to stagnate. At the same time, Taiwan's process technology improved dramatically due to fierce competition between local manufacturers, such as VIA, TI Acer, UMC and TSMC. As a result, the leaders of Taiwan's IC industry have closed the technology gap with the most advanced IDMs, and surpassed most of the second-tier manufacturers by a substantial margin. This has resulted in two major changes in the world wafer foundry market. First, IC design houses around the world have cooperated with Taiwan's wafer foundries to greatly increase the competitiveness of their products, taking market share away from the IDMs. Second, many IDMs will be forced turn to Taiwan's wafer foundries to produce their most advanced products, using their own production capacity for lagging-edge products. These are two remarkable developments, and they will further contribute to the growth of Taiwan's wafer foundry industry.

According to forecasts, if the IC industry grows at an annual rate of 10% over the next five years, the IC design industry's annual growth may reach 25% resulting in a US$42 billion market by the year 2007. The growth of the wafer foundry industry should be even faster, reaching US$55 billion by the year 2007. Everyone's sights are trained on what promises to be a US$100 billion market in the years to come. However, the remaining question is "who is best positioned to profit from these opportunities?" The answer very well could be Taiwan, and the international IC design houses that are working with Taiwan's foundries. Therefore, it is necessary that Taiwan's IC industry seize this opportunity to increase R & D expenditures and investments to ensure that Taiwan will have a high-technology flagship capable of joining the fleet of the world's most advanced industrial nations in the 21st century.

Section 4.3 Industry Case Study B: Taiwan OEM Notebook Computers

4..31 OEM Hub Becomes ODM Hub: Taiwan Flourishing from Notebook Production

Taiwan's notebook PC industry has played an important role in the global notebook PC supply chain. Sales by Taiwan's notebook PC manufacturers totaled more than US$13.5 billion in 2000, up 40% YoY. Taiwan's global notebook market share increased from 39% in 1998 to 49% in 2000, according to Taiwan's Market Intelligence Center (MIC). The gain in market share over the past few years was mainly due to rising notebook outsourcing by global top 10 brands. For notebooks in 2000, Japan was second with a 30% share as a majority of Japanese notebook brands were produced in-house. Korea's market share rose from 1.8% in 1999 to 6% in 2000 on the back of an adequate supply of TFT LCD panels and other components, which prompted US vendors to increase orders. LG and Samsung are the two largest Korean notebook manufacturers. LG supplied IBM and Compaq, while Samsung produced mainly for Gateway.

Taiwan: Birthplace of Well-Positioned Suppliers

Notebook PC design and manufacturing can be characterized by thousands of complex and non-standardized key components, a short product life, complexity of assembly and production and design and integration of both mechanical and electrical aspects. Taiwan notebook producers are capable of using this know-how to capitalize on notebook PC outsourcing opportunities. Solid PC infrastructure, greater flexibility in mass production and a superior global logistics capability all fortify Taiwan's global position in notebook PC production. Moreover, as

Taiwan is building TFT-LCD supply capability, some believe Korean manufacturers' absolute advantage will decline over the longer term. Further Consolidation within Top Tier is still expected. Consolidation in the notebook industry has resulted in the collective global market share of the top five Taiwan notebook makers rising from 19% in 1997 to 39% in 2000. Due to economies of scale and better procurement negotiating power, tier-one notebook makers in Taiwan mainly gained market share from smaller notebook manufacturers. However, recent data shows that the combined market share of the top-tier Taiwan notebook manufacturers was over 70% of Taiwan's production

Increasing Outsourcing Opportunity

Compared with the average 70% outsourcing ratio by US brands, the top 10 Japanese notebook companies outsource less than 25% of production, hence, further outsourcing opportunities should come from Japan. However, the pace of Japanese outsourcing was slow as the yen's depreciation has lifted the pressure to outsource. Moreover, most Japanese brands are increasing notebook production in China. Thus, some do not expect to see Japanese companies expediting outsourcing to Taiwan any time soon. Taiwan notebook companies are attempting to reduce costs and increase operating efficiency to sustain margins. In one view, margins did not expand further in 2002, and some believe that downward margin pressure was inevitable as major global brands initiate price wars during the current down cycle. However, thanks to the depreciation of the New Taiwan dollar, tier-one Taiwan notebook companies resisted margin pressure in 1Q02. Moreover, economies of scale of tier-one notebook companies made for better margin performance than the rest of the sector. In one view, the relocation of some production to China was did not offer cost benefits that could help lift margins beyond 2003 because by then, being in China may no longer be simply an advantage but a necessity to stay competitive.

Notebooks Gradually Replacing Desktops

In the past, there was a 6-12 month lag before desktop PC technologies migrated to notebook PCs, and because of the cultural stigma attached to mobile computing and connectivity difficulties, notebook PC penetration was less than 20% of the total PC market (it was at the time about 21% and rising). However, these issues have largely been resolved through advances in technology. This includes the narrowing of the performance gap between desktop and notebook PCs and the installation of wireless technology into notebooks. One US PC analyst's forecast that notebook PC shipments this year did grow 11% YoY compared with overall PC shipment growth of 3% for 2001.

It was expected that Quanta and Compal did outperform the industry as the two companies are gaining market share despite the global PC downturn. Indeed, Taiwan's tier-one notebook companies posted strong volume shipments in 2Q02 with combined notebook shipments surging 24% QoQ and 10% YoY. Some attribute this robust performance to channel inventory rebuild after a 1Q02 inventory workout and demand triggers from the launch of new notebook models. Although a seasonal up tick for 3Q02 is not yet visible, causing some channel inventory concern, and July notebook shipments likely to be relatively weak based on historical patterns, some think individual company performance will vary. It is expected Compal's 3Q02 notebook shipments to grow 15% QoQ on the back of new models from Toshiba and Dell, while It is expected Quanta's 3Q02 shipments to see single digit QoQ growth because of seasonal factors and an inventory overhang.

High Hopes for Diversification

Major Taiwan notebook companies have moved toward server, information appliances (IA) and the handset business as a way of capitalizing on new outsourcing opportunities. However, some believe that results from these efforts won't be visible for at least 2-3 years as either the competition already is intense or the underlying markets are not yet mature enough to provide critical volumes. Second-tier notebook makers often suit niche market-segment needs and serve distributors and own-brand sales demand. Consequently, top-tier notebook makers did not compete with second-tier ones directly by stepping into small-volume, niche segments or the distribution business. As a result, it is expected further consolidation within the top-five notebook companies given that some see tough competition among Taiwan's top-tier suppliers.

Global Top 10 Brands Dominate Market

Brand awareness appears to be a key factor in an end-customer's notebook-purchase, and the top 10 global brands continue to account for over 80% of global brand sales. US and Japanese brands accounted for 42% and 34% of global market share in 2000, respectively. Among the top 10 brands, Hewlett-Packard reported robust YoY unit shipment growth (165%), while Sony posted 71% growth on the back of the success of its VAIO model. Although Intel initiated a 'white box' mobile CPU strategy aimed at creating a notebook clone-market segment, the strategy has not been successful due to the complexity of moving toward a standardized notebook PC design and low end-market acceptance. Given the nature of Taiwan notebook makers' ODM business model, it is vital for them to work with prospective global brands that have an advantage in gaining global market share.

4.32 More Value-Added: Logistics and Support

As the product design differentiation among top-tier makers continues to narrow, the notebook industry has evolved into a volume business relying on growing economies of scale. In addition, logistics and after-service support has become increasingly important as a way of providing more flexibility and complete service to customers. Making up for the lack of a global manufacturing footprint, Taiwan notebook makers have provided the Taiwan direct shipment (TDS) service to shorten delivery lead times. According to Quanta, TDS allows end-customers to receive notebooks within seven days of placing an order. Building a TDS system requires robust supply-chain management and strong manufacturing flexibility. In one view, only two companies have the will and the resources to install this business model; namely Quanta and Compal. Currently, about 20% of Taiwan notebook shipments are done through a TDS system, and demand for delivery systems will likely continue to grow.

Unlike Quanta and Compal, which focus on TDS implementation, Inventec, which primarily serves Compaq's commercial models, wants to enhance after-service support. Some view this effort as a way for Inventec to differentiate itself as the design and manufacturing of notebook PCs has matured over the past few years. More value-added for end-customers would help to reinforce long-term relationships. Further outsourcing opportunities exist because Japanese companies collectively still outsource less than 35% of notebook production, while US companies outsource around 80% of their volumes to Taiwan manufacturers. The possibility of further market-share expansion for Taiwan notebook companies lies either in Japanese companies increasing outsourcing or US brands continuing to gain market share at the expense of Japanese brands. However, these possibilities seem unlikely over the near term. First, the pace of Japanese notebook outsourcing appears to be slower than some had anticipated. Second, it is questionable whether US brands will become more popular than Japanese brands, making Taiwan notebook makers a major beneficiary.

Looking ahead, some estimate that the aggregate global market share of Taiwan notebook makers could expand slightly in 2003 mainly due to Dell and Sony increasing outsourcing. In one view, individual notebook companies' performance will vary widely depending on the customer base. The US is still expected to be a Tough Contract-Bidding Environment. The relative saturation of outsourcing opportunities from US brands resulted in severe contract competition among Taiwan notebook makers starting from late 1999. Moreover, US brand-name companies prefer to use several suppliers to diversify their supplier risk. A notable example is Compaq, which changed its outsourcing strategy in 2000 when it added Quanta as a new supplier for its consumer models. It is expected bidding for orders among Taiwan producers to become more competitive and subsequently hinder possible margin expansion. In addition, forecast risk over the long term has been increasing given more dynamic competition, and notebook contracts normally offer only 6-9 month visibility.

Dell – Increasing Notebook Procurement

Last year, Dell shifted its strategy to increase in-house notebook PC assembly and outsourced mainly to US electronic manufacturer, Jabil. However, this year, the growing complexity of inventory management, complex mobile PC design associated with a shorter product life cycle and margin pressure led Dell to increase its outsourcing ratio to Taiwan makers. Dell shipped 3 million notebooks in 2000, up 19% year on year. Because Dell implements an aggressive outsourcing strategy and offers aggressive pricing, it was able to expand its global market share from 10.4% in 1Q00 to 12.6% in 1Q02. Some estimate that Dell's outsourcing ratio to Taiwan suppliers will increase from 52% in 2000 to 70% in 2002. Dell's outsourcing partners include Quanta, Compal and Acer. Should Dell's global market share continue to rise, its notebook procurement from Taiwan could hit 3 million units this year.

Compaq – Employing a Diverse Supplier Strategy

Compaq uses more than five suppliers for its notebook PCs and contracts nearly 100% of its notebook production. Inventec is primarily a notebook supplier for Compaq's commercial model – Armada – while the rest of its suppliers mainly focus on the consumer model – Presario. Because Compaq adopts a diverse-supplier strategy, bidding for Compaq orders is highly competitive with successful bidders having to put up with slim margins. Compaq shipped around 3.2 million notebooks in 2000. Some estimate that Inventec, Arima and Quanta accounted for 48%, 30%, and 7%, respectively, of Compaq's notebook production in 2000.

HP – Firming Outsourcing Partners

Taking advantage of Compal and Quanta's direct shipment model, HP reported organic notebook shipment growth and substantial market-share expansion in 2000. As direct shipments require robust supply-chain management and greater manufacturing flexibility, Compal and Quanta were able to employ this model, which creates a barrier to entry for other suppliers. Hence, It is expected Quanta and Compal to remain the two primary suppliers for HP for the next two years. HP shipped about 1 million notebooks in 2000 with a 4.1% global market share. Nonetheless, HP's organic market-share expansion appears to have slowed this year. Some estimate that Quanta and Compal will supply 30% and 70%, respectively, of HP's notebook production in 2002. In other words, HP's market-share performance will closely reflect Compal's shipment outlook.

IBM – Still Relative Low Outsourcing

IBM sold about 3 million notebooks in 2000, of which around 1.1 million were made by Acer and Quanta. IBM's outsourcing is the most conservative among the global top 10 notebook brands given that the company still keeps over 50% of production either in-house or subcontracts it to EMS manufacturers. IBM outsourced consumer, low-end models to Taiwan suppliers and continues to design motherboards for mid- and high-end models and subcontracts manufacturing to Solectron.

However, IBM is hoping to reduce its reliance on Solectron and to spread the outsourcing of its high-end notebook motherboards. The company recently signed contracts with USI, a Taiwan EMS supplier, and shipments should start from 3Q02. In addition, Acer was awarded a new IBM commercial notebook order in 2H02. Nonetheless, some do not expect to see drastic outsourcing strategy changes favoring Taiwan suppliers from IBM this year.

Apple – Niche Market Segment Relying on Outsourcing

Apple sold 721,000 notebook PCs with a 2.8% market share in 2000, and mainly outsourced to Quanta (Powerbook) and Alphatop (iBook). While Apple's notebook PCs were positioned in niche-market segments, the supplier relationship with Apple was much stronger than with other US brands, thus offering higher margins. It is expected this relationship to remain strong but orders could suffer because of Apple's sales fluctuations.

Japan: Obstacles Remain for Increased Outsourcing

Japanese notebook producers have been forced to outsource by the appreciation of the yen relative to the US dollar since 1998 – the resulting erosion of price competitiveness slashed Japan's notebook market share from 41% in 1998 to 30% in 2000. Taiwan manufacturers have been the main beneficiaries. For example, orders from Toshiba were a major driver for Compal's robust shipment growth in 2000. However, the yen's recent depreciation slowed Japanese OEM outsourcing to Taiwan manufacturers in 1H02. Indeed, the yen's depreciation, which has lowered production costs in Japan, also has lifted some of the pressure to outsource. Thus, to lower production costs, Japanese companies are ramping up China production. The expansion capacity of Japanese makers' production in China could adversely affect Taiwan notebook makers. In general, Japanese outsourcing strategy is cautious, and companies tend to prefer establishing a long-term relationship. Japanese customers generally take a longer time than their US counterparts to qualify a new vendor and focus on quality, loyalty and suppliers' capability to provide service. Moreover, Japanese companies believe that to ensure long-term survival, they must retain portions of their production capability either at home or in China. In addition to Toshiba's Shanghai plant, which began operations in 2001, other Japanese companies such as Sony and Fujitsu are setting up facilities in China. As a result, some do not expect to see Japanese companies increasing their notebook outsourcing any time soon.

NEC – Riding on the Outsourcing Wave

NEC had sold its manufacturing line in Japan and is unlikely to expand capacity over the long term. Among Japanese companies, only NEC contracted out the majority of its notebook production – mainly notebook bare bone systems. NEC, which shipped around 1.7 million notebooks last year, ranked fifth globally with a 7.1% market share. Some estimate that NEC will outsource about 70% of its notebook production in 2003. In the past, First International Computer (FIC) mainly shipped bare bone notebooks to NEC, thus, it is likely that NEC will survey new vendors if it follows other Japanese OEMs' "full-system" outsourcing strategy. Quanta, Compal, and Acer all are aggressively courting this new order. Nonetheless, some do not expect the order to go to new suppliers by the end of this year. Some understand that Acer started trial production of the new NEC model in June. Should Acer's quality and service meet NEC's expectations, Acer could win the order for 2002.

Toshiba – the Hesitant One

Toshiba started to outsource to Taiwan in 1999 and so far the company has outsourced less than 16% of annual notebook production. However, Toshiba has been rapidly losing market share. The company is now restructuring its global PC manufacturing operations to reduce costs and has shifted its US PC manufacturing and printed circuit board manufacturing/assembly and testing to the Philippines. Its US plant now focuses only on configuration. Toshiba is also setting up a new factory in China to serve the local market. Before the restructuring is complete, Toshiba may continue to rely on an outsourcing partner for the low-end laptop segment and its outsourcing ratio will likely remain at around 15% of total shipments. Moreover, according to one Japan PC analyst, Takatoshi Yamamota, the reason that Toshiba is maintaining an outsourcing partner is to better understand Taiwan notebook makers' cost structure as a way to improve its own notebook manufacturing, design and technology.

Nonetheless, the company's long-term strategy implies that Toshiba intends to keep the majority of its production in-house. Recent yen and peso depreciation indicates that Toshiba now enjoys fewer cost benefits from outsourcing partners than it had expected. Some believe that a further loss of cost benefits could discourage more outsourcing. Compal manufactured two Toshiba models but one stopped shipping in 1H02, although additional new model transition should pick up in late 3Q02. As a notebook model normally offers a 6-9-month life cycle, some think that whether Toshiba will continue to contract new 2002 model orders to Compal depends on the performance of its outsourcing. Should Toshiba take advantage of outsourcing to expand its market share, and then some believe that its current outsourcing ratio would be more sustainable. In short, it remains to be seen whether Taiwan notebook companies' capability (Compal) in implementing design and manufacturing processes to cut costs and build more efficient logistics networks can be more competitive than that of Japanese companies in an environment of shorter product life cycles.

Fujitsu Siemens – Focus on Outsourcing Partner

In April 2000 Fujitsu Siemens entered an ODM customer relationship with Compal for the Japanese market, although Fujitsu Siemens had been outsourcing to Quanta for the European market. As Fujitsu Siemens implemented the rollout of global-consistent models in 1Q02, It is expected it to cut the number of models it produces and concentrate on its current outsourcing partner. Fujitsu Siemens shipped around 1.7 million notebooks in 2000 and outsourced about 20% of its notebook production. It is expected Fujitsu Siemens' outsourcing ratio to decline further this year on the back of the company's expanding in-house production.

Sony – Outsourcing Pace Still Slow

Sony shipped about 1.5 million notebooks in 2000 and continues to expand its global market share. It is expected Sony's orders to be a fresh growth driver for Taiwan companies as Sony's outsourcing ratio is likely to increase rapidly to 20% in 2003 due to the selection of two new outsourcing partners. Quanta mainly shipped motherboards for Sony last year while Asustek began to ship Sony notebooks in May 2002, accounting for 10% of Sony demand. Moreover, Asustek is responsible for shipping bare bone systems to Sony's distribution centers in the US, Europe and Japan. Sony requires that its notebook. Outsourcing orders to Taiwan notebook companies are filled in China to improve cost benefits.

4.33 China: Early Stages of ODM Relationships

Compared with the relatively lower growth in the US market, Asia/Pacific offers a potentially high unit shipment CAGR of 22% over 2000-2003, according to IDC. Taiwan notebook makers have consequently been establishing ODM relationships in the region, especially with major brands in China, to take advantage of this opportunity. Although Taiwan government policy only allows low-end (486 processors and below) notebook PC production in China, Taiwan producers anticipate gradual deregulation that would allow them to produce high-end notebooks in China. Should the government adjust its policy, some think Taiwan producers could better leverage their proximity to serve ODM customers in the China market.

Legend, a China-based PC maker, sold 110,000 notebooks in China in 2000 and did sell about 250,000 in 2002. As Legend lacks R&D, production and a component supply chain for notebook PCs, the company is dependent on several Taiwan makers including Mitac, FIC and Compal. Taiwan notebook companies' cooperation with Legend is often seen in a controversial light as Legend could set up its own in-house production based on Taiwan notebook makers' experience. Some understand that FIC will assist Legend's notebook production operation and cooperate on development efforts, according to the company. Legend plans to expand into the European market with its new QDI brand – a high-end notebook designed and manufactured by FIC that should launch in September. FIC manufactures 8,000 units a month for Legend, while Compal has supplied 5,000 units per month since 2000. Mitac previously produced a low-end model for Legend but is now conducting small-scale trial production since Legend is in the process of replacing the old model. As Legend is still moving toward several suppliers (among them FIC, Mitac and Compal), this could imply that the company has not yet formed a strong relationship with Taiwan notebook companies.

China Production – A Way to Stay Competitive: Bare bone Production First

Although the government has not yet lifted a ban on high-end notebook PC production in China, increasing pressure from customers is encouraging notebook companies to move production there to reduce costs. About 10 Taiwan notebook manufacturers have decided to move partial production to China. As a way of meeting government requirements, Taiwan notebook makers are mainly producing notebook bare bone systems instead of full systems configuration. However, should the government lift the high-end notebook PC production ban, Taiwan producers could accelerate the production transition given that they already have production facilities in China. In one view, moving production to China is not just a way of lowering costs but also a means of taking advantage of a growing local market. It is very possible that Cost Savings Could Decline Over the Long Term. MIC projects that Taiwan notebook shipments from China will reach 2.8 million in 2003. Indeed, notebook companies expect the Taiwan government to soon lift the restriction on moving high-end production to China. As labor costs in China are only about 15% of the comparable costs in Taiwan, and account for around 3-4% of total manufacturing cost, some estimate a cost saving of around 2.5%.

Infrastructure Not Mature

Some do not expect notebook mainland investment to have a major effect on costs in the next 2-3 years as transportation and distribution networks in China are underdeveloped. Some still think that notebook makers facing complicated customs procedures will find transport for different kinds of components difficult and delivery of finished products challenging. It is expected that most Taiwan notebook plants will be located in the Shanghai region. In China, mass manufacturing of notebooks from purchasing components to delivering shipments takes 14 days on average, compared with only 1-2 days in Taiwan. Because China's infrastructure is underdeveloped, this could add significant costs to Taiwan notebook companies.

Mature Industry with Thin Margins

Margins for notebooks have dropped to below 10%, hence, Taiwan notebook companies are aiming to reduce costs and increase efficiency. Although some think that margins did not expand further in 2002, and that margin pressure will be inevitable, the depreciation of the New Taiwan dollar helped notebook companies resist margin pressure in 1Q02. Economies of scale also helped margin performance. On average, Quanta had a margin premium over other notebook companies. Depreciation of the New Taiwan dollar benefits notebook makers as these companies have far more US dollar cash inflows than US dollar costs. During periods of depreciation, notebook companies usually enjoy considerable foreign-exchange gains as they hold large amounts of cash in US dollars, although some companies may have hedged positions that could offset the exchange-rate gain or loss. Moreover, currency depreciation also helps notebook companies to expand margins as the companies receive nearly 100% of their revenue in US dollars and only 60% of their raw-material cost is denominated in US dollars. However, some believe that margin gains resulting from currency depreciation may last for just one quarter as intense competition in the notebook industry encourages smaller notebook makers to cut prices, which in turn erodes any margin expansion.

Competition among Taiwan manufacturers also has led to a further squeeze on manufacturers' value added (the 'plus' in a cost-plus-pricing scheme). However, as there is usually a time lag when renegotiating prices with key customers, notebook companies benefit from a components pricing decline as a way to boost margins. Most TFT LCD suppliers are more willing to offer rebates of 3-8%, which have benefited Taiwan notebook companies over the past two quarters. Nonetheless, notebook OEM customers themselves are facing severe pricing and margin pressure, and have generally become increasingly sensitive to transparency in component pricing. Indeed, watching suppliers' margin trends on a regular basis is now market practice. In one view, falling component pricing could only benefit notebook makers over the short term, and notebook companies would need to pass on component pricing benefits to their customers.

It is expected TFT-LCD panel prices to have bottomed in 2Q02 thus, margin gains from this major component were not sustainable in 2H02. In an environment of rapid component pricing increases, Taiwan notebook companies could be vulnerable because passing on all increases to customers could be difficult. However, as some believe that most Taiwan notebook companies expect TFT-LCD panel prices to rise over the long term, they may choose to build more TFT-LCD panel capacity to better hedge price increases and sustain margins.

Notebooks Replacing Desktops: Reality Check

Due to pricing differences between notebook and desktop PCs, a 6-12 month lag for desktop PC technology to migrate to notebook PCs, and the cultural stigma attached to mobile computing and connectivity, notebook PC penetration has been less than 20% of the overall PC market. However, these issues, which once prevented widespread notebook PC adoption, have largely been resolved through advances in technology. As a result, in recent years portable PC shipments have shown moderate growth, while desktop PC growth rates have slowly declined. At the same time, worldwide portable PC shipments have risen an average of 28.4% YoY per quarter, compared with 14.2% for desktop PCs

Notebook Processors: Technology Improving

The technology gap between notebook PCs and desktop PCs continues to narrow, leading to increasing desktop PC replacement demand. In the past, notebook PCs were regarded as technologically inferior to desktops and microprocessor efficiency was at least six months behind that of desktop PCs. However, Intel has now launched processors with speed-step technology that decrease voltage use when computing needs are light. Wireless technology such as 802.11 and Bluetooth enable users to perform not only basic computing tasks but also to access data networks and the Internet. Wireless technology, coupled with improving connectivity, should help notebook popularity. As more people embrace mobile computing, it is expected that wireless functions will trigger demand for notebook PCs.

4.34 Gateways to Diversification: Server Outsourcing

Major notebook companies such as Quanta, Inventec and Arima want to capitalize on server outsourcing opportunities. Given that the top five global server makers have a combined market share of over 70%, some believe that ODM relationships with Compaq, Dell, IBM, H-P and Fujitsu are the best way to expand server-business revenue. Thanks to continuous margin pressure faced by server makers, it is expected that entry-level server outsourcing opportunities will increase in coming years. Although Taiwan motherboard and PC systems makers such as Asustek, Gigabyte, Acer and Mitac have invested R&D resources in the server segment to diversify their PC businesses ahead of notebook companies, notebook companies are capable of leveraging their existing customer relationships to expand into the server business. Owing to greater design complexity, the need for comprehensive software system integration and a longer qualification process, growth in server outsourcing is still slow. Competition also was intense, even at the initial stage.

Due to the absorption of Digital's facilities in Taiwan following Compaq's acquisition of Digital, Inventec has received business commitments from Compaq and has been producing Compaq's entry-level servers (1P and 2P) since late 1998. Some estimate that Compaq outsourced about 15% of its server production in 2000 to Inventec and that there remains room for more outsourcing. Moreover, Dell has begun trial runs for server outsourcing, and Quanta should be able to extend its customer relationship from notebook PCs to server business. Nonetheless, the underlying market size of the server business appears relatively small compared with the notebook market (27 million annually), given that the global server market is still less than 5 million units annually. Taiwan companies are unable to provide high-end models that can draw higher revenue (more value-added), and this should limit revenue-growth potential.

Although one US analyst, Gillian Munson, forecasts notebook PC shipments to grow 11% YoY in 2002, it is expected Quanta and Compal to beat the industry average as the two companies are gaining market share during the global PC downturn. 2Q02 Shipments Surged; 3Q02; Orders Relatively Weak Taiwan tier-one notebook makers have shown strong volumes. Combined notebook shipments in 2Q02 surged 24% QoQ and 10% YoY. Some attributed this to channel inventory rebuild after a 1Q02 inventory workout and new demand triggers from the launch of new notebook models. Among top-tier notebook companies, Arima reported organic QoQ growth given a low base in 1Q02 and NEC's new model launch in 2Q02. Both Quanta and Compal reported strong QoQ growth on the back of Dell's strong sales momentum, while Inventec's 2Q02 shipments fell due to Compaq's market-share decline. Although a seasonal up tick for 3Q02 is not yet visible, and July notebook shipments are historically weak, some think individual company performance in 3Q02 will likely vary as well. It is expected Compal's 3Q02 notebook shipments to grow 15% QoQ on the back of Dell's and Toshiba's new models, while it is expected Quanta's 3Q02 shipments to see single digit sequential growth.

As the notebook industry consolidates, some believe that top-tier notebook companies with a diversified customer base should trade at premiums to their peers because they experience less volatility from customer order fluctuations and can leverage their economies of scale to improve profitability and expand market share. Quanta, Compal, Inventec and Arima could be regarded as being in the same peer group, although their business structure differs in some ways. Both Quanta and Compal serve multiple customers (Compal has around 30% revenue exposure to the display monitor business, which has lower margins than notebooks). On the other hand, both Inventec and Arima focus on a single big client, Compaq, although Arima has diversified its client base with NEC. A global comparison is not available since there are no pure Notebook PC contract manufactures outside Taiwan. Some Included valuations for US PC companies such as Dell, and Compaq and EMS companies such as Solectron only for reference purposes.

Taiwan notebook companies are trading at discounts to both US EMS and PC companies in terms of P/E. Among Taiwan notebook companies, Quanta is still trading at premium to local rivals, although some believe that this premium is narrowing given that the gap between Quanta and Taiwan's top tier notebook companies appears to be narrowing in terms of product design and logistics capability. Nonetheless, Quanta's more diversified customer base, better economies of scale, which offer a high gross margin and higher return on equity, should justify the stock continuing to trade at a slight premium to other notebook companies. Some rate Compal Outperform given its undemanding valuation and an anticipated sales revival from late 3Q02 onward.

Case Study 8 : Compal Electronics OEM Notebooks –Current Trends

Compal Electronics Inc., a top-five notebook PC maker in Taiwan, was founded in 1984 and went Public in 1991. The company is primarily engaged in the production of notebook PCs and monitors on an original design-manufacturing basis. Some forecast quarter-on-quarter sales growth of 37% for 3Q02 and 30% for 4Q02, mainly as a result of increased orders from Dell for notebooks and from NEC for CRT monitors. Sales up tick in an environment of poor earnings visibility for the industry could trigger a short-term rally in the stock. However, some believe the company still lacks a long-term fundamental growth driver. With long-term doubt about Toshiba's outsourcing strategy the company accounted for about 32% of Compal's notebook shipments in 2000 – the price of Compal stock has dropped 28% in the past three months. Investors appeared to be factoring in the worst-case scenario – i.e., Toshiba ending its outsourcing agreement with Compal in 2002. Some believe lackluster sales in 2Q02 also caused the share price weakness. However, it is expected Compal's orders from Toshiba to stay at current levels until 2003 and to account for at least 15% of Toshiba's total notebook sales in that year. Outsourcing orders for notebooks are slowing, while new products such as PDAs (personal digital assistants) and handsets are unlikely, in this view, to offer robust growth soon. Nonetheless, some view this product direction as strategically imperative as technologies converge.

Riding the outsourcing wave, Compal's notebook business has grown progressively in the past two years. Nonetheless, in 1H02, notebook shipment momentum decelerated because of weak demand and Dell's model transition on top of a lack of fresh or incremental outsourcing orders. Given that Dell's new models are due to go out from 3Q02, it is expected Compal to ship

590,000 notebooks in 3Q02 and 740,000 in 4Q02, up from 510,000 units in 2Q02. In 2Q02, Compal's CRT monitor sales fell below the company's expectation. CRT orders from major customer Compaq were feeble, mainly due to the slowdown in global PC demand.

Replacement demand

Compal has successfully leveraged its notebook customer base into the display business. In light of strong LCD monitor demand, it has cross-sold LCD monitors to its notebook customers such as Toshiba and Dell. At the same time, Compal is attempting to cross-sell notebook PCs to its monitor customers such as Compaq and NEC. Compal's gross margin could remain above 9% thanks to better scale economies and lower component prices, coupled with favorable currency depreciation. Taiwan handset makers have reaped enormous benefits as major global brands have trimmed their R&D resources in handset hardware and software design and increased their reliance on contract manufacturers and ODM suppliers. Most global handset companies have downsized their operations recently. Compal, on the other hand, is speeding up its wireless design capability and aims to expand its R&D team from 140 engineers to 250 by the end of 2002. It expects to be prepared for the next wave of handset outsourcing and has a strong balance sheet to back up this strategy.

To ensure successful execution of its wireless strategy, Compal has developed multiple intellectual property platforms to support both TI and Lucent solutions. This should initiate competition among suppliers and reduce the risk of delay in time to market. Both Compal and its 58%-owned Compal Communications are developing GSM/GPRS (global system for mobile/general packet radio service) handsets, and Compal is developing CDMA (code-division multiple access). With two distinct operations, Compal is pursuing at least two top-tier customers that require a large percentage of R&D resources. Most handset projects have a 9-12 months lead-time between the award of an ODM contract and commencement of volume production. Hence, although Compal Communications received Motorola's GPRS handset order quite some time ago, volume shipment is to begin only in 3Q02. Given that the GPRS handset is still in the early promotion stage, the number of orders will depend greatly on market acceptance of this technology. Some have conservatively forecast 1 million handsets shipped in 2002, which would make Compal Communications profitable in 2H02.

Riding the Convergence Wave

Compal is geared up to ride the convergence wave over the long term and in this vein decided to fully integrate its PDA arm, Palmax, into Compal. To leverage Palmax PDA expertise, Compal has formed a personal mobile computer and communications (PMCC) department to ensure maximum co-operation and exchange of information in the development of wireless technology, integration of design and manufacturing capability. Given the robust growth in global demand for PDA devices, some are positive about the long-term ODM business opportunity, as most global brands look for ODM partners. Moreover, the Palmax integration should enable Compal to successfully leverage its relationships with big OEMs and pass on its mass-production experience to the PDA product line. In fact, Compal co-designed the PDA products with its existing notebook customer HP. some thus expect PDAs to account for 4% of Compal sales in 2002.

Toppoly, whose major shareholders include Compal (33.1%), Uni-President (34.5%), TECO (17.1%) and Kinpo (5.5%), invested NT$22.2 billion (Phase I) to construct a poly-si TFT (thin film transistor) fab with technology to be transferred from Japanese company Totorri Sanyo. The two companies are still working on final terms of a licensing agreement. Toppoly expects to complete the construction of the fab by the end of 2002 and commence volume production and shipments in 3Q02. In addition, the operation will require another NT$26 billion capex in the second phase of construction. Toppoly adopts Gn3.5 LTPS TFT-LCD manufacturing technology, and its planned capacity for the fab is 30,000 pieces of mother glass per month by 2Q02 and an additional 30,000 pieces by 2004. Toppoly's fab will be dedicated to producing small and medium-sized displays for mobile phones, PDAs and digital cameras (six inches and below). As LTPS TFT-LCDs (low temperature polysilicon liquid crystal displays) consume less power, their adoption for color and high-quality displays has been accelerating. The success of Compaq's iPAQ PDA device underpins the strength of the LTPS TFT-LCD in the PDA market. And LTPS TFT-LCDs' superior performance in terms of high resolution, rich colors and low power consumption offsets its cost disadvantages.

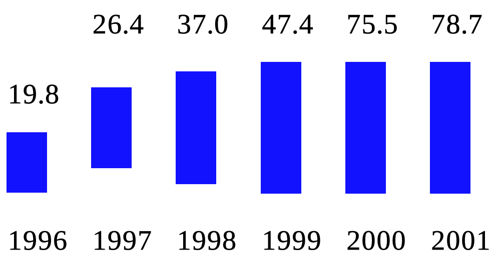
Competitor Analysis

Compal Electronics Incorporated operates within the Electronic computers sector. This analysis compares Compal Electronics Incorporated with three other companies in this sector in Taiwan: Benq Corporation (2001 sales of 73.75 billion Taiwanese Dollars [US$2.13 billion]), Inventec Corporation (81.62 billion Taiwanese Dollars [US$2.36 billion]), and Synnex Technology International Corp (64.88 billion Taiwanese Dollars [US$1.88 billion]).

Sales Analysis

During the year ended December of 2001, sales at Compal Electronics Incorporated were 78.66 billion Taiwanese Dollars (US$2.28 billion). This is an increase of 4.2% versus 2000, when the company's sales were 75.47 billion Taiwanese Dollars. This was the fifth consecutive year of sales increases at Compal Electronics Incorporated (and since 1996, sales have increased a total of 298%).

Table 4.48 Recent Sales at Compal Electronics Incorporated



Figures in Billions of Taiwanese Dollars)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

The company currently employs 2,500. With sales of 78.66 billion Taiwanese Dollars

(US$2.28 billion) , this equates to sales of US$910,533 per employee. The sales per employee levels at the three comparable companies vary greatly, from US$602,250 to US$3,562,970, as shown in the following table. Some of the variation may be due to the way each of these companies counts employees (and if they count subcontractors, independent contractors, etc).

Table 4.49 Sales Comparisons for CEI (Fiscal Year ending 2001)

Company	**Sales (blns)**	**Sales Growth**	**Sales/ Emp (US$)**	**Largest Region**
Compal Electronics Incorporated	78.657	4.2%	910,533	N/A
Benq Corporation	73.750	18.1%	1,227,329	Taiwan (46.8%)
Inventec Corporation	81.618	-19.0%	602,250	Taiwan (89.7%)
Synnex Technology International Corp	64.882	8.1%	3,562,970	Taiwan (66.0%)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.50 Recent Stock Performance for CEI

Company	**P/E**	**Price/ Book**	**Price/ Sales**	**52 Wk Pr Chg**
Compal Electronics Incorporated	15.3	2.12	1.08	-11.00%
Benq Corporation	19.6	2.12	0.88	-41.73%
Inventec Corporation	9.4	1.49	0.44	-35.97%
Synnex Technology International Corp	21.4	2.02	0.48	11.17%

The market capitalization of this company is 84.60 billion Taiwanese Dollars (US$2.45 billion) .

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Dividend Analysis

During the 12 months ending 12/31/01, Compal Electronics Incorporated paid dividends totaling 0.42 Taiwanese Dollars per share. Since the stock is currently trading at 33.90 Taiwanese Dollars, this implies a dividend yield of 1.2%. This company's dividend yield is lower than the three comparable companies (which are currently paying dividends between 1.9% and 4.7% of the stock price). The company has paid a dividend for 4 straight years. Compal Electronics Incorporated last raised its dividend during fiscal year 1999, when it raised its dividend to 1.67 Taiwanese Dollars from 0.47 Taiwanese Dollars. During the same 12 month period ended 12/31/01, the Company reported earnings of 2.22 Taiwanese Dollars per share. Thus, the company paid 18.9% of its profits as dividends.

Profitability Analysis

On the 78.66 billion Taiwanese Dollars in sales reported by the company in 2001, the cost of goods sold totaled 70.25 billion Taiwanese Dollars, or 89.3% of sales (i.e., the gross profit was 10.7% of sales). This gross profit margin is slightly lower than the company achieved in 2000, when cost of goods sold totaled 89.0% of sales. The gross margin in 2001 was the lowest of the previous five years (in 1998, the gross margin had been as high as 15.9%). There was a wide variation in the gross profit margins at the three comparable companies, from 5.7% of sales to 18.0% of sales. The company's earnings before interest, taxes, depreciation and amortization (EBITDA) were 5.35 billion Taiwanese Dollars, or 6.8% of sales. This EBITDA to sales ratio is roughly on par with what the company achieved in 2000, when the EBITDA ratio was 7.9% of sales. In 2001, earnings before extraordinary items at Compal Electronics Incorporated were 5.40 billion Taiwanese Dollars, or 6.9% of sales. This profit margin is lower than the level the company achieved in 2000, when the profit margin was 7.9% of sales. The company's return on equity in 2001 was 17.4%. This was a decline in performance from the 21.8% return that the company achieved in 2000. (Extraordinary items have been excluded).

Table 4.51 Profitability Comparison for CEI

Company	Year	Gross Profit Margin	EBITDA Margin	Earns bef. extra
Compal Electronics Incorporated	2001	10.7%	6.8%	6.9%
Compal Electronics Incorporated	2000	11.0%	7.9%	7.9%
Benq Corporation	2001	18.0%	7.2%	4.1%
Inventec Corporation	2001	8.6%	2.2%	4.7%
Synnex Technology International Corp	2001	5.7%	2.3%	2.2%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Inventory Analysis

As of December 2001, the value of the company's inventory totaled 5.96 billion Taiwanese Dollars. Since the cost of goods sold was 70.25 billion Taiwanese Dollars for the year, the company had 31 days of inventory on hand (another way to look at this is to say that the company turned over its inventory 11.8 times per year). In terms of inventory turnover, this is an improvement over December 2000, when the company's inventory was 6.97 billion Taiwanese Dollars, equivalent to 38 days in inventory.

Research and Development

Research and Development Expenses at Compal Electronics Incorporated in 2001 were 1.03 billion Taiwanese Dollars, which is equivalent to 1.3% of sales. In 2001 R&D expenditures increased both as a percentage of sales and in actual amounts: In 2000, Compal Electronics Incorporated spent 821.00 million Taiwanese Dollars on R&D, which was 1.1% of sales. During each of the previous 5 years, the company has increased the amount of money it has spent on Research and Development (in 1996, Compal Electronics Incorporated spent 310.48 million Taiwanese Dollars versus 1.03 billion Taiwanese Dollars in 2001).

Financial Position

As of December 2001, the accounts receivable for the company were 17.81 billion Taiwanese Dollars, which is equivalent to 83 days of sales. This is higher than at the end of 2000, when Compal Electronics Incorporated had 52 days of sales in accounts receivable. The 83 days of accounts receivable at Compal Electronics Incorporated are higher than all three comparable companies: Benq Corporation had 70 days, Inventec Corporation had 53 days, while Synnex Technology International Corp had 50 days outstanding at the end of the fiscal year 2001.

Table 4.52 Financial Positions for CEI

Company	Year	Days AR	Days Inv.	R&D/ Sales
Compal Electronics Incorporated	2001	83	31	1.3%
Benq Corporation	2001	70	66	2.8%
Inventec Corporation	2001	53	20	1.6%
Synnex Technology International Corp	2001	50	31	0.0%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.53 Stock Performance Indicators Note: (All figures are in U.S. Dollars)

		Ratios		Equity Capital					Dividends	
Year	Last Price	P/E	P/Bk	Earned Growth %	Profit Rate %	Book Value Begin Yr	Earnings Per Share	% Chg	Divs Per Share	Avg Yield
1994	0.26	24.0	n/c	n/c	n/c	n/a	0.011	n/c	0.00	0.0
1995	0.19	21.8	2.0	5.9	9.3	0.10	0.009	-19	A 0.00	1.7
1996	0.43	15.9	3.6	22.8	22.8	0.12	0.027	204	A 0.00	0.0
1997	0.93	14.2	6.4	45.4	45.4	0.14	0.066	142	A 0.00	0.0
1998	1.44	18.0	4.7	21.4	25.9	0.31	0.080	22	A 0.01	1.0
1999	1.96	n/c	5.1	9.7	22.2	0.38	n/a	7	A 0.05	2.5
2000	1.08	n/c	2.5	18.6	21.4	0.43	n/a	8	A 0.01	1.1
2001	1.07	16.6	2.2	10.8	13.3	0.48	B 0.064	-31	0.01	1.1
2002	1.04	n/c	2.3	n/c	n/c	0.46	n/a	n/c	A 0.00	0.0
3/7/03	0.98	15.3	2.1	n/a	n/a	0.46	0.064	n/c	A 0.01	1.2

The data included in the notes have not been converted to U.S. Dollars. To convert the data in the notes a use a factor of: 0.028940

(A): ALL ITEMS ADJUSTED FOR STOCK SPLITS OR DIVIDENDS - 20% IN 2002, 30% IN 2000, 35% & 100.1:100 RIGHTS ISSUE (0.03% DIV) IN 1999, 40% IN 1998 &100.2:100 RIGHTS ISSUE (.05% DIV) IN 1998, 30% & 1086.34:1000 RIGHTS ISSUE (7.24% DIV) IN 1997, 1177:1000 RIGHTS ISSUE (8.79% DIV) IN 96, 25% & 1350:1000 (10.82% DIV) IN 95

(B): BASED ON AVERAGE SHARES OUTSTANDING

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.54 Cash Flow and Sales in Billions of U.S. Dollars

Year	Sales	Sales Growth	EBITDA	% of sales	Inc. bef Extra	% of sales	Emps	Sales/ Empl
1994	0.280	n/c	0.011	3.9%	0.009	3.1%	n/a	n/a
1995	0.316	12.7%	0.008	2.6%	0.008	2.6%	n/a	n/a
1996	0.572	81.0%	0.042	7.3%	0.034	5.9%	n/a	n/a
1997	0.765	33.8%	0.066	8.6%	0.098	12.9%	n/a	n/a
1998	1.070	39.9%	0.132	12.3%	0.141	13.2%	1,606	666,339
1999	1.372	28.2%	0.157	11.5%	0.156	11.4%	n/a	n/a
2000	2.184	59.1%	0.173	7.9%	0.173	7.9%	2,500	873,629
2001	2.276	4.2%	0.155	6.8%	0.156	6.9%	n/a	n/a

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Case Study 9 : Quanta Computer

Company Description

The Group's principal activities are the designs, manufactures, processes and trades a full range of computer systems including notebook PC's in Taiwan, microprocessor, home PC, microcomputer, PC, floppy disk, add-on cards, terminals, printers, peripheral, accessories, communication electronic devices, digital transfer devices, video meeting (conference) devices and accessories, color LCD monitors, multimedia players and accessories; sales and provision of technical service for computer and periphery device; ventures capital; provides digital satellite, cable, terrestrial DSL and wireless set-top-boxes; and import, export and the agency of the aforesaid products. Products include full (complete) notebook PC line, LCD monitor, LCD PC, LCD IA, wireless communication line, book size PC and server. The Group engages in long-term cooperation with brands like Dell, HP, IBM, Gateway, Siemens and Sharp.

Current Trends for Quanta Incorporated

The Group's principal activities are manufacturing and selling of computer monitors, notebook computers, cell phones, LCD and various parts. The Group manufactures its products at two locations: Ping-chen in Taiwan and Kwunshan Factory in China. Both facilities are fully automated and equipped with the latest state-of-the-art equipment. The Group has established branches in Taiwan, the People's Republic of China, South Korea, England, Holland and the United States.

Quanta Computer Inc. Background Research

Quanta Computer Inc., Taiwan's largest notebook PC maker, designs and manufactures notebook computers for global brands such as Dell, Hewlett-Packard, IBM, Apple and Gateway. Quanta also manufactures wireless communication devices and information appliances. Some are reiterating one Outperform rating for the stock of notebook PC maker Quanta Computer. Backed by rising notebook orders from Dell, Quanta should expand its global notebook market share from 10.3% in 2000 to 15.2% in 2002. It is expected its 2002 sales to outstrip overall industry growth and rise by 49% YoY. Some estimate that the company will report 27% EPS growth in 2002, compared with an average 58% EPS decline forecast for one Taiwan electronics company universe. Quanta appears to be demonstrating that it is capable of bucking the downward trend and outperforming the Taiwan electronics sector. Buoyed by 1.1 million notebook shipments, Quanta should reach NT$29.5 billion in sales in 2Q02, up 12% QoQ, with EPS of NT$1.74, up 11% QoQ. Although the company's customers are aggressively slashing notebook prices, some believe Quanta can maintain gross margins above 12% in 2Q02 due to better economies of scale and lower component prices, as well as a weaker NT dollar.

Gaining Global Notebook Production Market Share

Despite the current down cycle, Quanta appears to have made good progress in expanding its share of the global notebook production market. The company's notebook sales for 2002 have been buoyed by orders from new notebook customers Compaq and Sony, coupled with increasing outsourcing and market share gains by existing customer Dell. Some estimate that Quanta's global market share could expand from 10.3% in 2000 to 15.2% in 2002 and 16.7% in 2003. Inventory management is growing in complexity, characterized by complex mobile PC designs associated with shortened product life cycles. As a result of this coupled with margin pressure due to sluggish global PC demand, Dell has re-embraced an outsourcing strategy and did increase orders to Taiwanese notebook companies in 2002.

Based on current model contracts, it is expected that Dell will outsource around 50% of its production to Quanta this year. Morgan Stanley US PC analyst, Gillian Munson, forecasts that Dell will ship 4.27 million notebooks, which implies that Dell's orders to Quanta could reach

2 million notebooks. In fact, Quanta's notebook shipments weakened last year –the first in which its global market share declined slightly. This was a result of Dell's strategy to shift to greater in-house assembly of notebook PCs and to outsource mainly from US electronics manufacturer service supplier Jabil. As a consequence of the cutback in Dell's orders in 2000, Quanta bid aggressively for new customer contracts last year and succeeded in securing Compaq and Sony. Some estimate that Compaq orders will reach 500,000 units and Sony's 200,000 units this year, although Sony shipments will be mainly bare bone. Of importance, Quanta has been shipping motherboards to Sony since mid-2000 and will likely extend to full system configuration over the long term should the two companies establish a solid relationship. Sony's has been the fastest growing portable PC brand, and some believe its potential market share expansion will benefit Quanta's long-term growth. Solid and Diverse Customer Base In this view, Quanta's customer profile is the strongest of the Taiwanese notebook companies. Some estimate that the company's 2002 notebook shipments Will break down by customer as follows: Dell (47%), Compaq (12%), Hewlett-Packard (9%), Apple Computer (8%), Gateway (7%), Sony (5%), Sharp (4%), Fujitsu-Siemens (4%) and IBM (3%). This broad customer base should insulate Quanta from individual customer order fluctuations. The company is also establishing customer relationships with Chinese brands, which should boost growth momentum.

Quanta owns 31.25% of Quanta Display (QDI), which will operate a 3.5Gn TFT-LCD fab. QDI's planned capacity is 30,000 substrates (mother-glass) per month. The subsidiary is expected to commence mass production in 2H02. According to one Taiwan TFT LCD analyst, George Chu, QDI should break even in 2003. It is expected Sharp, which owns 10% of QDI, to accelerate technology transfer to QDI to improve the fab's yield rate. Moreover, given the substantial economies of scale Quanta enjoys in notebook production, the company should help digest QDI's panel capacity and provide early qualification support. In addition to Sharp as a main customer for QDI's panels, Dell, according to Quanta, according to Quanta, has agreed to adopt QDI panels. With the adoption by both Sharp and Dell, it is expected QDI's fab utilization to reach over 88% in 2003.

Although Quanta's share price appreciated by 38% in 1H02 and outperformed the electronics index by 30%, it is expected the stock to continue to outperform the electronics sector in 2H02 on the back of its solid shipment visibility, in contrast to the murky picture for PCs overall. Quanta is trading at 15.4 times this 2002 forecast earnings. Although Quanta's stock was berated in 2000 as the company shipped fewer notebooks and its global market share declined, it is expected the market to rerate the shares in 2002 following resumption of shipment momentum and global market share expansion this year. This target price of NT$133 is based on a P/E of 20 for this 2002 forecast earnings. Quanta, Compal, Inventec and Arima can be regarded as peers of Quanta, although their business structures differ in some ways. Quanta and Compal serve multiple customers (Compal has around 30% revenue exposure to the display monitor business, whose margins are lower than those for notebooks), while Inventec and Arima focus on a single big client, Compaq. Arima, however, has diversified its customer base with NEC since 2000.

Competitor Analysis

Quanta Computer operates within the Electronic computers sector. This analysis compares Quanta Computer with three other companies in this sector in Taiwan: Compal Electronics Incorporated (2001 sales of 78.66 billion Taiwanese Dollars [US$2.28 billion]), Inventec Corporation (81.62 billion Taiwanese Dollars [US$2.36 billion]), and Benq Corporation (73.75 billion Taiwanese Dollars [US$2.13 billion]).

Sales Analysis

During the year ended December of 2001, sales at Quanta Computer were 111.58 billion

Taiwanese Dollars (US$3.23 billion). This is an increase of 34.9% versus 2000, when the company's sales were 82.74 billion Taiwanese Dollars. This was the third consecutive year of growth at Quanta Computer. The company derives almost all of its revenues in Domestic: in 2001, this region's sales were 100.75 billion Taiwanese Dollars, which is equivalent to 90.3% of total sales. Geographic breakdowns may be skewed since the breakdown includes Adjustment accounts, which totaled -1.69 billion Taiwanese Dollars (equivalent to 1.5% of sales) in 2001. The company's sales increased faster in 2001 than at all three comparable companies. While Quanta Computer enjoyed a sales increase of 34.9%, the other companies saw smaller increases: Compal Electronics Incorporated sales were up 4.2%, Inventec Corporation decreased 19.0%, and Benq Corporation experienced growth of 18.1%. The company currently employs 2,400. With sales of 111.58 billion Taiwanese Dollars (US$3.23 billion) , this equates to sales of US$1,345,469 per employee. This is much higher than the three comparable companies, which had sales between US$602,250 and US$1,227,329 per employee.

Table 4.55 Sales Comparisons for Quanta (Fiscal Year Ending 2001)

Company	Sales (blns)	Sales Growth	Sales/ Emp (US$)	Largest Region
Quanta Computer	111.580	34.9%	1,345,469	Domestic (90.3%)
Compal Electronics Incorporated	78.657	4.2%	910,533	N/A
Inventec Corporation	81.618	-19.0%	602,250	Taiwan (89.7%)
Benq Corporation	73.750	18.1%	1,227,329	Taiwan (46.8%)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.56 Recent Stock Performance for Quanta

Company	P/E	Price/ Book	Price/ Sales	52 Wk Pr Chg
Quanta Computer	11.7	3.46	1.29	-43.70%
Compal Electronics Incorporated	15.3	2.12	1.08	-10.98%
Inventec Corporation	9.4	1.49	0.44	-35.97%
Benq Corporation	19.6	2.12	0.88	-41.73%

The market capitalization of this company is 144.02 billion Taiwanese Dollars (US$4.17 billion) .

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Dividend Analysis

During the 12 months ending 12/31/01, Quanta Computer paid dividends totaling 2.17 Taiwanese Dollars per share. Since the stock is currently trading at 58.50 Taiwanese Dollars, this implies a dividend yield of 3.7%. The company has paid a dividend for 4 straight years. During the same 12 month period ended 12/31/01, the Company reported earnings of 4.98 Taiwanese Dollars per share. Thus, the company paid 43.6% of its profits as dividends.

Profitability Analysis

On the 111.58 billion Taiwanese Dollars in sales reported by the company in 2001, the cost of goods sold totaled 96.61 billion Taiwanese Dollars, or 86.6% of sales (i.e., the gross profit was 13.4% of sales). This gross profit margin is better than the company achieved in 2000, when cost of goods sold totaled 88.5% of sales. The company's earnings before interest, taxes, depreciation and amortization (EBITDA) were 11.19 billion Taiwanese Dollars, or 10.0% of sales. This EBITDA margin is better than the company achieved in 2000, when the EBITDA margin was equal to 7.5% of sales. The three comparable companies had EBITDA margins that were all less (between 2.2% and 7.2%) than that achieved by Quanta Computer. In 2001, earnings before extraordinary items at Quanta Computer were 11.93 billion Taiwanese Dollars, or 10.7% of sales. This profit margin is an improvement over the level the company achieved in 2000, when the profit margin was 10.3% of sales. The company's return on equity in 2001 was 37.5%. This was an improvement over the already high 33.2% return the company achieved in 2000. (Extraordinary items have been excluded).

Table 4.57 Profitability Comparison for Quanta

Company	Year	Gross Profit Margin	EBITDA Margin	Earns bef. extra
Quanta Computer	2001	13.4%	10.0%	10.7%
Quanta Computer	2000	11.5%	7.5%	10.3%
Compal Electronics Incorporated	2001	10.7%	6.8%	6.9%
Inventec Corporation	2001	8.6%	2.2%	4.7%
Benq Corporation	2001	18.0%	7.2%	4.1%

During the first quarter of 2001, Quanta Computer reported earnings per share of 1.25 Taiwanese Dollars.

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Inventory Analysis

As of December 2001, the value of the company's inventory totaled 10.71 billion Taiwanese Dollars. Since the cost of goods sold was 96.61 billion Taiwanese Dollars for the year, the company had 40 days of inventory on hand (another way to look at this is to say that the company turned over its inventory 9.0 times per year). This is an increase in days in inventory from December 2000, when the company had 6.35 billion Taiwanese Dollars, which was only 32 days of sales in inventory.

Research and Development

Research and Development Expenses at Quanta Computer in 2001 were 1.34 billion Taiwanese Dollars, which is equivalent to 1.2% of sales. In 2001 R&D expenditures increased both as a percentage of sales and in actual amounts: In 2000, Quanta Computer spent 945.73 million Taiwanese Dollars on R&D, which was 1.1% of sales. This company's R&D expenditures in 2001 were less than all three companies as a percentage of sales: Compal Electronics Incorporated spent 1.3% of its sales on R&D, Inventec Corporation spent 1.6%, and Benq Corporation spent 2.8%.

Financial Position

As of December 2001, the company's long-term debt was 948.00 million Taiwanese Dollars and total liabilities (i.e., all monies owed) were 32.53 billion Taiwanese Dollars. The long-term debt to equity ratio of the company is very low, at only 0.02. As of December 2001, the accounts receivable for the company were 24.21 billion Taiwanese Dollars, which is equivalent to 79 days of sales. This is higher than at the end of 2000, when Quanta Computer had 54 days of sales in accounts receivable.

Table 4.58 Financial Positions for Quanta

Company	Year	LT Debt/ Equity	Days AR	Days Inv.	R&D/ Sales
Quanta Computer	2001	0.02	79	40	1.2%
Compal Electronics Incorporated	2001	0.00	83	31	1.3%
Inventec Corporation	2001	0.00	53	20	1.6%
Benq Corporation	2001	0.40	70	66	2.8%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.59 Stock Performance Indicators Note: (All figures are in U.S. Dollars)

		Ratios		Equity Capital					Dividends	
Year	Last Price	P/E	P/Bk	Earned Growth %	Profit Rate %	Book Value Begin Yr	Earnings Per Share	% Chg	Divs Per Share	Avg Yield
1999	3.54	n/c	n/c	n/c	n/c	n/a	n/a	n/c	A 0.04	1.1
2000 B	1.75	16.7	5.5	20.2	32.8	0.32	C 0.105	-9	A 0.04	2.3
2001	2.87	19.9	7.3	20.8	36.9	0.39	C 0.144	37	A 0.06	2.2
2002	1.65	n/c	3.4	n/c	n/c	0.49	n/a	n/c	A 0.00	0.0
3/7/03	1.69	11.7	3.5	n/a	n/a	0.49	0.144	n/c	A 0.06	3.7

The data included in the notes have not been converted to U.S. Dollars. To convert the data in the notes a use a factor of: 0.028940 (A): ALL ITEMS ADJUSTED FOR STOCK SPLITS OR DIVIDENDS - 15% IN 2002, 25% IN 2001, 40% IN 2000, 68% & 100.1:100 RIGHTS ISSUE (.041% DIV) IN 1999 (B): CHANGE FROM UNCONSOLIDATED TO CONSOLIDATED REPORTS (C): BASED ON AVERAGE SHARES OUTSTANDING

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.60 Cash Flow and Sales in Billions of U.S. Dollars

Year	Sales	Sales Growth	EBITDA	% of sales	Inc. bef Extra	% of sales	Emps	Sales/ Empl
1999	2.179	n/c	0.260	11.9%	0.268	12.3%	n/a	n/a
2000	2.395	9.9%	0.179	7.5%	0.247	10.3%	2,400	997,741

2001	3.229	34.9%	0.324	10.0%	0.345	10.7%	n/a	n/a

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Case Study 10: Mitac International Corporation

Company Description

The Group's principal activities are the manufacture and sale of computers and peripheral equipment. The Group operates in North America, Asia and other foreign countries.

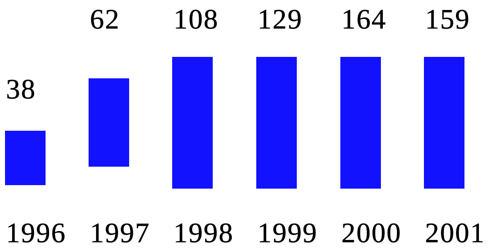
Competitor Analysis

Mitac International Corporation operates in the Electronic computers sector. This analysis compares Mitac International with three other companies in this sector in Taiwan: Compal Electronics Incorporated (2001 sales of 78.66 billion Taiwanese Dollars [US$2.28 billion]), Quanta Computer (111.58 billion Taiwanese Dollars [US$3.23 billion]), and Inventec Corporation (81.62 billion Taiwanese Dollars [US$2.36 billion]).

Sales Analysis

Mitac International reported sales of 159.03 billion Taiwanese Dollars (US$4.60 billion) for the year ending December of 2001. This represents a decrease of 3.2% versus 2000, when the company's sales were 164.22 billion Taiwanese Dollars.

Table 4.61 Recent Sales at Mitac International



(Figures in Billions of Taiwanese Dollars)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Most of the company's 2001 sales were in North America: in 2001, this region's sales were 98.94 billion Taiwanese Dollars, which is equivalent to 62.2% of total sales. On a geographical basis, contributing to the decline in the company's sales in 2001 were the declines in Taiwan, where sales dropped 22.7% to 37.67 billion Taiwanese Dollars. Sales in North America were also lower, falling 8.4% (to 98.94 billion Taiwanese Dollars) . However, not all regions experienced a decline in sales. Sales in Asia/Far East increased 120.7% (to 18.34 billion Taiwanese Dollars). Sales also increased in other countries (up 286.1% to 5.60 billion Taiwanese Dollars) . Geographic breakdowns may be skewed since the breakdown includes Adjustment accounts, which totaled -1.52 billion Taiwanese Dollars (equivalent to 1.0% of sales) in 2001. Mitac International currently has 1,968 employees. With sales of 159.03 billion Taiwanese Dollars (US$4.60 billion) , this equates to sales of US$2,338,596 per employee. This is much higher than the three comparable companies, which had sales between US$602,250 and US$1,345,469 per employee. Note that some of the figures stated herein could be distorted based on exact classification of employees and subcontractors.

Table 4.62 Sales Comparisons for Mitac (Fiscal Year ending 2001)

Company	Sales (blns)	Sales Growth	Sales/ Emp (US$)	Largest Region
Mitac International	159.031	-3.2%	2,338,596	North America (62.2%)
Compal Electronics Incorporated	78.657	4.2%	910,533	N/A
Quanta Computer	111.580	34.9%	1,345,469	Domestic (90.3%)
Inventec Corporation	81.618	-19.0%	602,250	Taiwan (89.7%)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.63 Summary of Company Valuations. for Mitac

Company	P/E	Price/ Book	Price/ Sales	52 Wk Pr Chg
Mitac International	11.8	0.79	0.08	-37.90%
Compal Electronics Incorporated	15.3	2.12	1.08	-10.98%
Quanta Computer	11.7	3.46	1.29	-43.70%
Inventec Corporation	9.4	1.49	0.44	-35.97%

The market capitalization of this company is 12.13 billion Taiwanese Dollars (US$351.17 million) .

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Dividend Analysis

During the 12 months ending 12/31/01, Mitac International paid dividends totaling 0.10 Taiwanese Dollars per share. Since the stock is currently trading at 11.65 Taiwanese Dollars, this implies a dividend yield of 0.9%. This company's dividend yield is lower than the three comparable companies (which are currently paying dividends between 1.2% and 4.7% of the stock price). The company has paid a dividend for 3 straight years. During the same 12 month period ended 12/31/01, the Company reported earnings of 0.99 Taiwanese Dollars per share. Thus, the company paid 10.1% of its profits as dividends.

Profitability Analysis

On the 159.03 billion Taiwanese Dollars in sales reported by the company in 2001, the cost of goods sold totaled 147.40 billion Taiwanese Dollars, or 92.7% of sales (i.e., the gross profit was 7.3% of sales). This gross profit margin is very slightly better than the company achieved in

2000, when cost of goods sold totaled 93.5% of sales. Mitac International's 2001 gross profit margin of 7.3% was lower than all three comparable companies (which had gross profits in 2001 between 8.6% and 13.4% of sales). The company's earnings before interest, taxes, depreciation and amortization (EBITDA) were 3.72 billion Taiwanese Dollars, or 2.3% of sales. This EBITDA to sales ratio is roughly on par with what the company achieved in 2000, when the EBITDA ratio was 2.3% of sales.

Although sales at Mitac International fell 3.2% in 2001, the company actually increased its selling, general and administrative expenses 1.02 billion Taiwanese Dollars (approximately 14.9%).

In 2001, earnings before extraordinary items at Mitac International were 1.01 billion Taiwanese Dollars, or 0.6% of sales. This profit margin is lower than the level the company achieved in 2000, when the profit margin was 1.1% of sales. The company's return on equity in 2001 was 7.0%. This was significantly worse than the 13.8% return the company achieved in 2000. (Extraordinary items have been excluded).

Table 4.64 Profitability Comparison for Mitac

Company	Year	Gross Profit Margin	EBITDA Margin	Earns bef. extra
Mitac International	2001	7.3%	2.3%	0.6%
Mitac International	2000	6.5%	2.3%	1.1%
Compal Electronics Incorporated	2001	10.7%	6.8%	6.9%
Quanta Computer	2001	13.4%	10.0%	10.7%
Inventec Corporation	2001	8.6%	2.2%	4.7%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Inventory Analysis

As of December 2001, the value of the company's inventory totaled 14.94 billion Taiwanese Dollars. Since the cost of goods sold was 147.40 billion Taiwanese Dollars for the year, the company had 37 days of inventory on hand (another way to look at this is to say that the company turned over its inventory 9.9 times per year). In terms of inventory turnover, this is an improvement over December 2000, when the company's inventory was 18.28 billion Taiwanese Dollars, equivalent to 43 days in inventory.

Research and Development

Research and Development Expenses at Mitac International in 2001 were 1.28 billion Taiwanese Dollars, which is equivalent to 0.8% of sales. In 2001 R&D expenditures increased both as a percentage of sales and in actual amounts: In 2000, Mitac International spent 1.21 billion Taiwanese Dollars on R&D, which was 0.7% of sales. This company's R&D expenditures in 2001 were less than all three companies as a percentage of sales: Compal Electronics Incorporated spent 1.3% of its sales on R&D, Quanta Computer spent 1.2%, and Inventec Corporation spent 1.6%. During each of the previous 5 years, the company has increased the amount of money it has spent on Research and Development (in 1996, Mitac International spent 290.71 million Taiwanese Dollars versus 1.28 billion Taiwanese Dollars in 2001).

Financial Position

As of December 2001, the company's long-term debt was 5.88 billion Taiwanese Dollars and total liabilities (i.e., all monies owed) were 28.38 billion Taiwanese Dollars. The long-term debt to equity ratio of the company is 0.29. As of December 2001, the accounts receivable for the company were 13.20 billion Taiwanese Dollars, which is equivalent to 30 days of sales. This is an improvement over the end of 2000, when Mitac International had 31 days of sales in accounts receivable. The 30 days of accounts receivable at Mitac International are lower than all three comparable companies: Compal Electronics Incorporated had 83 days, Quanta Computer had 79 days, while Inventec Corporation had 53 days outstanding at the end of the fiscal year 2001.

Table 4.65 Financial Positions for Mitac

Company	Year	LT Debt/ Equity	Days AR	Days Inv.	R&D/ Sales
Mitac International	2001	0.29	30	37	0.8%
Compal Electronics Incorporated	2001	0.00	83	31	1.3%
Quanta Computer	2001	0.02	79	40	1.2%
Inventec Corporation	2001	0.00	53	20	1.6%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Case Study 11 : First International Computer Incorporated

Company Description

The Group's principal activities are the design and production of motherboards, PC systems, servers and notebooks. At 31-12-2001, the Group operated 8 manufacturing sites and operated 6 branch offices in Taiwan, North America, Asia and Europe. Major products include Motherboard, VGA Card, System, SFF, mobile IA, PDA, Bluetooth, Notebooks and other. Personal computers accounted for 71% of 2001 revenues; notebooks, 28%; IC testing development, 1% and other, nominal.

Competitor Analysis

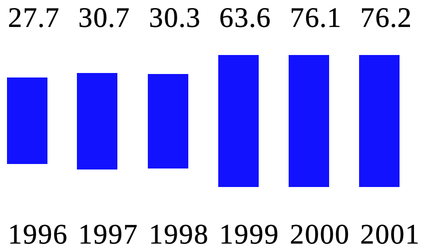
First International Computer Incorporate operates within the Computers, peripherals & software sector. This analysis compares First International Computer Incorporate with three other computer and electronic stores in Australasia: Daiwabo Information System Co., Ltd. of Japan (2001 sales of 310.51 billion Japanese Yen [US$2.65 billion] of which 97% was Info Eqpt Wholesale), Itochu Techno Science of Japan (302.87 billion Japanese Yen [US$2.59 billion] of which 91% was Systems), and Creative Technology Limited which is based in Singapore (2.17 billion Singapore Dollars [US$1.25 billion] of which 100% was Computer & computer related products).

Sales Analysis

During the year ended December of 2001, sales at First International Computer

Incorporate were 76.22 billion Taiwanese Dollars (US$2.21 billion). This is a very small increase of 0.2% versus 2000, when the company's sales were 76.07 billion Taiwanese Dollars. This was the third consecutive year of growth at First International Computer Incorporate.

Table 4.66 Recent Sales at First International Computer Incorporate



(Figures in Billions of Taiwanese Dollars)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

The company derives most of its revenues in Domestic: in 2001, this region's sales were 43.36 billion Taiwanese Dollars, which is equivalent to 56.9% of total sales. The company currently employs 3,250. With sales of 76.22 billion Taiwanese Dollars (US$2.21 billion) , this equates to sales of US$678,674 per employee. The sales per employee levels at the three comparable companies vary greatly, from US$228,533 to US$1,467,495, as shown in the following table. Some of the variation may be due to the way each of these companies counts employees (and if they count subcontractors, independent contractors, etc).

Table 4.67 Sales Comparisons for FICI (Fiscal Year ending 2001)

Company	Year Ended	Sales (US$blns)	Sales Growth	Sales/ Emp (US$)	Largest Region
First International Computer Incorporate	Dec 2001	2.206	0.2%	678,674	Domestic (56.9%)
Daiwabo Information System Co., Ltd.	Mar 2001	2.652	15.7%	1,467,495	Japan (100.0%)
Itochu Techno Science	Mar 2001	2.586	45.5%	813,872	N/A
Creative Technology Limited	Jun 2001	1.248	-5.0%	228,533	the Americas (48.7%)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.68 Summary of Company Valuations for FICI

Company	P/E	Price/ Book	Price/ Sales	52 Wk Pr Chg
First International Computer Incorporate	N/A	0.70	0.12	-53.70%
Daiwabo Information System Co., Ltd.	8.7	0.39	0.03	-34.39%
Itochu Techno Science	20.0	1.26	0.41	-67.63%

Creative Technology Limited	N/A	1.13	0.39	-54.27%

The market capitalization of this company is 9.40 billion Taiwanese Dollars (US$271.99 million) .

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Profitability Analysis

On the 76.22 billion Taiwanese Dollars in sales reported by the company in 2001, the cost of goods sold totaled 68.57 billion Taiwanese Dollars, or 90.0% of sales (i.e., the gross profit was 10.0% of sales). This gross profit margin is slightly lower than the company achieved in 2000, when cost of goods sold totaled 89.3% of sales. There was a wide variation in the gross profit margins at the three comparable companies, from 8.8% of sales to 29.4% of sales. Some of this disparity may be due to different accounting standards. The company's earnings before interest, taxes, depreciation and amortization (EBITDA) were 2.82 billion Taiwanese Dollars, or 3.7% of

Company	Year	Gross Profit Margin	EBITDA Margin	Earns bef. extra
First International Computer Incorporate	2001	10.0%	3.7%	-2.1%
First International Computer Incorporate	2000	10.7%	4.0%	0.2%
Daiwabo Information System Co., Ltd.	2001	8.8%	2.0%	1.0%
Itochu Techno Science	2001	22.3%	9.8%	4.9%
Creative Technology Limited	2001	29.4%	6.1%	-10.6%

Table 4.69 Profitability Comparison for FICI

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

sales. This EBITDA to sales ratio is roughly on par with what the company achieved in 2000, when the EBITDA ratio was 4.0% of sales. In 2001, earnings before extraordinary items at First International Computer Incorporate were -1.61 billion Taiwanese Dollars, or -2.1% of sales. This profit margin is lower than the level the company achieved in 2000, when the profit margin was 0.2% of sales. The company's return on equity in 2001 was -11.3%. This was significantly worse than the 1.0% return the company achieved in 2000. (Extraordinary items have been excluded).

First International Computer Incorporate reports profits by product line. During 2001, the itemized operating profits at all divisions were 5.42 billion Taiwanese Dollars, which is equal to 7.1% of total sales. Of all the product lines, Notebooks had the highest operating profits in 2001, with operating profits equal to 12.4% of sales. Personal Computer had the lowest operating profit margin in 2001, with the operating profit equal to only 7.1% of sales. (This product line is the largest product line at First International Computer Incorporate, accounting for approximately 71% of sales in 2001).

Inventory Analysis

As of December 2001, the value of the company's inventory totaled 6.33 billion Taiwanese Dollars. Since the cost of goods sold was 68.57 billion Taiwanese Dollars for the year, the company had 34 days of inventory on hand (another way to look at this is to say that the company turned over its inventory 10.8 times per year). This is an almost insignificant increase in days in inventory from December 2000, when the company had 6.03 billion Taiwanese Dollars, which was 32 days of sales in inventory.

Financial Position

At the end of 2001, First International Computer Incorporate had negative working capital, as current liabilities were 28.31 billion Taiwanese Dollars while total current assets were only 28.04 billion Taiwanese Dollars. The fact that the company has negative working capital could indicate that the company will have problems in expanding. However, negative working capital in and of itself is not necessarily bad, and could indicate that the company is very efficient at turning over inventory, or that the company has large financial subsidiaries. As of December 2001, the company's long-term debt was 5.86 billion Taiwanese Dollars and total liabilities (i.e., all monies owed) were 34.47 billion Taiwanese Dollars. The long-term debt to equity ratio of the company is 0.35. As of December 2001, the accounts receivable for the company were 15.06 billion Taiwanese Dollars, which is equivalent to 72 days of sales. This is slightly higher than at the end of 2000, when First International Computer Incorporate had 67 days of sales in accounts receivable.

Table 4.70 Financial Positions for FICI

Company	Year	LT Debt/ Equity	Days AR	Days Inv.
First International Computer Incorporate	2001	0.35	72	34
Daiwabo Information System Co., Ltd.	2001	0.14	105	31
Itochu Techno Science	2001	0.00	95	62
Creative Technology Limited	2001	0.05	29	68

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.71 Stock Performance Indicators (All Figures are in U.S. Dollars)

		Ratios		Equity Capital					Dividends	
Year	Last Price	P/E	P/Bk	Earned Growth %	Profit Rate %	Book Value Begin Yr	Earnings Per Share	% Chg	Divs Per Share	Avg Yield
1994	0.49	32.1	n/c	n/c	n/c	n/a	C 0.015	n/c	A 0.00	0.0
1995	0.38	19.5	3.4	n/c	21.1	0.11	C 0.020	55	A 0.00	0.0
1996	0.66	18.7	3.3	n/c	17.6	0.20	C 0.035	50	A 0.00	0.0
1997	0.91	19.8	3.6	n/c	18.3	0.25	C 0.046	30	A 0.00	0.0
1998 B	0.69	272.7	2.2	0.8	0.8	0.31	C 0.003	-95	A 0.00	0.0
1999	0.72	n/c	2.5	0.3	0.3	0.29	n/a	-69	A 0.00	0.0
2000	0.23	78.0	0.8	1.1	1.1	0.27	C 0.003	267	A 0.00	0.0
2001	0.37	n/c	1.3	-11.4	-11.4	0.28	C -0.032	n/c	0.00	0.0
2002	0.20	n/c	0.8	n/c	n/c	0.26	n/a	n/c	0.00	0.0
3/7/03	0.18	n/c	0.7	n/a	n/a	0.26	-0.032	n/c	0.00	0.0

The data included in the notes have not been converted to U.S. Dollars. To convert the data in the notes a use a factor of: 0.028940

(A): ALL ITEMS ADJUSTED FOR STOCK SPLITS OR DIVIDENDS - 10% IN 2000, 15% IN 1999, 30% IN 1998, 40.20% IN 97, 1120.72:1000 RIGHTS ISSUE (3.70% DIV) & 26% & 1034.78:1000 RIGHTS ISSUE (1.18% DIV) IN 96, 26% IN 96, 20% & 1186.04:1000 RIGHTS ISSUE (6.22% DIV) IN 94 (B): CHANGE FROM UNCONSOLIDATED TO CONSOLIDATED REPORTS (C): BASED ON AVERAGE SHARES OUTSTANDING

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.72 Cash Flow and Sales in Billions of U.S. Dollars

Year	Sales	Sales Growth	EBITDA	% of sales	Inc. bef Extra	% of sales	Emps	Sales/ Empl
1994	0.481	n/c	0.021	4.4%	0.014	2.9%	n/a	n/a
1995	0.757	57.4%	0.042	5.5%	0.027	3.6%	n/a	n/a
1996	0.803	6.1%	0.055	6.9%	0.044	5.5%	n/a	n/a
1997	0.889	10.7%	0.045	5.1%	0.064	7.2%	n/a	n/a
1998	0.876	-1.5%	0.040	4.6%	0.004	0.4%	3,498	250,427
1999	1.840	110.0%	0.058	3.1%	0.001	0.1%	n/a	n/a
2000	2.201	19.6%	0.088	4.0%	0.004	0.2%	3,250	677,340
2001	2.206	0.2%	0.082	3.7%	-0.046	-2.1%	n/a	n/a

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Case Study 12: Inventec Corporation

Company Description

The Group's principal activities are the design, manufacture and sale of notebook PC, digit processors, personal computers, fax machines, scanners, translator CD and other related software products. It operates in Taiwan, Asia, the United States of America and Europe.

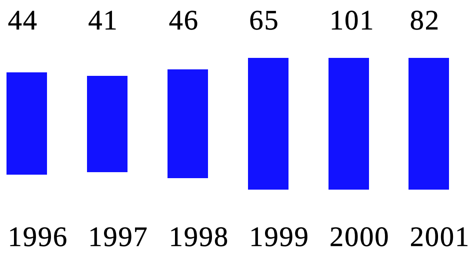
Competitor Analysis

Inventec Corporation operates in the Electronic computers sector. This analysis compares Inventec with three other companies in this sector in Taiwan: Compal Electronics Incorporated (2001 sales of 78.66 billion Taiwanese Dollars [US$2.28 billion]), Benq Corporation (73.75 billion Taiwanese Dollars [US$2.13 billion]), and Synnex Technology International Corp (64.88 billion Taiwanese Dollars [US$1.88 billion]).

Sales Analysis

Inventec reported sales of 81.62 billion Taiwanese Dollars (US$2.36 billion) for the year ending December of 2001. This represents a decrease of 19.0% versus 2000, when the company's sales were 100.76 billion Taiwanese Dollars.

Table 4.73 Recent Sales at Inventec



(Figures in Billions of Taiwanese Dollars)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Almost all of the company's 2001 sales were in its home market of Taiwan: in 2001, this region's sales were 73.20 billion Taiwanese Dollars, which is equivalent to 89.7% of total sales. While the company's sales decreased in 2001, all three comparable companies experienced an increase in sales (between 4.2% and 18.1%). Inventec currently has 3,922 employees. With sales of 81.62 billion Taiwanese Dollars (US$2.36 billion) , this equates to sales of US$602,250 per employee. This is a great deal lower than the three comparable companies, which had sales between US$910,533 and US$3,562,970 per employee. Note that some of the figures stated herein could be distorted based on exact classification of employees and subcontractors.

Table 4.74 Sales Comparisons for Inventec (Fiscal Year ending 2001)

Company	Sales (blns)	Sales Growth	Sales/ Emp (US$)	Largest Region
Inventec	81.618	-19.0%	602,250	Taiwan (89.7%)
Compal Electronics Incorporated	78.657	4.2%	910,533	N/A

Benq Corporation	73.750	18.1%	1,227,329	Taiwan (46.8%)
Synnex Technology International Corp	64.882	8.1%	3,562,970	Taiwan (66.0%)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.75 Recent Stock Performance for Inventec

Company	P/E	Price/ Book	Price/ Sales	52 Wk Pr Chg
Inventec	9.4	1.49	0.44	-36.00%
Compal Electronics Incorporated	15.3	2.12	1.08	-10.98%
Benq Corporation	19.6	2.12	0.88	-41.73%
Synnex Technology International Corp	21.4	2.02	0.48	11.17%

The market capitalization of this company is 35.78 billion Taiwanese Dollars (US$1.04 billion).

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Dividend Analysis

During the 12 months ending 12/31/01, Inventec paid dividends totaling 0.91 Taiwanese Dollars per share. Since the stock is currently trading at 19.50 Taiwanese Dollars, this implies a dividend yield of 4.7%. This company's dividend yield is higher than the three comparable companies (which are currently paying dividends between 1.2% and 2.1% of the stock price). The company has paid a dividend for 3 straight years. During the same 12 month period ended 12/31/01, the Company reported earnings of 2.08 Taiwanese Dollars per share. Thus, the company paid 43.8% of its profits as dividends.

Profitability Analysis

On the 81.62 billion Taiwanese Dollars in sales reported by the company in 2001, the cost of goods sold totaled 74.64 billion Taiwanese Dollars, or 91.4% of sales (i.e., the gross profit was 8.6% of sales). This gross profit margin is very slightly better than the company achieved in 2000, when cost of goods sold totaled 92.1% of sales. There was a wide variation in the gross profit margins at the three comparable companies, from 5.7% of sales to 18.0% of sales. The company's earnings before interest, taxes, depreciation and amortization (EBITDA) were 1.78 billion Taiwanese Dollars, or 2.2% of sales. This EBITDA to sales ratio is roughly on par with what the company achieved in 2000, when the EBITDA ratio was 3.3% of sales. The three comparable companies had EBITDA margins that were all higher (between 2.3% and 7.2%) than that achieved by Inventec. Although sales at Inventec fell 19.0% in 2001, the company actually increased its selling, general and administrative expenses 481.63 million Taiwanese Dollars (approximately 10.2%). In 2001, earnings before extraordinary items at Inventec were 3.81 billion Taiwanese Dollars, or 4.7% of sales. This profit margin is an improvement over the level the company achieved in 2000, when the profit margin was 3.8% of sales. The company's return on equity in 2001 was 18.1%. This was a decline in performance from the 21.5% return that the company achieved in 2000. (Extraordinary items have been excluded).

Table 4.76 Profitability Comparison for Inventec

Company	Year	Gross Profit Margin	EBITDA Margin	Earns bef. extra
Inventec	2001	8.6%	2.2%	4.7%
Inventec	2000	7.9%	3.3%	3.8%
Compal Electronics Incorporated	2001	10.7%	6.8%	6.9%
Benq Corporation	2001	18.0%	7.2%	4.1%

Synnex Technology International Corp	2001	5.7%	2.3%	2.2%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Inventory Analysis

As of December 2001, the value of the company's inventory totaled 4.02 billion Taiwanese Dollars. Since the cost of goods sold was 74.64 billion Taiwanese Dollars for the year, the company had 20 days of inventory on hand (another way to look at this is to say that the company turned over its inventory 18.6 times per year). In terms of inventory turnover, this is an improvement over December 2000, when the company's inventory was 6.59 billion Taiwanese Dollars, equivalent to 26 days in inventory. The 20 days in inventory is lower than the three comparable companies, which had inventories between 31 and 66 days at the end of 2001.

Research and Development

Research and Development Expenses at Inventec in 2001 were 1.28 billion Taiwanese Dollars, which is equivalent to 1.6% of sales. In 2001 R&D expenditures increased both as a percentage of sales and in actual amounts: In 2000, Inventec spent 1.09 billion Taiwanese Dollars on R&D, which was 1.1% of sales.

Financial Position

As of December 2001, the accounts receivable for the company were 11.91 billion Taiwanese Dollars, which is equivalent to 53 days of sales. This is an improvement over the end of 2000, when Inventec had 71 days of sales in accounts receivable.

Table 4.77 Financial Positions for Inventec

Company	Year	Days AR	Days Inv.	R&D/ Sales
Inventec	2001	53	20	1.6%
Compal Electronics Incorporated	2001	83	31	1.3%

Benq Corporation	2001	70	66	2.8%
Synnex Technology International Corp	2001	50	31	0.0%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.78 Stock Performance Indicators Note: (All figures are in U.S. Dollars)

		Ratios		Equity Capital					Dividends	
Year	Last Price	P/E	P/Bk	Earned Growth %	Profit Rate %	Book Value Begin Yr	Earnings Per Share	% Chg	Divs Per Share	Avg Yield
1996	0.40	11.4	n/c	n/c	n/c	n/a	C 0.035	178	A 0.00	0.5
1997	0.78	19.5	10.8	55.6	55.6	0.07	C 0.040	14	A 0.00	0.0
1998	1.77	31.4	16.6	53.0	53.0	0.11	C 0.056	41	A 0.00	0.0
1999 B	1.53	n/c	6.4	16.8	21.4	0.24	n/a	-10	A 0.01	0.7
2000	0.67	10.9	2.3	17.6	21.4	0.29	C 0.061	20	A 0.01	1.6
2001	0.72	11.9	2.1	10.1	18.0	0.33	C 0.060	-2	A 0.03	3.7
2002	0.58	n/c	1.5	n/c	n/c	0.38	n/a	n/c	A 0.00	0.0
3/7/03	0.56	9.4	1.5	n/a	n/a	0.38	0.060	n/c	A 0.03	4.7

The data included in the notes have not been converted to U.S. Dollars. To convert the data in the notes a use a factor of: 0.028940

(A): ALL ITEMS ADJUSTED FOR STOCK SPLITS OR DIVIDENDS - 10% IN 2002, 20% IN 2001, 20% IN 2000, 32% IN 1999, 61.9% & 103.146:100 RIGHTS ISSUE (1.67% DIV) IN 1998, 120% IN 1997, 30% IN 96

(B): CHANGE FROM UNCONSOLIDATED TO CONSOLIDATED REPORTS

(C): BASED ON AVERAGE SHARES OUTSTANDING

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.79 Cash Flow and Sales in Billions of U.S. Dollars

Year	Sales	Sales Growth	EBITDA	% of sales	Inc. bef Extra	% of sales	Emps	Sales/ Empl
1996	1.259	n/c	0.127	10.1%	0.096	7.6%	2,148	586,079
1997	1.181	-6.2%	0.105	8.9%	0.111	9.4%	3,406	346,706
1998	1.336	13.1%	0.117	8.7%	0.099	7.4%	4,061	328,985
1999	1.875	40.3%	0.111	5.9%	0.092	4.9%	n/a	n/a
2000	2.916	55.5%	0.095	3.3%	0.111	3.8%	n/a	n/a
2001	2.362	-19.0%	0.052	2.2%	0.110	4.7%	n/a	n/a

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Case Study 13: Hon Hai Precision Industry Company

Company Description

The Group's principal activities are the manufacture, processing and sales of edge and micro ribbon connectors for terminals, microcomputers, mouse and monitor cable. Other activities are design, production and sale of connectors, cable assemblers, chassis, riser cards, switches, keyboards, CD-ROMs and thermal products for the computer and communications industry.

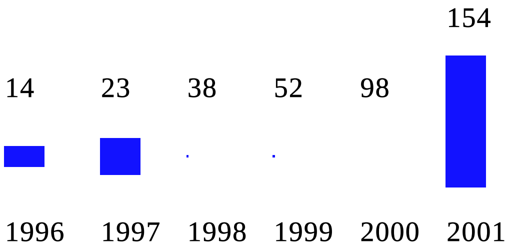
Competitor Analysis

Hon Hai Precision Industry Company Limit operates in the Electronic connectors sector. This analysis compares Hon Hai Precision Industry Company Limit with three other manufacturers of electronic components in Australasia: Hirose Electric Co Ltd of Japan (2001 sales of 83.54 billion Japanese Yen [US$713.43 million] of which 80% was Multi-Pin Connectors), Japan Aviation Electronics Ind Ltd of Japan (120.39 billion Japanese Yen [US$1.03 billion] of which 68% was Connectors), and Hosiden Corporation which is also based in Japan (222.53 billion Japanese Yen [US$1.90 billion] of which 59% was Mechanical parts).

Sales Analysis

Hon Hai Precision Industry Company Limit reported sales of 153.89 billion Taiwanese Dollars (US$4.45 billion) for the year ending December of 2001. This represents an increase of 57.3% versus 2000, when the company's sales were 97.82 billion Taiwanese Dollars. Sales at Hon Hai Precision Industry Company Limit have increased during each of the previous five years (and since 1996, sales have increased a total of 1,024%).

Table 4.80 Recent Sales at Hon Hai Precision Industry Company Limit



(Figures in Billions of Taiwanese Dollars)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Most of the company's 2001 sales were in Domestic: in 2001, this region's sales were 88.24 billion Taiwanese Dollars, which is equivalent to 57.3% of total sales. During 2001, the company's sales increased at a faster rate than all three comparable companies. While Hon Hai Precision Industry Company Limit enjoyed a sales increase of 57.3%, the other companies saw smaller increases: Hirose Electric Co Ltd sales were up 4.5%, Japan Aviation Electronics Ind. Ltd increased 20.3%, and Hosiden Corporation experienced growth of 26.0%. Hon Hai Precision Industry Company Limit currently has 1,600 employees. With sales of 153.89 billion Taiwanese Dollars (US$4.45 billion) , this equates to sales of US$2,783,556 per employee. This is much higher than the three comparable companies, which had sales between US$252,680 and

US$740,074 per employee. Note that some of the figures stated herein could be distorted based on exact classification of employees and subcontractors.

Table 4.81 Sales Comparisons for HHPICL (Fiscal Year ending 2001)

Company	Year Ended	Sales (US$blns)	Sales Growth	Sales/ Emp (US$)	Largest Region
Hon Hai Precision Industry Company Limit	Dec 2001	4.454	57.3%	2,783,556	Domestic (57.3%)
Hirose Electric Co Ltd	Mar 2001	0.713	4.5%	740,074	Japan (70.8%)
Japan Aviation Electronics Ind. Ltd	Mar 2001	1.028	20.3%	252,680	Japan (77.7%)
Hosiden Corporation	Mar 2001	1.900	26.0%	256,462	Japan (73.9%)

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.82 Recent Stock Performance for HHPICL

Company	P/E	Price/ Book	Price/ Sales	52 Wk Pr Chg
Hon Hai Precision Industry Company Limit	17.5	4.11	1.51	-19.10%
Hirose Electric Co Ltd	33.9	1.94	3.83	-24.58%
Japan Aviation Electronics Ind. Ltd	16.5	1.19	0.37	-8.49%
Hosiden Corporation	14.9	0.89	0.28	-63.21%

The market capitalization of this company is 232.27

billion Taiwanese Dollars (US$6.72 billion) .

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Dividend Analysis

During the 12 months ending 12/31/01, Hon Hai Precision Industry Company Limit paid dividends totaling 1.30 Taiwanese Dollars per share. Since the stock is currently trading at 112.50 Taiwanese Dollars, this implies a dividend yield of 1.2%. This company's dividend yield is higher than the three comparable companies (which are currently paying dividends between 0.2% and 1.0% of the stock price). The company has paid a dividend for 3 straight years. During the same 12 month period ended 12/31/01, the Company reported earnings of 6.43 Taiwanese Dollars per share. Thus, the company paid 20.2% of its profits as dividends.

Profitability Analysis

On the 153.89 billion Taiwanese Dollars in sales reported by the company in 2001, the cost of goods sold totaled 121.48 billion Taiwanese Dollars, or 78.9% of sales (i.e., the gross profit was 21.1% of sales). This gross profit margin is lower than the company achieved in 2000, when cost of goods sold totaled 75.2% of sales. There was a wide variation in the gross profit margins at the three comparable companies, from 16.2% of sales to 52.7% of sales. The company's earnings before interest, taxes, depreciation and amortization (EBITDA) were 18.48 billion Taiwanese Dollars, or 12.0% of sales. This EBITDA margin is worse than the company achieved in 2000, when the EBITDA margin was equal to 13.5% of sales. In 2001, earnings before extraordinary items at Hon Hai Precision Industry Company Limit were 13.08 billion Taiwanese Dollars, or 8.5% of sales. This profit margin is lower than the level the company achieved in 2000, when the profit margin was 10.6% of sales. Earnings before extraordinary items have grown for each of the past 5 years (and since 1997, earnings before extraordinary items have grown a total of 261%). The company's return on equity in 2001 was 29.6%. This was a decline in performance from the 29.7% return that the company achieved in 2000. (Extraordinary items have been excluded).

Table 4.83 Profitability Comparison for HHPICL

Company	Year	Gross Profit Margin	EBITDA Margin	Earns bef. extra
Hon Hai Precision Industry Company Limit	2001	21.1%	12.0%	8.5%
Hon Hai Precision Industry Company Limit	2000	24.8%	13.5%	10.6%
Hirose Electric Co Ltd	2001	52.7%	37.2%	19.0%
Japan Aviation Electronics Ind. Ltd	2001	32.5%	13.8%	4.5%
Hosiden Corporation	2001	16.2%	10.4%	6.5%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Inventory Analysis

As of December 2001, the value of the company's inventory totaled 12.57 billion Taiwanese Dollars. Since the cost of goods sold was 121.48 billion Taiwanese Dollars for the year, the company had 38 days of inventory on hand (another way to look at this is to say that the company turned over its inventory 9.7 times per year). In terms of inventory turnover, this is a significant improvement over December 2000, when the company's inventory was 15.54 billion Taiwanese Dollars, equivalent to 77 days in inventory.

Research and Development

Research and Development Expenses at Hon Hai Precision Industry Company Limit in 2001 were 2.27 billion Taiwanese Dollars, which is equivalent to 1.5% of sales. In 2000, Hon Hai Precision Industry Company Limit spent 1.83 billion Taiwanese Dollars on R&D, which was 1.9% of sales.

Financial Position

As of December 2001, the company's long-term debt was 6.10 billion Taiwanese Dollars and total liabilities (i.e., all monies owed) were 44.22 billion Taiwanese Dollars. The long-term debt to equity ratio of the company is 0.11. As of December 2001, the accounts receivable for the company were 32.42 billion Taiwanese Dollars, which is equivalent to 77 days of sales. This is an improvement over the end of 2000, when Hon Hai Precision Industry Company Limit had 93 days of sales in accounts receivable. The 77 days of accounts receivable at Hon Hai Precision Industry Company Limit are lower than all three comparable companies: Hirose Electric Co Ltd had 140 days, Japan Aviation Electronics Ind. Ltd had 103 days, while Hosiden Corporation had 94 days outstanding at the end of the fiscal year 2001.

Table 4.84 Financial Positions for HHPICL

Company	Year	LT Debt/ Equity	Days AR	Days Inv.	R&D/ Sales
Hon Hai Precision Industry Company Limit	2001	0.11	77	38	1.5%
Hirose Electric Co Ltd	2001	0.01	140	70	4.6%
Japan Aviation Electronics Ind. Ltd	2001	0.14	103	79	5.4%
Hosiden Corporation	2001	0.02	94	31	1.2%

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.85 Stock Performance Indicators (All Figures are in U.S. Dollars)

		Ratios		Equity Capital					Dividends	
Year	Last Price	P/E	P/Bk	Earned Growth %	Profit Rate %	Book Value Begin Yr	Earnings Per Share	% Chg	Divs Per Share	Avg Yield
1995	0.28	10.3	n/c	n/c	n/c	n/a	B 0.027	n/c	A 0.00	0.0

1996	0.48	15.4	5.1	33.2	33.2	0.09	B 0.031	25	A 0.00	0.0
1997	1.36	23.0	11.3	49.0	49.0	0.12	B 0.059	89	A 0.00	0.0
1998	2.05	23.4	11.1	47.2	47.2	0.19	B 0.088	49	A 0.00	0.0
1999	3.77	33.1	14.2	35.0	42.9	0.27	B 0.114	30	A 0.02	0.6
2000	3.52	23.6	6.9	23.1	29.2	0.51	B 0.149	31	0.03	0.9
2001	4.03	21.6	6.3	23.2	29.2	0.64	B 0.186	25	A 0.04	0.9
2002	3.47	n/c	4.4	n/c	n/c	0.79	n/a	n/c	A 0.00	0.0
3/7/03	3.26	17.5	4.1	n/a	n/a	0.79	0.186	n/c	A 0.04	1.2

The data included in the notes have not been converted to U.S. Dollars. To convert the data in the notes a use a factor of: 0.028940

(A): ALL ITEMS ADJUSTED FOR STOCK SPLITS OR DIVIDENDS - 15.00% IN 2002, 20% IN 2001, 40% IN 1999, 40% IN 1998, 40% IN 97, 50% IN 96, 40% & 1159.70:1000 RIGHTS ISSUE (6.11% DIV) IN 95

(B): BASED ON AVERAGE SHARES OUTSTANDING

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Table 4.86 Cash Flow and Sales in Billions of U.S. Dollars

Year	Sales	Sales Growth	EBITDA	% of sales	Inc. bef Extra	% of sales	Emps	Sales/ Empl
1994	0.191	n/c	n/a	n/a	n/a	n/a	n/a	n/a
1995	0.313	63.5%	0.058	18.7%	0.035	11.2%	n/a	n/a

1996	0.396	26.7%	0.063	15.8%	0.054	13.5%	925	428,315
1997	0.678	71.0%	0.061	9.0%	0.105	15.5%	1,185	571,828
1998	1.108	63.5%	0.114	10.3%	0.159	14.4%	1,193	928,697
1999	1.499	35.3%	0.152	10.1%	0.215	14.3%	n/a	n/a
2000	2.831	88.8%	0.383	13.5%	0.299	10.6%	n/a	n/a
2001	4.454	57.3%	0.535	12.0%	0.379	8.5%	1,600	2,783,556

Source: (Compiled by author from *Company Annual Financial Reports* for the years 1998-2002)

Conclusion Part IV

The combination of industry structure, domestic market, and national capabilities (especially human resources) explains why Japanese companies thrived as producers of high-volume hardware and became competitive in the mainframe business, yet struggled in PCs and software. The closely integrated keiretsu industry structure provided ready capital, reliable supply chains, and captive customers. The domestic market also served as a proving ground for both consumer electronics and electronics components that could be exported in high volumes. However, both producers and users were slow to react to the PC revolution. Vertical integration left Japan partly isolated from the dynamic global production system for PC hardware. Software factories were of no use in creating packaged software. Entrepreneurial start-ups were starved for capital and access to distribution channels. And engineers, programmers, and other professionals were trained to be average, and they were lured into large organizations that offered prestige but discouraged innovation. Only in the 1990s, faced with a slump in the entire electronics industry, did Japanese companies begin to make changes in their corporate cultures and practices, and these changes have been very slow at best.

These facts return us to the question raised earlier concerning the ineffectiveness of Japan's industrial policies in the PC era. The concept of the capitalist development state rests on the notion of enlightened industrial policy guided by an economic "pilot agency" and carried out through close cooperation between government and industry. The prototype for this model was Japan's Ministry of International Trade and Industry or MITI, which has been credited for engineering the Japanese economic miracle, in particular by targeting key industries and successfully "choosing winners" in those industries. This appeared to be exactly the case in the development of Japan's mainframe computer industry. Why then, was MITI unable to help the Japanese computer industry make the adjustments necessary to compete in the PC era?

Part V. For and Against Taiwan: Confronting Criticisms and Revealing Success

Introduction Part V

This section Looks at both the criticisms and the praise for Taiwan's success and explains some of the misunderstandings about Taiwan's rules of the game. In Francis

Fukuyama's book Trust: The Social Virtues and the Creation of Prosperity (1995) he expounds on the weaknesses of the Ethnic Chinese Economies entrepreneurship and even more specifically the harmful effects of Confucian culture on business and regional integration because it involves trusting groups outside of the immediate family. Highly centralized authoritarian family controlled firms, nepotism, lack of Schumpeterian entrepreneurship and small scale OEM firms are the oft-cited weaknesses of the NIEs Chinese business practices. In addition he talks about the inability of Confucian Capitalism to have smooth transitions of power during generational changeovers as well as the inability to achieve international brand name recognition.

Fukuyama sees the Ethnic Chinese Economies entrepreneurship as a kind of anachronistic holdover of the mom and pop family management system unwilling to associate with outsiders and also unwilling to give up control to professional managers because of nepotism (pp.74-89) and therefore unable to develop large scale firms using a more Schumpeterian kind of entrepreneurship. Fukuyama attributes these weaknesses to what he calls lack of social trust, lack of spontaneous association and lack of civic virtue (pp.70-78) and blames this on the Confucian heritage. From inside these companies looking out the view is quite different. Through analysis of case studies and utilization of available research it is possible to present a far different picture of the Ethnic Chinese Economies entrepreneurship and also begin to understand some long-standing misunderstandings about the success of these 3 “little tigers” strategic integration achievements. It is possible to show that these 3 Chinese tigers (Ethnic Chinese Economies) in many cases can offer a viable alternative to Western or Japanese styles of entrepreneurship and can also act as a compliment to Schumpeterian entrepreneurship.

In the last section entitled “5.5: Revealing Success: Taiwan’s IT OEMs Compared to USA / Japan Big Brands for IT” we look at the statistics that show the success of Taiwan’s unique diversity strategy for OEM vertical division of labor. It is through the experience of the Asian Financial Crisis that we are starting to see just how well the entrepreneurship of the 3 Tigers had prepared to survive and even excel in the post crises time when many other conventional management systems are failing to produce. Some examples of these mid-crisis success stories would be United Microelectronics, Compal Computer, Quanta Computer, TSMC, Macronix, Hon Hai, Asustek Computer, Yageo, UMAX, Cathay Life, Acer Computer Co., Hutchison Whampoa (profits up 14% for2001) etc. with many of them still experiencing well over 20% return on equity and 15% annual growth in 2000-2001. Also some such as TSMC (Taiwan Semiconductor Manufacturing. Corp.) are up as high as 23% profit on sales 2001 and are paying employee bonuses above 200% of annual salary. For another example, of the largest 19 Hong Kong enterprises 18 are still making a healthy profit in spite of the bad world economy for the fiscal year ending March 2001. Also Taiwan's 120 largest Hsin Chu (新竹 Taiwan's Silicone Valley) based enterprises are averaging 11.0% profit on sales as compared to 3.9% for California's Silicone Valley for the fiscal year ending 2001.

In addition to this the Chinese business community's entrepreneurs have expanded and become the major middle man agent and/or OEM (original equipment manufacturer) for such companies as Fujitsu, Nike, TDK, Yamaha, IBM, Apple, Dell Computers and many more often controlling all of their Mainland China manufacturing and sometimes acting as the total OEM producer (Tanzer 98 June). This is an area of business success that indicates the dynamic ability of Ethnic Chinese Economies as a strong entrepreneurial society to be studied and explained. But first let us address the issue of Confucianism and its modern influence on family businesses and entrepreneurship in the Ethnic Chinese Economies.

During the 1990's the ideas of “best practices” (Bartlett 96) and “not invented here” (Bartlett and Ghoshal 95) became key concepts for restructuring and re-engineering in the massive attempt of huge corporations to downsize, decentralize, revitalize and cut costs. However, these concepts, and many others, for improving productivity through cross functional teams, niche marketing, strategic business units, decentralization, stewardship and information sharing were already being widely practiced in the 3 little tigers of Taiwan, Hong Kong and Singapore. Although these ideas have all caught on in the USA, very few publications give the Ethnic Chinese Economies any credit for these innovations. This paper will introduce four of the primary types of entrepreneurial strategies of the Ethnic Chinese Economies business community including:

Table 5.01 Four of the Primary Types of Entrepreneurial Strategies of the Ethnic Chinese

1. Middleman co-ordination (subcontracting, arbitrage etc…),
2. OEM and followership (product or process imitation and original equipment manufacturer)
3. Spin-offs and networked firms (family businesses and SMEs unofficially but tightly linked)
4. Integration and restructuring (transnational, cross-functional, alliance or spatial arbitrage)

(Source: H.B. Cheah 1992 p.468; Drucker 1985 pp.210-215)

Section 5.1: Some Common Criticisms of Taiwan's System

All of the East Asian countries and especially the Ethnic Chinese Economies have at one time or another come under critical attack in the 1990's as will be shown below. Although there are many different types of theoretical camps that have attacked Ethnic Chinese Economies and High Performance Asian Economies from their various angles, this thesis focuses on four basic groups that will be explained in an overly simplistic manner due to the limited scope of this study. Roughly categorized, these four are as follows:

1. **Statists** (also called revisionist, neomercantilist, interventionist and many are neo-keynesian) believing that governments must intervene into the market and guide the private sector towards the right direction or conduct as some have called "industrial targeting" or "supporting national champions" (like keiretsu or Chaebol) because the free market needs a lot of extra help in co-ordination. Statists claim that many Asian economies were successful exactly by

violating neoclassical principles by having the State intervene with strong industrial policies. (See works by Alice Amsden, Laura D'Andrea Tyson, Chalmers Johnson and James Fallows etc…).

2. **Anti-Statists** (also called anti-statist, most neoclassical economists fit in here, as well as mainstream economists and much of the US government and quasi-governmental groups such as the World Bank and IMF) believing that the free market mechanism is best left alone and that only minor intervention is needed to prevent distortions in the market or where no market exists such as pollution control etc. Also the market keeps itself in equilibrium through the utilization of perfect knowledge by the "rational maximizer" therefore the role of adaptive entrepreneurs is almost non-existent. (See works by Milton Friedman, Gary Becker, George Stigler and James Buchanan as well as many, many others)
3. **Conventional Asian Studies** (includes many famous sinologists, Asian studies and cultural theory scholars) This group believes that historically the Chinese have not displayed entrepreneurial ability, innovation or creativity in doing business and that actually the Chinese have always held businessmen or "shang ren" in very low esteem preferring highly educated scholars and poets. Therefore, we need not look at entrepreneurship in explaining the success of the Chinese. (See the works of Albert Feuerwerker, Marion Levy, Shih Kuo-heng, Edward G. Hinkleman (1994 p.3), Gilbert Rozman (1991 p.24) and Brigitte Berger (1991 p.24) and Francis Fukuyama (1995 pp.56-76) and see why they find entrepreneurship lacking in Chinese society)
4. **Anti-OEM and SME** (only global brands and giant firm size represent real success). This group believes that the Ethnic Chinese Economies have a good stock of entrepreneurship however, small and medium sized enterprises (SME) and OEM are only stepping stones when a country is on its way towards reaching the "big success" which is having many giant brand name companies. For countries like Taiwan, Hong Kong and Singapore to stay with SMEs and OEM is shameful even if they are making higher profits and revenue growth than even

the best giants such as IBM, Compaq, Fujitsu, NEC, Toshiba, and GE. Longing to be "recognized" with well known brands seems to be more important than just plain making money and expanding at over 25% a year for over 10 years. Also some just focus on attacking "familism" and "Confucianism" as stunting the growth of Chinese firm size leaving them stuck in SME and OEM shamefulness. This group often accepts that Ethnic Chinese Economies are very creative, innovative and display great amounts of adaptive entrepreneurship. (See the works of Hicks & Redding (1982 pp.212-19), Gordon Redding (1990 pp.143-55), Brigitte Berger (1991 p.24) and Siu-lun Wong (1985 pp58-72, 1988 pp.143-51), Francis Fukuyama (1985 pp.84-98).

These four roughly outlined groups or perspectives have criticized and attacked the Ethnic Chinese Economies from many different angles and techniques. With the exception of number 4, the anti-SME & OEM group, all groups neglect the role of entrepreneurship and integration in explaining the success of the Chinese tigers. Some groups such as the anti-interventionist (neoclassical economists) do not even have any place for the role of the entrepreneur within there framework therefore he is excluded *a priori* from the analytical framework (See Casson 1999 pp.46-49 and Kirzner 1992 pp.3-37). Although the 4th group tends to acknowledge the contribution of Ethnic Chinese Economies entrepreneurship, this group dwells on the authoritarian, patriarchal, and nepotistic flaws of Confucian influenced "familism" and how this historical baggage has stifled and impeded Taiwan, Hong Kong and Singapore's potential progress towards modern, professional and large scale firm status. Francis Fukuyama is given a lot of attention below because he is unique in attempting to use all of these arguments together to form a massive criticism of Chinese business culture and lack of Schumpeterian entrepreneurship with great emphasis on the failure to produce world brands and large-scale firms. At the same time he fails to mention the fantastic success of the Ethnic Chinese Economies in terms of market share, profitability and innovation within the IT and electronics industry. Fukuyama's final point is that the Chinese Tigers face certain decline in the future and will be some of the first to fall in the event of any major Asian crisis (Fukuyama 1995 pp.64-145).

Section 5.2: Ethnic Chinese Economies' Criticisms by Cultural Theory, Conventional Wisdom and Anti-familism

At first glance the evidence against the Chinese NIEs entrepreneurial culture and civil society seems overwhelming in Fukuyama's book Trust. However, a closer examination "from the inside looking out" reveals a totally different perspective from that of Fukuyama and friends neatly packaged conventional wisdom argument. A closer look reveals that the culture and civil society of the three Chinese tigers cannot be so neatly and easily comprehended and package as the conventional wisdom perspective claims. The nature of the modern influence and adaptation of Confucianism in Ethnic Chinese Economies society and it affects its entrepreneurship is not easily understood without a thorough inside-out approach that takes into account many factors and relevant perspectives coming from within the actual society. One of the conclusions of this thesis is that the case studies and research on the "inner workings" of the Ethnic Chinese Economies have been available since the early 1990's but have not been well utilized by those of the so called "conventional wisdom" school. This conventional wisdom according to Professor Yen Ching-hwang includes famous scholars of Asian studies as he tells us "The orthodox view on the lack of Chinese entrepreneurship held by Albert Feuerwerker, Marion Levy and Shih Kuo-heng has gradually been revised. Economic historians on China such as Yen-p'ing Hao, Thomas Rawski, Sherman Cochran and Wellington K.K. Chan have contributed substantially to the revision of this view." (Yen 1995 p.247). The so called "conventional wisdom" as presented by Fukuyama and others makes it seem clear that Western and Japanese companies are clearly far above the Chinese in decentralized decision making and the use and execution of entrepreneurial strategies. As we will see in the case studies of IBM, Xerox, Ford, Apple and Digital, things were not always as entrepreneurial or as decentralized as they appear to be from the outside looking in.

It is through the experience of the Asian Financial Crisis that we are starting to see just how well the entrepreneurship of the 3 Tigers had prepared to survive and even excel in the post crises time when many other conventional management systems are failing to produce. Some examples of these mid-crisis success stories would be United Microelectronics, Compal Computer, Quanta Computer, TSMC, Macronix, Hon Hai, Asustek Computer, Yageo, UMAX, Cathay Life, Acer Computer Co., Hutchison Whampoa (profits up 14% for2001) etc. with many of them still experiencing well over 20% return on equity and 15% annual growth in 2000-2001. Also some such as TSMC (Taiwan Semiconductor Manufacturing. Corp.) are up as high as 23% profit on sales 2001 and are paying employee bonuses above 200% of annual salary. For another example, of the largest 19 Hong Kong enterprises 18 are still making a healthy profit in spite of the bad world economy for the fiscal year ending March 2001. Also Taiwan's 120 largest Shin Zhu (Taiwan's Silicone Valley) based enterprises are averaging 11.0% profit on sales as compared to 3.9% for California's Silicone Valley for the fiscal year ending 2001. In addition to this the Chinese business community's entrepreneurs have expanded and become the major middle man agent and/or OEM (original equipment manufacturer) for such companies as Fujitsu, Nike, TDK, Yamaha, IBM, Apple, Dell Computers and many more often controlling all of their Mainland China manufacturing and sometimes acting as the total OEM producer (Tanzer 98 June). This is an area of business success that indicates the dynamic ability of Ethnic Chinese Economies as a strong entrepreneurial society to be studied and explained. But first let us address the issue of Confucianism and its modern influence on family businesses and entrepreneurship in the Ethnic Chinese Economies.

One puzzling aspect of Fukuyama's seven chapters and more than 60 pages of text dealing with Chinese business culture is that he does it without using one direct quote and not even one footnote referring to any of the really major Chinese case studies concerning NIEs economic policy or recent private sector entrepreneurship (Such as Krause 1988, 1989; Lee & Low 1990; Chen T.J. 1992; Wang N.T. 1992; Chu Y.H. 1994; Hsu C.K. 1994; etc.). Instead he chooses to base his claims on more than ten references to Redding's above-mentioned book (Redding 1990, in Fukuyama's Notes pp.376-77) and secondary commentary by Western Sinologists from the conventional wisdom school. The problem with this is that the main theme of Fukuyama's book is that there are "low-trust societies" and "high trust societies." China and especially Overseas Chinese are considered "low trust" which is caused by extreme "Familism" which in turn owes its origin to the Chinese Confucian heritage according to Fukuyama (Fukuyama 95 pp.31, 56,74-81). If this necessary linkage is not solidly anchored directly to real concrete case studies and native scholarship concerning the actual everyday inner workings of the firms and institutions then the whole argument falls apart.

In part, Fukuyama is possibly not to blame. He basically followed the conventional wisdom available in the West about Chinese business, culture and political economy as seen through English publications by Sinologists and others. However, considering the severity with which Fukuyama forcefully condemns the Chinese society and entrepreneurship one would expect that he would at least know his subject very well and seek out at least a few samples of native research and opposing views. According to Fukuyama "…the strength of the family bond implies a certain weakness in ties between individuals not related to one another: there is a relatively low degree of trust in Chinese society the moment one steps outside the family circle. Hence the distribution of associations in Chinese societies like Taiwan or Hong Kong…there is a reluctance to bring in professional managers because this requires reaching outside the bounds of the family where trust is low." (Fukuyama 95 p.56) This statement is supported by many quotes and citations referring to experts and studies on European and South American countries that have high percentages of Family business but Fukuyama and others do not refer to even one in depth case study that is prepared by native researchers who know their culture and country far more intimately than any outsider could hope for.

One of the deepest and most thorough Western studies on NIEs familism often cited by Fukuyama is the groundbreaking study done by Edwin Winckler entitled “Statism and familism on Taiwan” (1987). Although Winckler is not a NIEs Chinese he uses a good amount of native research and resources and is much more persuasive concerning his “Chinese centered approach” put forward by Paul Cohen (1984). The problem here is that Winckler's conclusions about Familism in Taiwan directly contradict Fukuyama’s thesis but we never hear about this fact. Fukuyama ignores the conclusions and evidence of one of the foremost Western scholars of Chinese Familism while at the same time selectively borrowing a few bits and pieces from the very same book, give the impression of supporting his thesis. Winckler Clearly states: “Statism and familism have contributed to the effectiveness, efficiency, and equity of development in Taiwan.” (Winckler 1987, p.190) Also on page 175 Winckler runs down a long list of the advantages he attributes to family businesses in Taiwan and does not make a point to emphasize any of the main weak points put forward by Fukuyama.

In general, Winckler concludes that familism is a tool that is manipulated by entrepreneurs and used to benefit the business when it is advantageous and when it is not, they just improvise. The utility value of familism and family business can be explained in a concept that GE's Jack Welch or maybe executives at 3M or Hewlett Packard (HP) would call "stewardship" or "ownership". Many case studies by Harvard University and others conclude that a key factor in restructuring these giant firms to become entrepreneurial once again was that they tried to instill a new attitude into every employee that GE (or 3M, HP) was "their" company and that they owned it and were responsible to be the "good stewards". Aside from their jobs, everyone was in charge of making the company successful "like a family". (See the conclusions of Xerox-- Kotter 1990, Ford-- Pelofsky 1989, HP-- King & Stevenson 1983, Yoffie & Pearson 1990, IBM-- Cohn & Yoffie 1992, GE-- Bartlett & Elderkin 1991, 3M-- Bartlett & Mohammed 1995). Therefore, Fukuyama and Redding were assessing this familistic stewardship as a grave drawback at a time when cutting edge Consulting groups like McKinsey and Andersen Consulting were raking in multi- million dollar fees for helping the ailing giants implement familism or stewardship into the companies because they needed to regenerate their entrepreneurship. What needs to be explained now is why Fukuyama was so against the Chinese SME's and family businesses of the Ethnic Chinese Economies.

Section 5.3 Familism and Patrimony Can be Stewardship and Leadership

The most cited support for Fukuyama's anti-Confucian, anti-family business argument is S. Gordon Redding's book The Spirit of Chinese Capitalism (1993) and the most relevant part is chapter 7 entitled "The Chinese Family Business" (pp.144-181). A look at this book explains a lot about how Fukuyama was influenced. A closer look also explains a lot about the numerous conclusions that contradict many other studies and also fly in face of what was actually happening right at that time within the business community of the Ethnic Chinese Economies. Chapter 7 begins with "this analysis concentrates very specifically on one line of influence---that running from the culture into the mental frameworks of the key actors, the entrepreneurs, and then on into the kinds of organizations they create." (pp.144). We see that he is focusing on the entrepreneur as building organizations that are indicative of their cultural backgrounds so it will be kind of like reverse engineering only applied to social-psychology instead. This book is based on a survey by questionnaires collected by interviewing 94 non-randomly selected Chinese entrepreneurs from Hong Kong, Taiwan, Singapore and Indonesia. After presenting this data he concludes:

"The data will lead us to the conclusion that the typical Chinese family business remains small and relatively unstructured. Because of cultural restraints on the sharing of trust, it does not develop decentralized decision making, and this acts as an inhibitor to successful growth…the overwhelmingly consistent theme in discussions about their organizations by Chinese executives is patrimonialism. That **word as such is not used by them**, but it is the **only word which captures adequately** the themes of paternalism, hierarchy, responsibility, mutual obligation, family atmosphere, personalism and protection." (emphasis added)(Redding 1993 p.155).

At this point it can be seen where Fukuyama acquired his ideas about the Ethnic Chinese Economies family business. But the critical contradiction is twofold. First, most of what Redding and Fukuyama describe as an "inhibitor to successful growth" (i.e. familism and paternalism) could also be called stewardship or ownership. These two are truly cutting edge restructuring key words of the 80's and 90's as mentioned above with citations included (Also see Hammer & Champy 1993; Ulrich 1990, 1998; Friedman et al 1998). And seeing that not even one respondent used a word like patrimonialism, it is very reasonable to assume that they were describing something that has been discovered in many studies conducted by the Chinese themselves, that is, instilling a sense of stewardship and belonging or "ownership" that makes everybody feel like family (Kraus 1988 pp.S46-S66, 1989 pp.436-451; Chou & Tsai 1992 pp.269-296; Wu 1992 pp.309-326; Cheah 1994; Hong 1997; Partee 1999 pp.10-22). The second contradiction is that before the time these books came out was exactly the most explosive growth period for family business in Taiwan, Singapore and Hong Kong. The period from 1988-1993 saw many family businesses grow incredibly fast at around 20-80 % yearly revenue growth with examples such as Acer, Mitac (Lian Hwa- Mitac group), Compal, TSMC, First International Computer, Asustek, Cathay Life and the list goes on (See various issues of a Chinese periodical 商業週刊 which reports financial data on Ethnic Chinese Economies firms 1988-1993).

In other words, just at the time when one should have been looking to explain the success of Ethnic Chinese Economies family business, Redding and Fukuyama came up with a first rate argument to explain their stunted growth and inefficiency. They jumped on the conventional wisdom bandwagon just when the wheels were falling off the proverbial wagon. In addition, Redding's above mentioned book when seen in its overall context does not clearly confirm the "lack of entrepreneurship" (Redding 1993 pp.227-240) assertions made by Fukuyama even though Redding's book is his most cited source for supporting his claims about Confucianism and Chinese business (Over 10 citations). The primary point of agreement is the detrimental impact of Confucianism, familism and patrimony on the development of dynamic firms that can grow, innovate and be highly competitive. Redding concludes chapter 7 with:

> "It is apparent from this consideration of the Chinese tendency to think small that certain possessiveness grips all Chinese organizations. Although some examples in organization building are visible, their common denominator---a capacity to trust---stands in some way as a pointer to all the rest who can't. In consequence, cooperation between organizations, in any structured sense, is limited: 'they don't like the good things to go to others,' and this inhibits joint ventures. The infusion of new stimuli is thus also restricted, and the organization remains in a form where arguably its characteristics are most potent---the village with its seignior, the feudal condition." (Redding 1993 p.181).

Upon reading this passage there is no doubt about the origins of Fukuyama's argument. Redding and Fukuyama seem to be a little out of touch with what was going on at that time in the Ethnic Chinese Economies. So many local publications written in Chinese at that time were literally screaming the slogans "Taiwan, king of the strategic alliance through OEM", "Singapore, master of joint ventures with MNC's", "Hong Kong, conductor of international integration and co-ordination" were very usual at that time and even more so today (For documentation see Huang 1995, 1997; Zhan 97; Miau 97; Yuan & Bai 98; Hong 1997). Next we go on to more examples from the conventional wisdom perspective.

To generalize briefly about the conventional wisdom on Chinese business and the Confucian influence in English publications here are some representative quotes by sources mentioned in Fukuyama's book. Edward G. Hinkleman tells us about Confucianism in Taiwan saying "The basic tenets of Confucian thought are obedience and respect for superiors and parents, duty to family, loyalty to friends, humility, sincerity and courtesy....young people are expected to obey their elders unquestioningly." And remember this is in a publication entitled <u>Taiwan Business</u> (Hinkleman 1994 p.3) and is addressing the state of business in Taiwan in the 1990's. He then concludes his section on "Confucianism" with the following "The general effect of Confucianism on the Taiwanese people has been to homogenize their culture and eradicate any traits of individuality. Unquestioning acceptance of the status quo is the norm, and people are not known for their creativity or inventiveness." This is very close to Fukuyama's version on pages 74-85 in his book <u>Trust</u>.

We now look at Fukuyama paraphrasing from Gilbert Rozman's book <u>The East Asian Region: Confucian Heritage and Modern Adaptation</u> (1991 pp.24). Describing the Chinese system of authoritarian management he writes, "that is, Confucianism's support for a hierarchical system of social relations, with an emperor at the top and a class of gentleman scholars manning an elaborate centralized bureaucracy below him." Again here the key point is that we're talking about a book that's supposed to be depicting the "modern adaptation" of Confucianism and Fukuyama paraphrases Rozman (1991 p.24) saying "The superior man (jun zi) possessed "Li", the ability to behave in accordance with the elaborately articulated rules of propriety, and as such was very far from the modern entrepreneur. He sought leisure rather than hard work, derived his income from rents, and saw himself as a guardian of Confucian tradition, not as an innovator."(Fukuyama 1995,p.84 in which the Rozman footnote appears) In this passage we can see Fukuyama's support for his assertions that the Chinese lack innovation, creativity and entrepreneurship.

Soon after this Fukuyama makes his bold leap of faith linking Confucianism to the plight of the modern Chinese family (and then on into the weakness in entrepreneurship and innovation) and he does it on his own, without a citation, claiming for the Confucian personal ethic that: "The central core of this ethical teaching was the apotheosis of the family---in Chinese, the "jia"---as the social relationship to which all others were subordinate. Duty to the family trumped all other duties, including obligations to emperor, Heaven, or any other source of temporal or divine authority" (Fukuyama. p.85). With Chinese culture all neatly packaged up, he now goes into family business mode for the next 10 pages basically trying to show how this Confucian Familism became the primary force in the world of Chinese business management and that this is the system that has carried on right into today's Chinese Management Style of the 1990's. Concerning all the weaknesses and grave consequences of these Chinese "habits of the heart" he mentions things like the "important consequences for business organization" and "The weakness of a sense of duties and obligations to anyone outside the family" and also in addition to the above he adds "distrust of nonkin has lead to a pattern of economic behavior…that anticipated the business culture of contemporary Taiwan and Hong Kong in many respects." (Fukuyama pp.86-89) The key question here is that can we really sum up Taiwan and Hong Kong's business culture so neatly into one tight little package? It would surely be difficult to explain the sustained success of the Ethnic Chinese Economies, as outlined above, under such terms.

It is now possible to understand and summarize Fukuyama's arguments against Confucianism, Chinese Familism and modern Chinese business culture in the NIEs. From the above quotes we can now summarize Fukuyama, Rozman, Hinkleman, Redding, and Berger's seven basic assertions about Chinese business culture and management. (According to

Fukuyama's book these assertions are greatly supported by Berger 91; Heller 91a, 91b; Silin 76; Rozman 91; Hicks & Redding 82).

Summary of Assertions about Chinese NIEs Family, Confucian and Business Culture:

1. To eradicate traits of individuality and follow the status quo
2. To guard tradition by shunning creativity, innovation and diversity.
3. To support authoritarian centralized organizations not entrepreneurship or stewardship.
4. To produce blind obedience and unquestioned respect for elders.
5. To absolutely subordinate all other duties, obligations to the family (as apotheosis).
6. To extremely distrust nonkin and outsiders to the detriment of joint ventures & alliances.
7. That knowing these helps us to understand and explain modern Ethnic Chinese Economies business.

(Above points--Fukuyama pp.31, 56, 70-76, 84-89)

Section 5.4 Productivity of Taiwan's IT OEMs Compared to USA / Japan Big Brands for IT

It is through the experience of the Asian Financial Crisis that we are starting to see just how well the entrepreneurship of the 3 Tigers had prepared to survive and even excel in the post crises time when many other conventional management systems are failing to produce. Some examples of these mid-crisis success stories would be United Microelectronics, Compal Computer, Quanta Computer, TSMC, Macronix, Hon Hai, Asustek Computer, Yageo, UMAX, Cathay Life, Acer Computer Co., Hutchison Whampoa (profits up 14% for2001) etc. with many of them still experiencing well over 20% return on equity and 15% annual growth in 2000-2001. Also some such as TSMC (Taiwan Semiconductor Manufacturing. Corp.) are up as high as 23% profit on sales 2001 and are paying employee bonuses above 200% of annual salary. For another example, of the largest 19 Hong Kong enterprises 18 are still making a healthy profit in spite of the bad world economy for the fiscal year ending March 2001. Also Taiwan's 120 largest Hsin Chu (新竹 Taiwan's Silicone Valley) based enterprises are averaging 11.0% profit on sales as compared to 3.9% for California's Silicone Valley for the fiscal year ending 2001.

In addition to this the Chinese business community's entrepreneurs have expanded and become the major middle man agent and/or OEM (original equipment manufacturer) for such companies as Fujitsu, Nike, TDK, Yamaha, IBM, Apple, Dell Computers and many more often controlling all of their Mainland China manufacturing and sometimes acting as the total OEM producer (Tanzer 98 June). This is an area of business success that indicates the dynamic ability of Ethnic Chinese Economies as a strong entrepreneurial society to be studied and explained. But first let us address the issue of Confucianism and its modern influence on family businesses and entrepreneurship in the Ethnic Chinese Economies.

In 1999, in terms of the total shipment of ICs, Taiwan was ranked as #3, just behind the US and Japan (ERSO, 2000 pp.12-34). In less than 20 years, Taiwan producers not only greatly increased their production capacities and market shares in the IC industry, but also, more impressively, improved their R&D capabilities. In 1983, Korea and Taiwan were granted no IC-related patents in the US, whereas Germany received 110 patents. In 1997, 14 years later, Korea and Taiwan were granted 386 and267 IC-related patents in the US, respectively, whereas Germany was granted only 155 such patents (Chang, 1999 pp.35-55). Thanks to this explosive growth in IC-related patents, in 1999, Samsung Electronics was ranked as the #4 company in terms of the total number of patents granted in the US in all technology classes. In the same year, fabless design houses in Taiwan were rated as #2 in the world, just behind the US, capturing 20% of world market shares measured in terms of revenues in the chip design area; these design houses also began to produce a substantial number of patents (ERSO, 2000 pp.28-36). These statistics clearly suggest that Korea and Taiwan caught up with Germany, the UK, and France in the global IC industry, in terms of both market shares and patent numbers. In selected areas, the two countries are also threatening the leadership of the US and Japan.

Table 5.02 Taiwan's World Market Share in PC Related Products, 1994

Products	Share (%)	Products	Share (%)
Motherboard	*80*	Switching Power Supply	31
Mouse	*80*	Notebook PC	*28*
Scanner	*61*	Video Card	*24*
Monitor	*56*	Terminal	*22*
Keyboard	*52*	Network Hub	*18*
Network Interface Card	34	Audio Card	11
Graphics Card	32	Desktop PC	8

Source: *ITRI Statistical Yearbook* (1996 pp.34-98)

How did Taiwanese IC firms acquire and develop technologies in such a rapid technological catch-up process? Almeida (1996 pp.155-161) shows that part of their learning behavior can be attributed to the activities of their subsidiaries in the US, which source technology locally. But there is also evidence to suggest that the inter-country exchange of experts has played a crucial role. In its extensive analysis of the "Asian miracle," the World Bank (1993 pp.13-34) emphasizes that the return of foreign-educated nationals has provided significant transfer of best practices and state-of-the-art knowledge.

Recent case studies (Hou & Gee 1993 pp.384-401; Kim 1997 pp.86-99; Cho,Kim,Rhee 1998 pp.489-501) also provide evidence of the importance of human-embodied technology transfer in the time compressed learning processes of Taiwanese firms in the IC and computer industry. Based in part on such evidence, the recent World Development Report on knowledge and economic development (World Bank 1998 pp.22-65) identifies the international movement of people as one of four principal channels for acquiring imported knowledge (along with trade, foreign direct investment, and technology licensing). Human exchange within or across firms has played a very important role in transferring knowledge or knowledge-building capabilities (Ettlie 1980 pp.1055-65; Leonard-Barton 1995 pp.99-156; Chesbrough 1999 pp.465-79).

Below in Table 6.2 it is easy to see that Taiwan's computer hardware share has grown at the fastest rate worldwide over 16 years and also has a very smooth and consistent growth pattern that did not back slide at all over those 16 years. This is a sign that Taiwan had a more long-term consistent plan and stuck to it consistently. Also note that this was all high profit growth as contrasted to Japan and Korea's near profitless growth.

Table 5.03 Computer Table Hardware Production by Country 1985-2000

Hardware	Production	85-2000	(in US $)	(Millions)	
Hong Kong	Singapore	Korea	Taiwan	Japan	United States

1985	$660	$1,194	$579	$989	$18,318	$47,122
1986	$704	$1,914	$880	$1,739	$30,083	$43,685
1987	$853	$2,928	$1,459	$2,890	$39,952	$47,635
1988	$1,341	$4,503	$2,431	$4,001	$52,391	$48,504
1989	$1,593	$5,368	$31.11	$5,046	$54,587	$49,296
1990	$1,930	$6,974	$3,073	$5,886	$53,241	$48,559
1991	$2,145	$7,977	$3,499	$6,106	$59,563	$47,965
1992	$2,264	$10,123	$3,647	$7,849	$56,598	$50,866
1993	$2,264	$12,346	$4,212	$10,003	$58,757	$52,176
1994	$1,953	$16,536	$4,893	$12,020	$66,654	$62,544
1995	$2,167	$21,127	$6,795	$16,111	$73,475	$77,835
1996	$2,067	$24,789	$7,698	$18,398	$74,324	$80,547
1997	$2,178	$25,432	$7,865	$21,390	$75,568	$81,349
1998	$2,264	$27,321	$7,490	$24,476	$75,709	$83,298
1999	$2,589	$29,498	$9,354	$28,835	$77,254	$88,943
2000	$2,365	$28,432	$7,854	$31,879	$74,965	$86,854

Source: Compiled by author from various-- *Reed Yearbook of World Electronics Data* 1991-2000 pp.22-98.

Table 5.04 Computer Hardware as % of GDP

Computer Hardware As % of GDP 85-2000

	Hong	Singapore	Korea	Taiwan	Japan	United

	Kong					States
1985	1.89	6.75	0.61	1.6	1.37	1.17
1986	1.76	10.8	0.81	2.28	1.52	1.03
1987	1.73	14.5	1.07	2.8	1.66	1.06
1988	2.3	18.21	1.33	3.25	1.79	1
1989	2.37	18.41	1.43	3.38	1.88	0.95
1990	2.58	19.08	1.21	3.64	1.8	0.88
1991	2.5	18.89	1.19	3.41	1.75	0.85
1992	2.25	20.46	1.18	3.68	1.52	0.86
1993	1.95	21.55	1.27	4.39	1.37	0.83
1994	1.49	23.83	1.29	4.94	1.42	0.94
1995	1.51	25.29	1.49	6.12	1.44	1.12
1996	1.62	27.2	1.65	6.38	1.55	1.24
1997	1.85	28.45	1.73	6.88	1.69	1.29
1998	1.9	29.49	1.84	7.33	1.66	1.41
1999	2.03	30.11	1.99	8.21	1.91	1.65
2000	1.91	28.94	1.92	8.44	1.68	1.45

Source: Compiled from Various-- Reed, *Yearbook of World Electronics Data* 1991-2000.

Vertical Division of labor of the Win-Win OEM strategy (苗豊強 1997) Has Given Birth to a Globally Competitive IC Industry in Taiwan

It is well known that the IC industry is divided into highly specialized sectors, including

IC design, mask making, wafer processing, and assembly and test. One of the most significant changes in the Taiwan IC industry in recent years has been the transition from a vertically integrated model to a vertical division of labor business model. This transition has been driven by the need to constantly adapt to the rapidly changing business environments that characterize each sector of the production cycle, and by the massive investment needed to remain competitive in the global economy. The so-called IDM (integrated device manufacturer) model, in which one company is responsible for all aspects of production, is no longer competitive due to the excessive strain it places on a company's financial, research and development, and management resources. As a result, the vertical division of labor of production is becoming the mainstream business model in Taiwan.

Interestingly, as recently as ten years ago, many analysts of Taiwan's IC industry suggested Taiwan could not compete globally in technology fields because the vertical integration of its companies was not as complete as with large foreign manufacturers.(Fukuyama 1994) Nine years later, these arguments have been completely refuted by the course of industry development. In fact, to the contrary, numerous studies demonstrate the superiority of the vertical division of labor over an integrated manufacturing system(陳添枝 1994, 陳競玲 1999).

Table 5.05 Average Profit on Sales 1985-2000 Top 20 Taiwan OEM vs. Top 20 Brands

From 1985 to 2000

Top 20	Computer	Hardware	Firms Avg.	Profit Rate
	Taiwan (OEM only)	Japan Big Brands	USA Big Brands	(ROS) (%)
1985-90	10.7	4.1	6.1	
1991-95	11.5	1.1	5.7	
1996-00	17.5	2.7	7.3	
Total Avg.				
1985-00	13.2	1.7	6.37	

Source: *China Credit* 1990—1995 various issues and pages; 商業週刊 various issues 1995-2000; *Asia Week Top 1000* "Biggest Companies in Asia" various issues 1993-2000.

*Calculated by average of top 20 for each country using after tax income on sales. Since Taiwan's tax system is quite different but income is actually very equivalent when comparing after tax income.

To the surprise of many, Taiwan's vertical division of labor OEM system is far more profitable than the Big Brand companies that used to dominate. According to a Donaldson, Lufkin & Jenrette research report, in 1998, the average profit margin for companies in each sector of the disintegrated production chain was 20%, while the average profit margin for integrated device manufacturers (IDM) was only 4%. Cash flow (EBITDA) at companies operating in a disintegrated environment accounted for approximately 50% of revenues, while it was only 18% for IDMs; a difference of 2.5 times. This translates into 2.5 times more potential for new investments, an undeniable competitive advantage. For the majority of logic ICs, the disintegrated manufacturing environment is superior to the IDM business model. However, the

DRAM and CPU markets continue to be dominated by integrated device manufacturers, such as Intel and Samsung. This is largely due to the fact that these products have relatively long life cycles, require extremely high production volumes and are produced in few varieties. In addition, the correlation of design and process technology for these products is relatively high, minimizing the advantages of division of labor.

Table 5.06 Domestic and Offshore Computer Production Taiwan.

	1992	1993	1994	1995	1996
Hardware production (US$ millions)	8,391	9,693	14,582	18,871	24,347
Domestic	**7,418**	**8,002**	**11,579**	**13,587**	**16,587**
Offshore	973	1,691	3,003	5,284	7,760
Offshore as % of total	12%	17%	21%	28%	32%

Source: MIC/Ill, *Asia IT Report* (December 1996, 1997 pp.56-143).

There was a downturn in the IC industry from 1995-1998. At the end of 1998, the total production value of the global IC industry had fallen from US$150 billion dollars in 1995 to US$120 billion in 1998. But from the beginning of 1999, the economic conditions did recover, and then had two good years but so far 2001 was bad and now 2002 is even worse. However, Taiwan has done comparatively better than Japan, the US and Korea by loosing less market share and still staying more profitable even in these hard times.

In 1998, the total production value of the global IC design community was US$6.2 billion, and the total market for wafer foundry services was US$5 billion. These figures represent a small percentage of the total market for ICs. However, the growth rate of these two. sectors have already far surpassed the growth rate of the IC industry in general between 1998 and 2002. This is because the shift from vertical integration to the vertical division of labor is accelerating. The weakness of the vertical division of labor companies in the past was their lack of financial strength, small size, and lagging technology. However, the three-year downturn in the IC industry (1996-1998) caused technology development and capacity expansion at most of the leading IDMs (integrated device manufacturers) to stagnate. At the same time, Taiwan's process technology improved dramatically due to fierce competition between local manufacturers, such as VIA, TI Acer, UMC and TSMC. As a result, the leaders of Taiwan's IC industry have closed the technology gap with the most advanced IDMs, and surpassed most of the second-tier manufacturers by a substantial margin. This has resulted in two major changes in the world wafer foundry market. First, IC design houses around the world have cooperated with Taiwan's wafer foundries to greatly increase the competitiveness of their products, taking market share away from the IDMs. Second, many IDMs will be forced turn to Taiwan's wafer foundries to produce their most advanced products, using their own production capacity for lagging-edge products. These are two remarkable developments, and they will further contribute to the growth of Taiwan's wafer foundry industry.

According to forecasts, if the IC industry grows at an annual rate of 10% over the next five years, the IC design industry's annual growth may reach 25% resulting in a US$42 billion market by the year 2007. The growth of the wafer foundry industry should be even faster, reaching US$55 billion by the year 2007. Everyone's sights are trained on what promises to be a US$100 billion market in the years to come. However, the remaining question is "who is best positioned to profit from these opportunities?" The answer very well could be Taiwan, and the international IC design houses that are working with Taiwan's foundries. Therefore, it is necessary that Taiwan's IC industry seize this opportunity to increase R & D expenditures and investments to ensure that Taiwan will have a high-technology flagship capable of joining the fleet of the world's most advanced industrial nations in the 21st century.

Conclusion Part V

Conclusion to Sections 5.1—5.3

Although possibly not intentional, the result of Fukuyama's book is to cast a dark shadow of doubt on the achievements of the modern Chinese family, Chinese society and entrepreneurship. This book called Trust is a widely read book that was on the New York Times Best Sellers List during 1995 and has had a major influence on the American impression of the Chinese business culture, family values, and nature of the modern Confucian influence. In addition to this Fukuyama gets high exposure from the media and many academics because he formerly was deputy director of the US State Department's Policy Planning Staff and now has a very high position as an analyst at the Rand Corporation as well as enjoying A number one best seller in 1992 entitled The End of History and the Last Man (1992) which had a great influence on media people and academics for its being quote "Bold, Lucid, scandalously brilliant. Until now the triumph of the West was merely a fact. Fukuyama has given it a deep and highly original meaning." – Charles Krauthammer (Fukuyama 92, back cover). Actually, even the writer of this study has been a big fan and avid reader of Fukuyama's research not only because he is a profound academic but also he appeals to many intellectuals as a cross-over writer. This means that he conducts critical research at the academic level but still writes in a way that is more attractive and accessible to the general reader or layman. So, it is with admiration and reluctance that one finds oneself put to the task of dissection and criticism. Also this book is quite persuasive in its more than 60 pages (chap. 3, 7-10, 29, 30) of apparently in-depth coverage of the state of the Chinese business community in the 1990's. What this book does achieve is a survey and summary of the conventional wisdom in the West concerning Confucianism, the Chinese family and Chinese entrepreneurship. However, one could also argue the point that through a closer examination of native Chinese case studies, careful observation of the actual inner workings of NIEs Chinese entrepreneurial activities and economic policy and also having a more balanced view of the Chinese family business, it is possible to present a wholly different picture of this same situation.

Conclusion to Section 5.4

This research used a bounded rationality methodology from the New Institutional Economics perspective developed first at Stanford University during the 1980's by people such as Peter Evans and Aoki Masahiko which they call comparative institutional analysis or CIA. As we saw in Table A.1 in the Introduction at the beginning of this study, Taiwan made by far the biggest advances in the 3 most value added areas of desk PC, Notebook PC and integrated circuits (ICs, a type of high value added of semiconductor). Also notice that Japan lost market share in every area of hardware while Korea made only mild advances compared with Taiwan. In the 3 high value added areas of desk PC, notebooks and ICs Taiwan made 15-90% increases in revenue while Japan went down 10-30% in all three. The reason for this dramatic performance increase by Taiwan can be attributed mostly to 9 Taiwan companies setting up OEM Win-Win alliances with 4 major Japanese manufacturers. The 9 are Mitac, Compal, Quanta, FIT, TSMC, UMC, Winbond, Inventec and Asustek. The 4 Japanese companies are Fujitsu, Sharp, NEC and Sony which may surprise some people because they were all considered to be strong in manufacturing in 1994 but during 1994-1998 these four were all persuaded by the Taiwan 8 to turn over more than 50% of their IT manufacturing to Taiwan OEM companies. Only Taiwanese companies have been successful at procuring very large production orders from major Japanese IT firms. This fact has rarely been reported in English publications and to my knowledge research has never been published in English concerning the unique Chinese organizational strategies utilized in the success of this contrarian methodology that resulted in long term OEM profitability.

Japan seemed to have all the ingredients for success in the PC era, from strong manufacturing skills and control of many key components technologies to a corporate structure that could support a sustained drive into export markets. Yet in spite of their success in components and peripherals, the Japanese computer makers have had only limited success in PCs, and have been virtually shut out of the software industry. The reasons for this mixed record are complex, yet the most important have to do with Japan's industry structure. Japan's large, vertically integrated firms were well suited to high-volume, capital-intensive components production. They also did quite well in the relatively stable mainframe industry, because they could marshal the necessary resources within their keiretsu groups and count on the members of those groups as captive customers. However, in industry segments such as PCs, ICs and hard disk drives, where product cycles are short and timing critical, the Japanese industry structure was a liability. Unable to make decisions quickly, Japan's computer makers had limited success in such businesses. Also unwilling to take advantage of global human resource diversity, possibly the only strategy success was never even pursued.

MITI has recently been pressuring MOF to loosen its restrictions on IPOs, and the number of IPOs did rebound after 1993. However, this might have been only a temporary phenomenon related to an upturn on the Tokyo exchange. Asking a bureaucracy (Japanese or otherwise) to give up regulatory powers is something akin to asking a person to cut off a body part. Even as it pressures other ministries to deregulate, MITI itself remains one of the leading propagators of regulation in Japan, and has not offered to reduce its own regulatory role. To create a truly dynamic venture business sector in Japan would probably require a radical change in bureaucratic mentality, as well as a willingness to shake up an industry structure that tends to block newcomers out of distribution channels and production networks. Such change is unlikely, but even some moderate changes in the regulatory and tax system could unleash quite a bit of entrepreneurial activity.

When many big computer companies started looking for low-cost suppliers and subcontractors, they offered chances for Asian companies to enter the PC industry without having to master a wide range of technologies or develop their own marketing and distribution channels through original equipment manufacturing (hereafter OEM) type opportunities. A company could produce a cable, power supply, keyboard, or monitor based on IBM's design standards and sell the components to any PC maker. It could also assemble PCs or circuit boards for major companies that preferred to outsource some parts of the production process. The barriers to entry were low, and East Asian producers flooded into the market. However, Many business scholars consider OEM as just a short term strategy or stepping stone for getting started in IT hardware because they believe that the higher profitability potential lies only in developing brand name products by getting out of the OEM business and into the international brand recognition wars. Japan, Korea and Hong Kong believed in this western strategy and all got out of the OEM business as soon as possible. By 1989 only Taiwan still believed that OEM could be a profitable long term strategy and some of the well known leaders such as Miao Fengchiang of Mitac computers and Morris Chang of the Taiwan Semiconductor manufacturing Corporation (TSMC) had actually developed full scale plans for leveraging Taiwan's OEM based business infra-structure (苗豊強 1998 pp.86-95).

The direct investment and outsourcing by multinational computer makers and efforts by local companies to become part of the supply chain combined to create a boom in computer production in East Asia. The combination of approaches was different in each situation. Singapore relied mostly on production by foreign multinationals, Taiwan and Hong Kong had a combination of foreign and domestic producers, and domestic firms dominated Korea's industry. During the 1980s, each of the four NIEs experienced high-speed growth in the manufacturing of computers and peripherals (Fig. 4-1). However, in the late 1980s and early 1990s, production levels stagnated in Korea, Japan and Hong Kong but surged in Taiwan and Singapore. This surge in

Taiwan during the 1990's along with the commensurate decline of Japan, Korea and Hong Kong's market share along with a analysis of comparative organizational strategies is of primary concern in this dissertation

For firms or nations that lag others technologically, the challenge for technological catching-up is to acquire and build upon external knowledge that often resides in foreign countries or in their firms and institutions. The extent to which followers can acquire external knowledge is determined in part by the nature of knowledge (Zander and Kogut 1995 pp.76-92) and by the follower's absorptive capacities (Cohen and Levinthal, 1990 pp.135-52). State-of-the-art technologies, or the most valuable parts of knowledge, are often tacit (Winter, 1987). As we move further into the tacit domain, knowledge becomes increasingly difficult to separate from those who possess it.

Organizational boundaries serve as knowledge envelopes and valuable knowledge is much more likely to be diffused within an organization than outside of it (Zucker, Darby, Brewer, and Peng, 1996 pp.90-113). The sticky nature of tacit knowledge means, of course that it does not necessarily flow easily or quickly even within a firm (Szulanski 1996 pp.27-43). Due to the limited speed and scope of diffusion across firm boundaries, it is difficult for outsiders to get access to and master such tacit and complex knowledge. As shown by Zander and Kogut (1995 pp.76-92) multinational firms are superior to alliances or markets as conduits of knowledge transfer and building, especially when the knowledge is tacit.

CONCLUSION: Institutional Analysis of Taiwan's Organizational Strategies

The central inquiry of the PhD dissertation explored the answers to the questions below that correlate to the 5 main points raised in each respective part of this study.

Point 1-a. Evolution of Development Theories. How does this research conclude that in contrast to Taiwan, the state in Japan and Korea has played a largely different role? In particular, the role of the state in the Japanese accelerated industrial catch up strategy for information technology (IT) hardware has changed significantly over time, and so did the state-society and state-business relations. Part I goes into detail about the historical background which led to development paths that appear similar between Japan and Taiwan but are actually quite different in both practice and results.

Point 1-b. The Comparative Institutional Approach. Why are "bounded rationality" methodologies, such as CIA and game theory more useful than conventional "rational expectations" economic models in analyzing economic development and transition economies? This is explained at the end of Part I and refers to the strong trend in the 1990's for using more and more bounded rationality as the new methodology comes of age.

Point 2. Political Intervention. Japan and Taiwan both experienced strong political intervention into the IT hardware industry however the end result was far different in each case why? Part II examines the history of these interventions and answers this question.

Point 3. Bureaucracy and NGOs. What was unique about Taiwan's state-business and state-society relations for IT hardware development and how did the human resource diversity strategy of "open pluralism" for state institutions differ from others using "bureau pluralism" such as Japan and South Korea?

Point 4. Corporate Culture of Diversity. What strategies were used in the Taiwanese IT hardware industry that helped achieve the highest average rate of both profitability and world market share increase during the 1985–2000 period? Also, from the perspective of institutional economics, what is unique about the organizational strategies of "human resource diversity" and "OEM vertical division of labor" (Win-Win strategy) for IT hardware companies and research institutions that make Taiwan stand out in East Asia?

Point 5. For and Against Taiwan. Why was the early 1990's filled with so many criticisms about Taiwan's IT development and business style with many experts explaining why Taiwan would soon fail? However, there were few experts explaining why Taiwan's IT strategy was leading the world in profitability and revenue growth from 1990 until 2002. Part V explains the misunderstandings about Taiwan's strategy and why nobody saw the strong success coming in the future.

These questions were addressed through a complex comparative institutional analysis as the supporting proof for this dissertation. Now, we go through 5 main points of the Doctoral Dissertation in great detail to show the support for this conclusion.

5 Main Points in Concluding the Dissertation :

Point 1-a. Evolution of Development Theories. How does this research conclude that in contrast to Taiwan, the state in Japan and Korea has played a largely different role? In particular, the role of the state in the Japanese accelerated industrial catch up strategy for information technology (IT) hardware has changed significantly over time, and so did the state-society and state-business relations. Part I goes into detail about the historical background which led to development paths that appear similar between Japan and Taiwan but are actually quite different in both practice and results.

(This was covered in Parts I and II)

A small group of people in the state including high-ranking government officials with engineering backgrounds, senior managers of the ITRI/ERSO, the majority of who were trained at RCA, foreign advisors, and the overseas Chinese engineers, had enlightened visions about the future of Taiwan's IC industry, and pushed the IC project ahead. The direct outcomes of the aggressive state's efforts were the formation of the UMC, the TSMC, and other manufacturers as well as various technological upgrading represented by the VLSI project, the sub micron project, and the DRAM business. The IC industry, therefore, has been created directly by the state and the Taiwanese high-tech circle has played very similar roles to the Japanese MITI as described by Chalmers Johnson (1982).

Many researchers have tended to group together Taiwan, Japan and Korea as following very similar models of development because of the strong central roles played by each state's national government. However, this research will conclude that in sharp contrast to Taiwan, the state in Japan and Korea has played a largely different role. In particular, the role of the state in the Japanese accelerated industrial catch up strategy for information technology (IT) hardware has changed significantly over time, and so did the state-society and state-business relations. The Japanese state through MITI was a major promoter of the IT hardware industry with a primary emphasis on exports in the 1960s. During most of the 1970s, the state drew and implemented numerous ambitious plans to promote the IT hardware manufacturing industry such as heading up technology consortium proposals and co-operative think tanks but most of them did not materialize as planned (Fallows 1994 pp.52-74).

Though my conclusion on the role of the Taiwanese state in promoting the IC industry is the same as that of the developmental statist argument on the Taiwanese political economy (Amsden 1979, 1985; Wade 1990a, 1990b), the approach used here differs from the developmental statist argument. In contrast to the existing statist explanations, most of which emphasize economic backwardness as the source of state dominance over the market, this study analyzed a broader institutional relationship between the state and society which have been historically contingent. The unique institutions in state-society relations in regard to the development of the IC industry include not only state structures and actions but also the relationship between different state agents and agencies, the academic community, foreign advisors, and the small and medium-size business structure, all of which affect the interaction between the state and the private sector in a predictable direction, that is, the dominant and pervasive role of the state. The high-tech circle and agencies within the Taiwanese state have played such pivotal roles, not because of the ahistorically strong and autonomous state in backward economies but because of the institutional strength of the high-tech related agents and/or agencies as well as the unique state-society relations which hinder the penetration of parochial interests into the IC policy-making process." Thus the extraordinarily dominant and pivotal roles played by the Taiwanese state must be understood from a broader perspective focusing on the interplay between the state, NPOs, business and society under particular historical and structural constraints, that is, comparative institutional analysis approach to state-society relations, rather than from a narrow statist perspective.

In terms of business structure, Taiwan and Japan differ dramatically from each other despite many structural similarities shown in their developmental trajectories. The Taiwanese economy has been composed of mostly small and medium-size OEM enterprises while a few conglomerate types of business, known as Zaibatsu, have dominated the Japanese economy. Though this was a direct outcome of adopting different policies toward capital concentration by each government, Taiwan and Japan have had different structural conditions that affected why each state had to adopt the policies as such. The IT hardware industry reflects similar degrees of capital concentration though the IT hardware industry in Taiwan has been a little more concentrated than other industrial sectors. Different business structures directly affect the ways that interests are represented in the policy-making process. In Taiwan, for instance, the smallness effectively hindered private firms in the electronics industry from entering the IC business in the first place. Private firms could not develop their own technical expertise because they could not afford the huge investment for R&D and facilities that were indispensable for launching the IC industry. With this situation, the private sector could not have much say in IC policies, and the state had to launch various IC projects by itself. In sharp contrast, the bigness of Japanese electronics firms allowed them to enter into the IC business based upon large in-house demands at the beginning, and exports in later years. Given the large financial and organizational capacity of the conglomerate type of business, there is no question about the advantage of bigness in launching such a risky business as ICs, particularly the mass production of standardized memory products including DRAMs. Japanese electronics firms could develop their own research and organizational capabilities, which enabled them to penetrate the policy-making process more frequently and more effectively than their Taiwanese counterparts.

Another institutional difference that causes diverging approaches in the industrial catch up strategies for IT is found in the state structures. Taiwan could develop a coherent and autonomous S&T policy-making system due at first to the personal involvement of politically powerful figures who backed the state's IC initiative wholeheartedly. Later the system was fully institutionalized within the Taiwanese government through various organizational changes, which provided a relatively high autonomy to the technocrats who have been involved in the S&T policy-making process in general, and IT policies in particular. In particular the Taiwanese state could own far more excellent organizational and R&D capabilities than the private sector through various state-run research institutes and advisory organizations. Because the private sector did not own such capabilities and even the willingness to acquire them by itself, the state had to assume a leading role in promoting the IC industry.

The Japanese S&T policy-making system, however, has never been as autonomous and/or coherent as that of Taiwan. When the IC industry took off in the early 1980's, a bureaucratic cleavage between the liberalization and technology groups existed within the Japanese government, which considerably reduced the ability of the state (the MITI in particular) in promoting the IC industry. After the middle of the 1980s, the bureaucratic cleavage began to disappear. But it was quickly replaced by a bureaucratic competition between the MITI and the other agencies. This problem limited the state's ability to help the IC industry in coherent ways.

Point 1-b. The Comparative Institutional Approach. Why are "bounded rationality" methodologies, such as CIA and game theory more useful than conventional "rational expectations" economic models in analyzing economic development and transition economies? This is explained at the end of Part I and refers to the strong trend in the 1990's for using more and more bounded rationality as the new methodology comes of age.

The state in Taiwan has been very dominant and pervasive in making and implementing the IC policies, while the state in Japan has been more or less cooperative with the private sector. This is truly a surprising fact because both states have been considered what Chalmers Johnson calls capitalist developmental states during most of the postwar period (Johnson 1982, 1987). It is also surprising because as far as the IC industry is concerned, both countries were far behind in the early 70's compared with other advanced countries, which may require a strong state leadership in the processes of industrial catch-up. In explaining the causes of this variation, this research primarily focus' on the differences in three structural variables, business structures, state structures, and NPO / NGO structures and tries to explain how these variables have changed the institutional settings, according to which the relevant actors in the state and society have interacted with each other in order to result in different organizational strategies.

Professor Aoki Masahiko has explained how the effective management of Japanese firm organization that endogenizes contextual skill formation has been supported by the complementarity of the contingent governance structure and the imperfect labor market. He argues that the contingent governance structure in turn has been supported by regulations restricting entry to many industries that have made it possible for these industries, such as main banks, to accrue rents. In Aoki's words:

> The term "bureau" originally referred to a "drawer" and implied sorting or arranging something. The bureaucracy has played an important role as agent and arbitrator in protecting the vested interests of pluralistic groups in different fields. However, "bureau pluralism" is not an "open pluralism" as vested interests protected by bureaucratic administrative mediations merely coexist and various organizational modes cannot be freely created. This joint gain by all parties was made possible by the existence of quasi-rents acquired from the international market by upgrading the machine manufacturing industry, which accounts for 80 percent of exports. It was maintained by distributing the quasi-rents attained by the internationally advanced sectors to the underdeveloped sectors through such mechanisms as domestic price distortion, taxes and subsidies, and entrance regulations.
>
> If the learning or transplantation of these organizational innovations is combined with low cost factors of production overseas, the potential for the Japanese economy to acquire quasi-rents will rapidly decline. This trend will be further accelerated by organizational innovations or the emergence of new industries in other countries. In a previous work I referred to the following phenomenon as the "fundamental dilemma of bureau pluralism": advanced sectors that do not need bureaucratic protection tend to drift away from the bureau pluralistic framework, while less developed sectors tend to rely on it more.' As long as the acquisition of quasi-rents from the international market by the former is possible, the size of the pie that can be distributed among interest groups will expand, so that the maintenance of bureau pluralism will not be especially problematic. It may even contribute to social stabilization. (Aoki 2000 pp.129-131)

However, Aoki claims that if quasi-rents move toward extinction for the various reasons given above, the framework of bureau pluralism itself will be difficult to maintain. At that point he says that if comparatively disadvantaged industries seek continued protection, the advanced firms would either lose their competitiveness due to higher subsidization to disadvantageous sectors and interest groups, or would be under great pressure to move their manufacturing bases overseas to survive. The resulting dilemma would be that the only remaining employment opportunities would be in comparatively disadvantaged industries.

Aoki argues that, from the perspective of information processing, there is potential for the economy to continue to demonstrate efficiency in industries that can be characterized as high engineering industries. He also points out that a fairly high possibility that new innovations will be implemented domestically in cross-industrial technologies, such as formation technology driven electronic machinery, retail and service sector networking, and environmental management technologies. However, the dilemma of bureau pluralism might grow more serious, threatening the loss of international competitiveness of the leading industries according to his argument. How should this be handled? Aoki says:

> The combined effect of such factors as the bounded rationality of individuals, evolutionary pressures, and institutional complementarity is a tendency for a more or less homogeneous organizational convention to be adopted throughout a particular economy. However, different organizational conventions will evolve in different nations. This is an unintended outcome of the workings of bounded rationality. This chapter has made it clear that the potential gains from organizational diversity cannot be fully realized on a global scale merely through free trade. This is a proposition that stands even if we assume a purely theoretical situation in which all resources can be traded and there are no costs involved in transportation, storage, etc. If we acknowledge the existence of resources or services that cannot be traded, the proposition gains even more credence.
>
> In Ricardian classical trade theory, the primary source of comparative advantage within an economy is the relative quantities of the "primary factors of production"- land, labor, and capital - which cannot themselves be moved between countries. The world can enjoy the gains of trade by first converting these factors of production into outputs that can be traded. What has been emphasized here, however, is that a world comprised of boundedly rational individuals can reap economic gains because of the diversity of "organizational modes," a human construct. Theoretically, these could have been constructed by human intent anywhere, at any time.
>
> (Aoki 2000 pp.131-32)

Establishing a new organizational mode different from the prevailing convention is not so simple regardless of whether it is a creative innovation or a transplant from outside. The skill types needed to sustain a new organizational mode may not be readily available in the economy, and the institutional structure supporting the existing organizational mode may not be conducive to experimentation with mutant modes. Aoki says this places an exceptionally heavy burden on the Japanese economy, where bureau pluralism has been implemented, because tall barriers have been constructed to obstruct new entrants. By contrast, economies that have a regulatory stance is to allow free entry into industries, such as under the Anglo-American system, have institutional structures that are more tolerant of experimentation with mutant organizational modes.

Point 2. Japan and Taiwan both experienced strong political intervention into the IT hardware industry however the end result was far different in each case why? Part II examines the history of these interventions and answers this question.

Taiwan and Japan have taken largely different paths for the same policy goal mainly due to the institutional differences caused by different structures in business, state, and NPO / NGO sectors. These institutional differences in a combined way affect the interactions between the core players in the state and society and also affect the path dependency and options for their respective organizational strategies. By showing the different organizational strategies that were formulated and implemented by the states of Taiwan and Japan, and by uncovering the causes of such variation, this dissertation argues that the state and state-society relations in the development of organizing institutions for all sectors (institutional development in particular) vary through time, across societies, and across industrial sectors. Once economic backwardness has been overcome to a certain extent, institutions in the state and state-society relations that have been formulated throughout the developmental process may vary across societies and across industrial sectors and also time. Different institutions, in turn, affect the interactions among the people involved in the policy-making process as well as in interest group representation in a given society, which may result in different political and economic outcomes as shown in this dissertation.

The combination of industry structure, domestic market, and national capabilities (especially human resources) explains why Japanese companies thrived as producers of high-volume hardware and became competitive in the mainframe business, yet struggled in PCs and software. The closely integrated keiretsu industry structure provided ready capital, reliable supply chains, and captive customers. The domestic market also served as a proving ground for both consumer electronics and electronics components that could be exported in high volumes. However, both producers and users were slow to react to the PC revolution. Vertical integration left Japan partly isolated from the dynamic global production system for PC hardware. Software factories were of no use in creating packaged software. Entrepreneurial start-ups were starved for capital and access to distribution channels. And engineers, programmers, and other professionals were trained to be average, and they were lured into large organizations that offered prestige but discouraged innovation. Only in the 1990s, faced with a slump in the entire electronics industry, did Japanese companies begin to make changes in their corporate cultures and practices, and these changes have been very slow at best.

Japan seemed to have all the ingredients for success in the PC era, from strong manufacturing skills and control of many key components technologies to a corporate structure that could support a sustained drive into export markets. Yet in spite of their success in components and peripherals, the Japanese computer makers have had only limited success in PCs, and have been virtually shut out of the software industry. The reasons for this mixed record are complex, yet the most important have to do with Japan's industry structure. Japan's large, vertically integrated firms were well suited to high-volume, capital-intensive components production. They also did quite well in the relatively stable mainframe industry, because they could marshal the necessary resources within their keiretsu groups and count on the members of those groups as captive customers. However, in industry segments such as PCs, ICs and hard disk drives, where product cycles are short and timing critical, the Japanese industry structure was a liability. Unable to make decisions quickly, Japan's computer makers had limited success in such businesses. Also unwilling to take advantage of global human resource diversity, possibly the only strategy success was never even pursued.

Point 3. Bureaucracy and NGOs. What was unique about Taiwan's state-business and state-society relations for IT hardware development and how did the human resource diversity strategy of "open pluralism" for state institutions differ from others using "bureau pluralism" such as Japan and South Korea?

(Covered in Parts II and III)

Professor Aoki Masahiko has explained how the effective management of Japanese firm organization that endogenizes contextual skill formation has been supported by the complementarity of the contingent governance structure and the imperfect labor market. He argues that the contingent governance structure in turn has been supported by regulations restricting entry to many industries that have made it possible for these industries, such as main banks, to accrue rents. In Aoki's words:

> In Japan, most working people in all fields have been expecting the value of their human capital to be maintained through a multilayered structure comprising their employing firm, the industrial associations in their industry, and the ministry that oversees that industry. In my book published in *1988,* this system was referred to as "bureau pluralism. The term "bureau" originally referred to a "drawer" and implied sorting or arranging something. The bureaucracy has played an important role as agent and arbitrator in protecting the vested interests of pluralistic groups in different fields. However, "bureau pluralism" is not an "open pluralism" as vested interests protected by bureaucratic administrative mediations merely coexist and various organizational modes cannot be freely created. (Aoki

2000 pp.129-131)

However, Aoki claims that if quasi-rents move toward extinction for the various reasons given above, the framework of bureau pluralism itself will be difficult to maintain. At that point he says that if comparatively disadvantaged industries seek continued protection, the advanced firms would either lose their competitiveness due to higher subsidization to disadvantageous sectors and interest groups, or would be under great pressure to move their manufacturing bases overseas to survive. The resulting dilemma would be that the only remaining employment opportunities would be in comparatively disadvantaged industries.

The skill types needed to sustain a new organizational mode may not be readily available in the economy, and the institutional structure supporting the existing organizational mode may not be conducive to experimentation with mutant modes. Aoki says this places an exceptionally heavy burden on the Japanese economy, where bureau pluralism has been implemented, because tall barriers have been constructed to obstruct new entrants. By contrast, economies that have a regulatory stance is to allow free entry into industries, such as under the Anglo-American system, have institutional structures that are more tolerant of experimentation with mutant organizational modes.　He then goes on to add:

> Accordingly, permanently solving the dilemma of bureau pluralism requires institutional reform that allows new organizational modes to be experimented with and implemented in industries where the conventional assimilated information structure is inefficient. There is no guarantee that the Japanese-type of horizontal hierarchy will maintain an absolute advantage in the industries in which it was originally an organizational innovation. The operations of a self-sufficient horizontal hierarchy may be especially inefficient in fields in which strategic alliances between various firms can be expected, like the communications industry. In these fields, the relevant systemic environment extends across several industries, and processing information regarding that environment may require a greater breadth of information processing capabilities than can be accumulated by a single firm. However, it is not yet

altogether clear which organizational mode is most suitable for these industries.

(Aoki 2000 pp.133-34)

Bureau pluralism is by nature resistant to institutional reforms that threaten the vested interests of certain interest groups, making it politically difficult to carry out radical reforms. However, bureau pluralism cannot be sustained, as the quasi rents are inevitably eliminated by the maturation of that pluralism itself and by changes in the international environment. As Aoki repeatedly emphasizes, attempts to sustain it would only result in the loss of comparatively advantaged industries. Thus, the only tenable choice remaining is to seek a new path to economic gains by lowering barriers in all industries and allowing the entry of diverse organizational modes from both domestic and foreign sources in order to fully take advantage of global human resource diversity. Japan needs to make the painstaking efforts needed to endogenize the economic gains from diversity.

The four major projects undertaken in the 1980s were the Fifth Generation Computer Systems Project, the Supercomputer Project, the TRON Project, and the Sigma Project. However, in the end, these projects as well as many others failed because of Japan's bureau pluralism which avoided diversity strategies. At the same time in Taiwan and the USA both government and private technology projects had opened themselves to the wide diversity of the world human resource network actively welcoming the top IT talent from around the world regardless of race or nationality. In the USA and Taiwan most high-tech projects had more than 50% of the leadership and engineers that were globally diverse (Saxenian 2002 pp.3-24). Even large government projects in Taiwan and the USA often invited the best of the best from around the world to lead or participate in the top high-tech research projects. However, in the cases above for Japan, foreigners were never invited to lead a project or were they ever utilized for even minor engineering leadership roles. This is what Professor Aoki Masahiko of Tokyo University calls an "anti-diversity strategy" (青木 1995 pp.82-134).

In the developmental history for Taiwan and Japan, it was shown how the unique state-society relations and organizational strategies in Taiwan and Japan affected the formation of formal and informal institutions concerning the development of the IT hardware industry in which the state and societal actors interact with each other. It was argued that the Taiwanese state has played so dominant and pervasive role not because of the strong and autonomous state that was envisioned by the early statist literature, but because of the institutional strategies and state-society-business relations that are unique to the political economy of the accelerated industrial catch up strategy for IT in Taiwan. It was shown that although Taiwan's state literally built the whole IT sector in the beginning, it also built an enhanced version of a highly diverse free market "rules of the game" which unlike Japan and South Korea, did not grant special privileges to certain large firms but rather built a transparent and level playing field embracing both small and large enterprises. Taiwan also avoided bureau pluralism by embracing an open pluralism institutional strategy that involved the privatization of government think tanks and the spinning off of almost all state research programs into the private sector in order to create the fullest possible diversity of human resources.

Japan seemed to have all the ingredients for success in the PC era, from strong manufacturing skills and control of many key components technologies to a corporate structure that could support a sustained drive into export markets. Yet in spite of their success in components and peripherals, the Japanese computer makers have had only limited success in PCs, and have been virtually shut out of the software industry. The four major projects undertaken in the 1980s were the Fifth Generation Computer Systems Project, the Supercomputer Project, the TRON Project, and the Sigma Project. However, in the end, these projects as well as many others failed because of Japan's bureau pluralism which avoided diversity strategies. At the same time in Taiwan and the USA both government and private technology projects had opened themselves to the wide diversity of the world human resource network actively welcoming the top IT talent from around the world regardless of race or nationality. In the USA and Taiwan most high-tech projects had more than 50% of the leadership and engineers that were globally diverse (Saxenian 2002 pp.3-24). Even large government projects in Taiwan and the USA often invited the best of the best from around the world to lead or participate in the top high-tech research projects. However, in the cases above for Japan, foreigners were never invited to lead a project or were they ever utilized for even minor engineering leadership roles. This is what Professor Aoki Masahiko of Tokyo University calls an "anti-diversity strategy" (青木 1995 pp.82-134).

Point 4. Corporate Culture of Diversity. What strategies were used in the Taiwanese IT hardware industry that helped achieve the highest average rate of both profitability and world market share increase during the 1985--2000 period? (See Tables 5.02—5.08)

(This point was covered in Parts IV and V)

This study covered the unique organizational strategies of Taiwan's IT hardware sector by explaining the background and innovations of Taiwan's vertical division of labor OEM strategy (苗豊強 1997) with its primary focus on the strategy of vertical division of labor throughout IT manufacturing value chain. It is well known that the IC industry is divided into highly specialized sectors, including IC design, mask making, wafer processing, and assembly and test. One of the most significant changes in the Taiwan IC industry in recent years has been the transition from a vertically integrated model to a vertical division of labor business model. This transition has been driven by the need to constantly adapt to the rapidly changing business environments that characterize each sector of the production cycle, and by the massive investment needed to remain competitive in the global economy. The so-called IDM (integrated device manufacturer) model, in which one company is responsible for all aspects of production, is no longer competitive due to the excessive strain it places on a company's financial, research and development, and management resources. As a result, the vertical division of labor of production is becoming the mainstream business model in Taiwan. Taiwan's unique model of corporate organizational strategy for the IT hardware sector are: A comprehensive and dynamic vertical division of labor organizational structure; Complete integration into the diversity of the global supply chain (global competency, worker diversity); and a unique employee stock bonus distribution system.

Also in Point 4, from the perspective of institutional economics, what is unique about the organizational strategies of "human resource diversity" and "OEM vertical division of labor" (Win-Win strategy) for IT hardware companies and research institutions that make Taiwan stand out in East Asia?

(This point was covered in Parts III, IV and V)

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Interestingly, as recently as ten years ago, many analysts of Taiwan's IC industry suggested Taiwan could not compete globally in technology fields because the vertical integration of its companies was not as complete as with large foreign manufacturers.(Fukuyama 1994)

Nine years later, these arguments have been completely refuted by the course of industry development. In fact, to the contrary, numerous studies demonstrate the superiority of the vertical division of labor over an integrated manufacturing system(陳添枝 1994, 陳競玲 1999).

To the surprise of many, Taiwan's vertical division of labor OEM system is far more profitable than the Big Brand companies that used to dominate. According to a Donaldson, Lufkin & Jenrette research report, in 1998, the average profit margin for companies in each sector of the disintegrated production chain was 20%, while the average profit margin for integrated device manufacturers (IDM) was only 4%. Cash flow (EBITDA) at companies operating in a disintegrated environment accounted for approximately 50% of revenues, while it was only 18% for IDMs; a difference of 2.5 times. This translates into 2.5 times more potential for new investments, an undeniable competitive advantage. For the majority of logic ICs, the disintegrated manufacturing environment is superior to the IDM business model. However, the DRAM and CPU markets continue to be dominated by integrated device manufacturers, such as Intel and Samsung. This is largely due to the fact that these products have relatively long life cycles, require extremely high production volumes and are produced in few varieties. In addition, the correlation of design and process technology for these products is relatively high, minimizing the advantages of division of labor.

Point 5. For and Against Taiwan. Why was the early 1990's filled with so many criticisms about Taiwan's IT development and business style with many experts explaining why Taiwan would soon fail? However, there were few experts explaining why Taiwan's IT strategy was leading the world in profitability and revenue growth from 1990 until 2002. Part V explains the misunderstandings about Taiwan's strategy and why nobody saw the strong success coming in the future.

Against Taiwan: (This point was covered in Part V)

The result of Fukuyama's book and many other critics is to cast a dark shadow of doubt on the achievements of the modern Chinese family, Chinese society and entrepreneurship. This book called Trust is a widely read book that was on the New York Times Best Sellers List during 1995 and has had a major influence on the American impression of the Chinese business culture, family values, and nature of the modern Confucian influence. What this book does achieve is a survey and summary of the conventional wisdom in the West concerning Confucianism, the Chinese family and Chinese entrepreneurship. However, one could also argue the point that through a closer examination of native Chinese case studies, careful observation of the actual inner workings of NIEs Chinese entrepreneurial activities and economic policy and also having a more balanced view of the Chinese family business, it is possible to present a wholly different picture of this same situation.

One of the deepest and most thorough Western studies on NIEs familism often cited by Fukuyama is the groundbreaking study done by Edwin Winckler entitled "Statism and familism on Taiwan" (1987). Although Winckler is not a NIEs Chinese he uses a good amount of native research and resources and is much more persuasive concerning his "Chinese centered approach" put forward by Paul Cohen (1984). The problem here is that Winckler's conclusions about Familism in Taiwan directly contradict Fukuyama's thesis but we never hear about this fact. Fukuyama ignores the conclusions and evidence of one of the foremost Western scholars of Chinese Familism while at the same time selectively borrowing a few bits and pieces from the very same book, give the impression of supporting his thesis. Winckler Clearly states: "Statism and familism have contributed to the effectiveness, efficiency, and equity of development in Taiwan." (Winckler 1987, p.190) Also on page 175 Winckler runs down a long list of the advantages he attributes to family businesses in Taiwan and does not make a point to emphasize any of the main weak points put forward by Fukuyama.

In general, Winckler concludes that familism is a tool that is manipulated by entrepreneurs and used to benefit the business when it is advantageous and when it is not, they just improvise. The utility value of familism and family business can be explained in a concept that GE's Jack Welch or maybe executives at 3M or Hewlett Packard (HP) would call "stewardship" or "ownership". Many case studies by Harvard University and others conclude that a key factor in restructuring these giant firms to become entrepreneurial once again was that they tried to instill a new attitude into every employee that GE (or 3M, HP) was "their" company and that they owned it and were responsible to be the "good stewards". Aside from their jobs, everyone was in charge of making the company successful "like a family". (See the conclusions of Xerox-- Kotter 1990, Ford-- Pelofsky 1989, HP-- King & Stevenson 1983, Yoffie & Pearson 1990, IBM-- Cohn & Yoffie 1992, GE-- Bartlett & Elderkin 1991, 3M-- Bartlett & Mohammed 1995). Therefore, Fukuyama and Redding were assessing this familistic stewardship as a grave drawback at a time when cutting edge Consulting groups like McKinsey and Andersen Consulting were raking in multi- million dollar fees for helping the ailing giants implement familism or stewardship into the companies because they needed to regenerate their entrepreneurship. What needs to be explained now is why Fukuyama was so against the Chinese SME's and family businesses of the Ethnic Chinese Economies.

For Taiwan : (Covered in Section 5.4)

As we saw in Table A.1 in the Introduction at the beginning, Taiwan made by far the biggest advances in the 3 most value added areas of desk PC, Notebook PC and integrated circuits (ICs, a type of high value added of semiconductor). Also notice that Japan lost market share in every area of hardware while Korea made only mild advances compared with Taiwan. In the 3 high value added areas of desk PC, notebooks and ICs Taiwan made 15-90% increases in revenue while Japan went down 10-30% in all three. The reason for this dramatic performance increase by Taiwan can be attributed mostly to 9 Taiwan companies setting up OEM Win-Win alliances with

4 major Japanese manufacturers. The 9 are Mitac, Compal, Quanta, FIT, TSMC, UMC, Winbond, Inventec and Asustek. The 4 Japanese companies are Fujitsu, Sharp, NEC and Sony which may surprise some people because they were all considered to be strong in manufacturing in 1994 but during 1994-1998 these four were all persuaded by the Taiwan 8 to turn over more than 50% of their IT manufacturing to Taiwan OEM companies. Only Taiwanese companies have been successful at procuring very large production orders from major Japanese IT firms. This fact has rarely been reported in English publications and to my knowledge research has never been published in English concerning the unique Chinese organizational strategies utilized in the success of this contrarian methodology that resulted in long term OEM profitability.

In spite of their success in components and peripherals, the Japanese computer makers have had only limited success in PCs, and have been virtually shut out of the software industry. The reasons for this mixed record are complex, yet the most important have to do with Japan's industry structure. Japan's large, vertically integrated firms were well suited to high-volume, capital-intensive components production. They also did quite well in the relatively stable mainframe industry, because they could marshal the necessary resources within their keiretsu groups and count on the members of those groups as captive customers. However, in industry segments such as PCs, ICs and hard disk drives, where product cycles are short and timing critical, the Japanese industry structure was a liability. Unable to make decisions quickly, Japan's computer makers had limited success in such businesses.

In Taiwan and the USA both government and private technology projects had opened themselves to the wide diversity of the world human resource network actively welcoming the top IT talent from around the world regardless of race or nationality. In the USA and Taiwan most high-tech projects had more than 50% of the leadership and engineers that were globally diverse (Saxenian 2002 pp.3-24). Even large government projects in Taiwan and the USA often invited the best of the best from around the world to lead or participate in the top high-tech research projects. However, in the cases above for Japan, foreigners were never invited to lead a project or were they ever utilized for even minor engineering leadership roles. This is what Professor Aoki Masahiko of Tokyo University calls an “anti-diversity strategy” (青木 1995 pp.82-134).

Several analysts argue that a key factor was the shortage of venture capital, which they blame largely on the Ministry of Finance (MOF) for limiting the number of initial public offerings (IPOs) by Japanese venture companies. Without the prospect of a big payoff from an IPO, venture capitalists have been unwilling to make risky investments. Also, Japanese companies cannot attract top workers with offers of stock options, as U.S. venture companies often do, since stock options have little value without the prospect of an IPO. The Finance Ministry squeezed IPOs to almost zero after the stock market crash in the early 1990s in order to prevent dilution of stock prices of existing companies and protect the banking system from a further meltdown of the stock market. The effect was to protect large companies, as well as investors, while starving small companies of capital.

5 New Contributions of this Doctoral Dissertation

1. 72 New Interviews in Japan, Taiwan and China: Interviews with corporate insiders, industry or university experts and government officials were conducted and used as direct

references throughout this study. This allowed the author the chance to add completely new material and insights in order to verify facts and get a direct interview survey of the IT industry in Taiwan and Japan.

2. **16 New Case Studies that Utilize First Hand Original Data**: 16 completely new case studies using original sources from Chinese, Japanese and English publications. Japanese Company studies are not included because they are readily available in many languages but references to many Japanese studies are referenced and quoted often. Because OEM case studies are very hard to find for Taiwan Companies, This study puts together a new set of 16 studies including Studies 1-13 plus Studies A, B, and Section 1.5.

3. **Wide Use of Chinese, Japanese and English Sources**: After reading through hundreds of books and articles on this topic over the last 5 years, I have found few in English that take full use of Chinese and Japanese sources so I focused on including a full range of sources as a new contribution.

4. **New Type of Analysis:** This research contributes to the analytical richness of institutional approaches. As discussed earlier, the existing paradigms in explaining development and organizational strategies, the statist approach in particular, have been criticized due to their ambiguous explanation about the causal linkage between structure and outcomes such as economic performance. By analyzing the effects of structure upon institutional settings, and again by explaining how changed institutional settings affect the actions and reactions of the key actors in the state and society, this study sheds light on the causal relations between structure, individual behavior, and political economic outcomes.

5. **New Theoretical Contributions**: This study makes a few important contributions to the study of development. First of all, the existing literature deals with the state in East Asia either as a dominant actor (a leader) in economic management or a supporter (a follower) of the market factors. The uniform application of either the statist or the market-oriented approaches, that is, the dichotomization of the role of the state in development, is no longer appropriate in explaining

development. The institutional settings in which the state and societal actors interact have been well established as developments proceed, and thereby they affect the behavior of core actors in the policy-making process rather differently. Thus those who intend to study development have to look at the complex interplay between the state and society under the changing institutional environment. The recent democratization that Taiwan and Japan have undergone is particularly important in this regard because it will change the ways that interests are represented in the two societies though the process may be gradual.

Secondly, another theoretical contribution is related to the external constraints that the states have to cope with in the future industrial upgrading. In the existing literature, the international political economy in which Taiwan and Japan have been located is viewed as the same or at least very similar for each country. For instance, the embedded liberalism was the typical external variable in explaining the Taiwanese and Japanese development up until the early 1970s. Likewise, after the middle of the 1970s, the growing neo-protectionist tendency among the advanced industrial countries has been viewed as a common external constraint that Taiwan and Japan have to deal with. This dissertation however, shows that though both countries occupy very similar positions in the international political economic structure and thereby meet very similar external constraints, the effects of common external constraints upon the development of a particular industry can vary according to the nature of the industry concerned. This is a particularly important finding because it suggests that the societal variation of a certain industry may provoke radically different external constraints that the state has to cope with. Thus there is no a priori reason to assume that East Asian states have to deal with the same external constraints even though the international political economic structure in which they have been located is the same or very similar.

Final Comments

Many researchers have tended to group together Taiwan, Japan and Korea as following very similar models of development because of the strong central roles played by each state's national government. However, this research concludes that in sharp contrast to Taiwan, the state in Japan and Korea has played a largely different role. In particular, the role of the state in the Japanese accelerated industrial catch up strategy for information technology (IT) hardware has changed significantly over time, and so did the state-society and state-business relations. The Japanese state through MITI was a major promoter of the IT hardware industry with a primary emphasis on exports in the 1960s. During most of the 1970s, the state drew and implemented numerous ambitious plans to promote the IT hardware manufacturing industry such as heading up technology consortium proposals and co-operative think tanks but most of them did not materialize as planned (Fallows 1994 pp.52-74).

As we saw in Table A.1 above, Taiwan made by far the biggest advances in the 3 most value added areas of desk PC, Notebook PC and integrated circuits (ICs, a type of high value added of semiconductor). Missing from the list is the fact that Taiwan increased its share for CD Rom drives from 37% to 51% of world market. Also, Japan lost market share in every area of hardware while Korea made only mild advances compared with Taiwan. The reason for this dramatic performance increase by Taiwan can be attributed mostly to 9 Taiwan companies setting up OEM Win-Win alliances with 4 major Japanese manufacturers. The 8 are Mitac, Compal, Quanta, FIT, TSMC, UMC, Winbond, Inventec and Asustek. The 4 Japanese companies are Fujitsu, Sharp, NEC and Sony which may surprise some people because they were all considered to be strong in manufacturing in 1994 but during 1994-1998 these four were all persuaded by the Taiwan 8 to turn over more than 50% of their IT manufacturing to Taiwan OEM companies. Only Taiwanese companies have been successful at procuring very large production orders from major Japanese IT firms. This fact has rarely been reported in English publications and to my knowledge research has never been published in English concerning the unique Chinese organizational strategies utilized in the success of this contrarian methodology that resulted in long term OEM profitability. This research will use a bounded rationality methodology from the New Institutional Economics perspective developed first at Stanford University during the 1980's by people such as Peter Evans and Aoki Masahiko which they call comparative institutional analysis or CIA (see section 1.3---1.4 above).

This study adopted an "institutional approach to state-society and state-business relations," originally developed by Peter Hall (1986 pp.7-15) in his comparative study on the French and British economic policies and Peter Evans (1985 pp.13-25) in his study of "comparative institutional analysis" (CIA) for industrial transformation as well as many other scholars at Stanford University in the 1980's. In addition, the theoretical foundation for this new analytic method is founded on Von Neumann and Morgenstern's (1980 pp.2-28) theory of "bounded rationality" laid out in their now famous book entitled Theory of Games and Economic Behavior for which the first edition came out in 1944.

Taiwan and Japan have taken largely different paths for the same policy goal mainly due to the institutional differences caused by different structures in business, state, and NPO / NGO sectors. These institutional differences in a combined way affect the interactions between the core players in the state and society and also affect the path dependency and options for their respective organizational strategies. By showing the different organizational strategies that were formulated and implemented by the states of Taiwan and Japan, and by uncovering the causes of such variation, this dissertation argues that the state and state-society relations in the development of organizing institutions for all sectors (institutional development in particular) vary through time, across societies, and across industrial sectors. Once economic backwardness has been overcome to a certain extent, institutions in the state and state-society relations that have been formulated throughout the developmental process may vary across societies and across industrial sectors and also time. Different institutions, in turn, affect the interactions among the people involved in the policy-making process as well as in interest group representation in a given society, which may result in different political and economic outcomes as shown in this dissertation.

NOTES

1. Though an accelerated catch up strategy has helped the fast growth of the IT hardware industry, it also makes both Taiwan and Japan very dependent upon Europe and the United

States. Most of the advanced IC technologies, machinery and materials, as well as know-how have been imported from Europe and the United States. About 3 per cent of the total revenues of Taiwanese chipmakers have gone to the firms in the United States and Europe as royalty payments, which reached USD$193 million in 1993 (ITRI 1995). Also, in places such as Korea as much as 5% of industry revenues goes to the USA and Japan in the form of royalty payments.

2. Up until late 1989, Taiwan did not enter the memory market because of the extremely large scale involved in competing in the memory business. Memory chips are standardized products that require huge investments just to survive in the market. Japanese and Western firms are already in the market and are engaging in head-on competition. Also, memory markets show recurring up and down cycles that affect the nation's industrial stability greatly. With these conditions, Taiwan's policymakers as well as firms had been hesitant to enter the memory business. However, after memory shortages (blamed on Japan) of 1988 and 1989 the Taiwanese government decided to enter the DRAM market in early 1990 by launching the sub micron project (see ITRI, 1993).
3. ICs include many kinds of devices. In general there are three types of integrated circuits (ICs): micro components (microprocessors, micro controllers, and so on), logic ICs (standard logic devices, application specific integrated circuits, and so on), and analog devices (hybrid ICs, linear ICs, and so on).
4. The price of 16M DRAM fell sharply to about $8 in 1996. Because Korean chipmakers are very dependent upon DRAMs, their advantageous position in the world market also went down in 1996. Samsung ranked the seventh with USD$6,196 million, Hyundai ranked the eighteenth (USD$2,230 million), and LG ranked the seventh (USD$2,255 million), respectively. The fact that about 88 per cent Korean IC production consists of DRAMs while only about 32 per cent of the world market for semi-conductors is for DRAMs shows us why Korea had a bad year in 1996. Japan and Taiwan are more immune to these kinds of

problems because they make up a smaller ratio of their markets.

5. Okimoto (1986) provides detailed lists of the characteristics of the IT industry as follows: a) staying abreast of swiftly changing technology; b) sustaining high rates of R&D investments; c) innovating in order to stay competitive, bartering for other technology, and being quick to enter new product markets; d) moving through steep learning curves; e) expanding the volume of production and sales, thereby lowering per unit costs; f) recouping up-front R&D investments through rapid commercialization of products; g)stressing process technology, product reliability, and after-service; h) exporting actively and taking a global view of markets; i) meeting climbing levels of capital intensity; j) overcoming conservative, risk-averse strategies and mobilizing to undertake risky and uncertain projects; and k) coping with relatively brief product life cycles (Okimoto 1986, p.37).

6. Peter Evans renamed this method as "comparative institutional analysis" in his research that compares the computer industries in various economies. Most of his argument on "embedded autonomy of the state and state-society relations is quite similar to the argument on "developmental corporatism".

7. Industrial catch-up and accelerated catch up strategy are similar to each other but I often use the latter to represent a much more systematic and coherent long term strategy such as that of Taiwan and Singapore.

8. Neo-Marxist and/or world-system arguments are found in the works of Koo (1984a, 1984b, 1987).

Some neo-classical arguments on East Asian development can be found in such research as Wu (1985), Fei et al. (1979, 1985), and Little (1981) Hong and Krueger (1975), Hasan (1976), Kuznets (1977), Kuo (1981), World Bank (1993), Balassa (1981). From the dependency approach there is Barret and Whyte (1982), Lim (1985), Song (1984), and Evans (1987) that show how Taiwan, Japan and South Korea achieved development. Developmental statist arguments can be seen in such research as Chu (1987), Schmitz (1984), Wade and White

(1984), H. Park (1986), 9 Wade (1990a, 1990b), Haggard (1990), and Woo (1991). Amsden (1979, 1989).

9. Although there are terms to describe this version of corporatism such as the state corporatism (Katzenstein 1985), concentration without labor (Lehmbruch 1985), and corporatism without labor (Pempel and Tsunekawa 1979), some call this Asian version of corporatism the "developmental corporatism" because in addition to the non-participation of labor from policy-making network, both the state and business usually share the same or similar developmental goals.

10. For the details of European corporatism, see Schmitter and Lehmbruch (1979), Stephens (1979), and Katzenstein (1985)

11. Evans (1986) has a similar view on the relationship between the state and business in his case study on the Brazilian computer industry. He writes: "dependence is a dynamic condition whose character is continually being transformed and that the state, while it may play a crucial role in the initiation of new industries, is limited in its ability to act autonomously once an industry is established" (Evans 1986, 791).

12. Though he applies these analytical methods to different countries, Katzenstein does not view the role of the state and state-society relations as constant over time and across different societies. To put it another way, Katzenstein categorizes different kinds of capitalist political systems according to the patterns of policy-making and interest group representation rather than based upon different theories of the state. Katzenstein shows "three dominant political forms of contemporary capitalism: liberalism in the United States and Britain; statism in Japan and France; and corporatism in the small European states and to a lesser extent, in West Germany" (Katzenstein 1985, pp.19-21).

13. As pointed out earlier, Evans renamed this approach as comparative institutional analysis. But, the basic ideas are exactly the same as the previous argument. To get the details see chapter 2 of Evans (1995).

14. Skocpol's extensive research on various viewpoints for bringing the state back into comparative social studies serves as a primary source for the reviewing the statist paradigm (Skocpol 1985pp.32-68).

15. State autonomy was a major theoretical concern with neo-Marxist scholars. Miliband (1969) and Domhoff (1967, 1970, 1978, 1979) counter state autonomy by arguing that the state is an instrument of the capitalist dominion. Marxists such as Poulantzas (1969, 1978) and Offe (1974) reach similar conclusion by showing the class nature of the state and the limitations put onto the governments by the basic nature of the capitalist society.

16. According to the systematic renewals undertaken in December 1994, the EPB was renamed as the Finance and Economy Board (FEB) by merging with the previous section called the Ministry of Finance.

17. Moon and Prasad (1994, pp.29-37) give us a good summary regarding the inadequacies of the developmental statist explanation on Asian Development.

18. Wade gives us a very thorough outlining of neo-classical arguments on economic development with a strong focus on Taiwan's unique development story. For more in depth coverage see chapter 3 of Wade (1990).

19. In analyzing the Japanese macro and industrial economic management policies, Chose (1987) observes the patterned anti-statist theory works very effectively in Japan's political economy.

20. Because of this, the post-statist argument may be considered a version of the statist approach. But I classified this as an anti-statist approach because it basically argues for the anti-statist mode for policy-making process.

21. Comparing Japan with Switzerland, Katzenstein argues that the image of Japan as a Switzerland in the Far East is misleading because they have many differences even though the Japanese government and businesses have close connections as some research concerning state corporatism often make a point of mentioning (Katzenstein 1988).

22. Andrew Shonfield has a similar perspective about Japanese political economy and argues, "effective corporatist organization has been at the root of successful economic and social performance .... It is no accident that it [Japan] has the most advanced large corporatist system" (Shonfield 1984, 134-5).

23. The adjective "old" is used here as opposed to the "new" comparative political economy or CIA.

24. Held and Krieger (1984, 14-8) show us a highly detailed discussion of the contemporary Marxist theories of the state.

25. This is also called the historical institutionalism (Steinmo et al. 1992) in comparison with the positive institutionalism (Levi 1988; Bates 1989; North 1990). Institutionalism is widely used in organizational theory also (see Powell and DiMaggio 1991).

26. As was pointed out earlier, I prefer to use the term "accelerated catch-up strategy" in the case of Taiwan because Taiwan's development of the IC industry has been much more systematic and coherent over the long term planning when compared to that of Japan, Korea or even Singapore.

27. When possessing a 0.6-micron level of CMOS technology a country can produce IC products that are at the level of 4M DRAM.

28. Though the details of neo-classical explanations can contrast greatly, they strongly focus on the very important role of the self-regulating markets (i.e. perfect equilibrium and perfect information) as the main reason for East Asian development. The neo-classical literature on East Asian development commonly argues that such factors as free trade policies for exports, free labor markets, high interest rates, high savings rates, conservative government budgeting, stable real effective exchange rates, well-trained labor supply, competitive industrial structure, and the stable government are the major causes of development. See chapter 3 of Wade (1990).

29. Although many arguments vary, the statist literature usually emphasizes the strength and

autonomy of the state and the capability of super intelligent techno-crats as the very important main factors for East Asian economic growth.

30. Most high-ranking public officials in the Taiwanese government are the core members of the KMT. Dr. Sun Yun-hsuan, who was the most important leader in the promotion of the IC industry, had been the Minister of Communications, the Minister of Economic Affairs, and the Premier between the time of 1967 and 1984. Also during this time he was a member of the Central Standing Committee of the KMT since 1969 on forward.
31. During my field research in Taiwan during the summers of 2000 and 2001, many interviewees identified the same four periods. In her paper on Taiwan's IC development, Meany (1990) also use these four periods. In order to avoid repetition with this research I have made a long story shorter. To get the story in more detail, please read her research of 1990.
32. American firms had additional incentives to invest overseas due to the enactment of Sections 806.30 and 807.00 of the Tariff Schedule of the United States (TSUS). The Tariff Schedule basically allowed duty-free entry of the American-made components. The share of IC items out of total duty-free imports under the aforementioned Tariff Schedule jumped from 14 per cent in 1969 to 42 percent in 1982 (Grunwald and Flamm 1985, pp.17-19).
33. Dr. Sun, an electrical engineer and a powerful politician, was the most important individual in understanding Taiwan's IC accelerated catch-up strategy. He served in many positions in the Taiwan Power Company including vice-president and president. During 1967-69, Dr. Sun served as the Minister of Communications. He became the Minister of Economic Affairs in 1969. In 1978, Dr. Sun became the Premier of the Executive Yuan, and served until his retirement in 1984 after having a stroke. He also served as a member of the Central Standing Committee of the KMT from 1969 on. His vision about the future plans for the Taiwanese economy was critically important for Taiwan's development of the IC industry.
34. Dr. Pan was very close to Dr. Sun Yun-hsuan. He was a member of the Modern Engineering

and Technology Symposium which was held every two years in order to get together Taiwanese and ethnic Chinese engineers from overseas. Another important leader in the IC and high-tech development in Taiwan is Dr. Li Guo-ding, a key economic policy-maker educated in England at Cambridge University. He was the Minister of Finance at the time when the first IC project was launched. The personal enthusiasm of these top administrative leaders was the major fuel for Taiwan's having highly centralized and autonomous policy-making and implementing institutions in regard to S&T issues.

35. Membership of TAC changes every two years. In early days, TAC members met mostly at Dr. Pan's house in Princeton, NJ during the weekends in order not to spend their company's time. Only meals and travel fees were provided by the Taiwanese government (楊文利 1989, 68). Currently TAC has a steady membership of approximately 15 highly regarded experts, all working at such leading American technical giants as IBM, AT&T, Bell Labs, General Electric, and Hewlett Packard. These people meet irregularly in small groups according to their specialties, and have served as free-of-charge consultants through close cooperation with ERSO or ITRI under the MoEA (Chang 1989, 14). It is apparent that TAC members are mostly driven by nationalistic sentiments, which may not be readily understandable to most Americans.

36. It is not clear whether Dr. Pan, an employee at RCA, exercised a certain influence on the selection of RCA as the source of technology imports. It was said that RCA was selected as a technology source mainly because it was one of the leading electronics company which owned a world class IC technology at that time and the conditions offered by RCA were especially good for manpower training (楊文利 1989).

37. Among them three people are of particular interest: Mr.-Ding-yuan Yang who was in ERSO and currently the President of Winbond Electronics (a private IC firm), Mr. Chintay Shih who became the Executive vice-president of ERSO and later the Executive vice-president of ITRI, and Mr. C. Chang who became the director of ERSO.

38. At first Dr. Sun intended to push IC projects within the telecommunications laboratory of the Telecommunications Directorate under the MoC. But Dr. Sun diverged from his original plan because he wanted to establish a high degree of autonomy within the state apparatus for IC projects (Meany 1990, p.6).

39. They include: electronics, opto-electronics, computer and communications, chemicals, energy and resources, mechanical industry, materials, measurement standards, pollution control, industrial safety and health, and aviation and space (ITRI 1993).

40. ITRI and ERSO are officially a part of state bureaucracy because they are located under the MoEA and their budgets are reviewed by the state. By making profits through the sales of its products and research contracts with the private sector, and using those profits for further researches, the identity of ITRI/ERSO in the early stage are a part of state bureaucracy but became an autonomous NPO in later years. This brought about certain conflicts between the economic bureaucrats in the MoEA and the people in ERSO's Marketing Division.

41. The reasons for the Canadian failure in developing the indigenous IC industry might be too complex to be explained here. Nor are they one of the major research questions. Though Canada is much more industrialized than Taiwan, especially in the early 1970s, it could not develop its own indigenous IC industry successfully partly because of the different socioeconomic structures and historical experiences that make the state-society relations different from that of Taiwan, and its geographical proximity with the United States that has several electronics giants. In addition, different states in the two countries might affect the different outcomes in the IC experiences.

42. Minister Sun told him that he would block every objection from everywhere. Due to this aggressive support by Minister Sun, TAC members and other people involved in this first and crucial phase of industrial catch-up for ICs simply did not care much about any objection. Dr. Pan added that the impressive IC industry in Taiwan would not exist without Minister Sun (楊文利 1989).

43. It was said that Minister Sun wanted to have a high level organization that could replace his personal influence upon the IC project. It was also argued that STAG was created in order to have independent diversity of advisors of many nationalities because the people already involved in the IC project were believed to have "their own views" (Meany 1990 p.10). It seems that the truth lies somewhere between the two.

44. Dr. Kuo-ting Li is another important person who played a critical role in the development of the IC industry, and the electronics industry in general. He was the Minister of Finance (MoF) at the time when the first IC project was launched, and later became the Minister of MoC. He strongly pushed the IC project ahead after the retirement of Dr. Sun in 1984.

45. Pat Haggerty, a former chairman of the STAG, knew Dr. Sun for many years, and also with Dr. Li. Pat Haggerty brought other members such as Dr. Frederick Seitz into the STAG (Meany 1990 p.10).

46. In the early 1970s, there were sharp debates on the basic direction of the HSIP among Taiwan's economic circles. On the one hand, the debate was about basic versus applied researches, and on the other hand it was about technology versus capital-intensive industries. In the end, the Taiwanese policy-makers decided to focus on applied research and the technology-intensive industry (Simon and Schive 1986, 202-5).

47. In addition to these incentives, the government also provided lots of benefits to the incoming engineers and scientists to the HSIP including good housing, schools for children, various sports facilities, and so on. Considering expensive costs of living, especially the housing in Taiwan, the facilities in HSIP were very impressive.

48. Phillips had the option to increase its share ultimately up to 51 per cent of the total investment. Currently Phillips owns about a 35 per cent share that may be decreased by enlisting the TSMC's stocks in New York stock exchange.

49. Among TI's share, 10 per cent was provided in the form of technology and 20 per cent was provided by equipment. TI also has the option to increase its share up to 51 per cent within

five years (data from ERSO).

50. Eight divisions include: Natural Science and Mathematics, Engineering and Applied Science, Life Science, Humanities and Social Science, Science Education, Central Processing, International Programs, and Planning and Evaluation. Three special units are Science and Technology Information Center, Science-Based Industrial Park Administration, and Precision Instrument Development Center (NSC 1988, 15-7).

51. Interview with the Assistant Director of the Planning and Evaluation Division of the NSC, July 2000 Hsin Chu, Taiwan.

52. As explained earlier, STAG was originally the idea of Dr. Yun-hsuan Sun who wanted to maintain his own control over the IC related projects. Although officially it was discussed in the Conference and adopted by the NSC.

53. They were biotechnology, electro-optics, hepatitis B control, and food technology.

54. Interview with the Deputy Director of the IDB, July 2001.

55. Data were provided by Dr. Si-chen Lee, of the Department of Electrical Engineering at the National Taiwan University.

56. The uniqueness of state-business relations in Taiwan has been well documented in the literature on the Taiwanese political economy (Gold 1981, 1986; Amsden 1979, 1985; Wade 1990a; White 1988). Because it is also closely related to the industrial structure in Taiwan, a detailed discussion on the Taiwanese state-business relations is conducted in this research.

57. External variables such as Taiwan's relative position in the international political economy, the niche market opportunity, and the bilateral trade relations with the United States are not discussed in this section because they did not impose serious constraints on the state in making and implementing semiconductor related policies. This is in sharp contrast to the Korean effort in the semiconductor industry.

58. "Computers: Japan Comes on Strong" (1989).

59. "Japan Computer Lead Seen," *New York Times* (May 2, 1990).

60. A former IBM executive told the author that in the 1980s, IBM was "almost obsessed" with the Japanese while underestimating the challenge from U.S. competitors in the PC industry. When he argued in a meeting that IBM's mainframe market forecasts looked too optimistic, he was told that IBM "was not going to get caught like the television industry." During the 1980s, IBM invested heavily in production capacity to be prepared for growth that never came as the market shifter from mainframes to PCs.

61. See Jon Choy, *Japan's Personal Computer Market: Awash in American Tsunami,* Japan Economic Institute (JEI) Report No. 6A (Washington, D.C.: JEI, 1994). For a history of NEC's PC business, see Martin Fransman, *Japan's Computer and Communications Industry* (New York: Oxford University Press, 1995).

62. The problems presented in dealing with the Japanese language are explained well in Choy (1994).

63. "Japanese Software: More Than Just Fun and Games?" *Electronics Business Asia 4* (April 1993) pp.30-41.

64. Mike Galbraith, "NEC Taking No Part in Japan Price War," *Asia Computer Weekly,* 14 (1992) p.1.

65. "Searching for a New Bullet," [Interview with Tadahiro Sekimoto] *Electronics Business Asia,* 5 (August 1994) pp.47-51.

66. Quoted in "Computer Makers Look Abroad For Parts: Competition from U.S. Makes All-Japan PCs Too Costly for Market," *The Nikkei Weekly* (September 20, 1993) p.8.

67. "NEC Fends Off Foes with Cheap PC," *Japan Times Weekly International Edition* (January 30-February 5, 1995).

68. Robert Poe, "Can Fujitsu Reinvent Itself?" *Electronic Business Asia, 4* (January 1993) pp.34-41.

69. IDC, Webpage.

70. Japan Electronics Industries Development Association (IEIDA), "Statistical Survey on

Software Export/Import, 1995 Results" (Tokyo: JEIDA, 1996 pp.24-45).

71. Organization for Economic Cooperation and Development (OECD), *Information Technology Outlook: 1994* (Paris: OECD, 1994 pp.56-77).

72. Mochio Umera, "Failing to Change: The Plight of the Japanese Computer Industry," *Prism* (second quarter, 1994).

73. For example, a manufacturer could gain an advantage over its competitors by employing proprietary CAD/CAM software that would be expensive for its competitors to copy.

74. Michael A. Cusumano, *Japan's Software Factories* (New York: Oxford University Press, 1991).

75. Tetsushi Nakahara, "The Industrial Organization and Information Structure of the Software Industry: A U.S.-Japan Comparison" (Stanford, Calif.: Center for Economic Policy Research, 1993), p.346.

76. Yasunori Baba, Shinji Takai, and Yuji Mizuta, "The User-Driven Evolution of the Japanese Software Industry: The Case of Customized Software for Mainframes," in David Mowery (ed.), *The International Computer Software Industry: Structure and Evolution* (New York: Oxford University Press, 1996) pp.104-130.

77. IBM, the world's largest software producer, makes most of its software revenue from mainframe operating systems and applications. It has failed to develop any big commercial successes of its own in the PC software market. But companies like Microsoft, Novell, Adobe, and Lotus (now owned by IBM) have more than filled the void in the United States.

78. Baba Takai, and Mizuta (1996) pp.89-124.

79. William F. Finan and Jeffrey Frey, *Understanding the Growth Crisis in Japan's Electronics Industry* [English manuscript of book published in Japanese], (Tokyo: Nikkei, 1995).

80. Network economies are best seen in the case of the telephone. One telephone is a useless device. Two telephones connected by a wire create a communications channel with limited usefulness. Millions of telephones connected by a network of wires and switches represent a

system with tremendous economic value. The same is true of PCs. While a single PC can be a valuable tool, its usefulness is limited. However, a networked PC provides access to a wire array of services, from electronic mail to electronic document interchange to a wide range of Internet services.

81. Still, a distressingly high number of bugs always seems to make it through in each new product generation, thanks to the tremendous time-to-market pressures in the software industry.

82. Data on human resources from: National Science Foundation (NSF), *Human Resources for Science & Technology: The Asian Region* (Washington, D.C.: NSF, 1993) and NSF, *Science and Engineering Indicators 1996* (Washington, D.C.: NSF, 1996).

83. Nakahara (1993).

84. NSF (1993 and 1996).

85. Chalmers Johnson, "MITI, MPT, and the Telecom Wars," in Chalmers Johnson, Laura D'Andrea Tyson, and John Zysman (eds.), *Politics and Productivity: The Real Story of Why Japan Works* (Cambridge, Mass.: Ballinger, 1989) pp.177-240.

86. Joel West, "Utopianism and National Competitiveness in Technology Rhetoric: The Case of Japan's Information Infrastructure," *The Information Society, 12* (1996) pp.251-272.

87. Japan Information Processing Development Center (JIPDEC), *Informatization White Paper* (Tokyo: JIPDEC, 1993).

88. Anchordoguy (1989).

89. Baba et al. (1996).

90. Ibid.

91. Callon (1996).

92. Ibid.

93. Anchordoguy (1989).

94. The plans for the Fifth Generation project were developed from 1979 to 1982 by a committee

established by JIPDEC consisting of government, university, and industrial researchers, Japan Information Processing Development Center (JIPDEC), *Japan Computer Quarterly* (Tokyo: JIPDEC, 1993) p.93.

95. Authors' interview with MITI official (2000 October).

96. Tom Cottrell, "Fragmented Standards and the Development of Japan's Microcomputer Software Industry" *Research Policy,* 23 (1994) pp.143-174.

97. The issue of software decompilation and its treatment under Japanese law is described in detail by Joel West, "Software Rights and Japan's Shift to an Information Society: Evidence from the 1993-1994 Copyright Revision Process," *Asian Survey,* 35 (1995).

98. Ibid.

99. JIPDEC (1993).

100. Interview with MITI official (2000 October).

101. Anchordoguy (1989); Martin Fransman, *The Market and Beyond* (Cambridge: Cambridge University Press, *1990);* Fumio Kodama, *Emerging Patterns of Innovation: Sources of Japan's Technological Edge* (Boston: Harvard Business School Press, 1995).

102. This point is argued by Johnson (1989) and by Steven Vogel, *Freer Markets, More Rules: The Paradoxical Politics of Regulatory Reform in the Advanced Industrial Countries,* (Ithaca, N.Y.: Cornell University Press, *1996).*

103. For retailer analysis of Japan's NII initiatives, see Joel West, Jason Derrick, and Kenneth L. Creamer, "Back to the Future: Japan's Nil Plans," in Brian Kahin and Ernest J. Wilson III (eds.), *National Information Infrastructure Initiatives: Visions and Policy Design* (Cambridge: MIT Press, 1996) pp.61-111.

104. Author interview (August 2000).

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Appendix A

Taiwan's IC Timeline

Stage 1: 1965-74

1966 Microchip starts transistor (discrete device) packaging

1967 Microchip extends packaging to ICs

1969 Philips Elements starts IC packaging

General Instruments starts diode (discrete) manufacturing First local electronics co. starts transistor and IC packaging

1970 Texas Instruments starts IC packaging in Taiwan Lingsen starts IC packaging

1971 RCA and local vendor cooperate in IC packaging Orient

starts IC packaging

1972 Goldstar enters joint venture with National Semiconductor to produce transistors (fails in 1973)

1973 Fine Products starts transistor manufacturing

Lingsen and Mitsubishi cooperate in transistor packaging

TRI established (July 1973) bringing together existing labs and with charter to bring technology to Taiwan

Stage 2. 1976-79

1974 Electronics Industry Research Center established (becomes ERSO in 1979) as part of

ITRI

Integrated Technology starts transistor manufacturing

1975 Taiwan Liten starts laser diode packaging

1976 ERSO signs technology transfer contract with RCA 37 ITRI engineers sent to RCA for training

1977 IC demonstration plant established at ITRI; first CMOS chips manufactured

1978 Formulation of Science & Technology Development Plan (passed by Executive Yuan in May 1979)

1979 First domestic-designed commercial IC produced ITRI's first bipolar IC produced UMC preparatory office set up

Stage 3. 1979-1988

1980 UMC launched (May)

1981 Promulgation of Long-Term Science & Technology Promotion Plan (eight sectors targeted, including semiconductors) ITRI develops Si-gate NMOS technology

1982 UMC establishes Fab on Hsinchu and starts manufacturing

Syntek IC design house established on Hsinchu

Strategic Industries initiative (145 strategic products, incl ICs and other semiconductors, targeted for preferential loans and tax breaks

1981-85 ITRI develops range of ICs for commercial application

1983 ITRI and NSC cooperate in MPC project; establish IC CAD cresign facilities on university campuses

1985 Dr. Morris Chang appointed Chairman of ITRI

ERSO starts electron-beam mask manufacturing service

ERSO establishes Common Design Centre to promote IC design services VLSI project: ERSO and Vitelic develop 64K then 256K DRAM using CMOS 1.5 micron technology

1986 Cadence CAD and other design houses established 1987 TSMC

spun off from ERSO: first VLSI fabrication *Stage 4: 1988-'93*

1988 TSMC foundry begins mass production HMC opens new fab in HSIP Taiwan now has six IC manufacturers

1989 IC Protection Law passed

Sub-micron project: ERSO plus local producers TMC spun

off from ERSO

Weltrend sets up in HSIP; specialising in digital/analogue ICs MXIC sets

up in HSIP

TI and Acer form joint venture to produce DRAMs Taiwan now

has 10 IC manufacturers

1990 Innova, a second mask company, established Holtek

starts IC manufacturing

Etron sets up in HSIP: memory IC design as part of sub-micron ERSO project

Semiconductor technology listed as one of 8 key technologies in ROC's future 10-year development plan

ERSO restructured, leading to separate establishment of Computer & Communication Research Laboratories (CCL)

1991 Acer-TI joint venture begins construction of DRAM fabrication facility

1993 Mosel-Vitelic imports technology from Oki, for DRAM manufacture

1994 Vanguard International Semiconductor Corp. launched

Korea's IC Timeline

Stage 1: 1965-1974

1965 Korean govt selects electronics industry as one of 13 priority sectors for exports

Komy (US) establishes first Korean transistor assembly operation

1966 Fairchild, Signetics establish semiconductor assembly operations in Korea Korean Institute for Science and Technology (KIST) established, with special brief to develop electronics expertise

1967 Motorola establishes semiconductor plant

Korean Electronics Industry Cooperative Association formed

1968 Electronics Industry Promotion Law enacted (implemented 1969)

1969 Toshiba establishes transistor plant

8-Year Plan for Promotion of the Electronics Industry (MCI)

Goldstar Electronics formed to manufacture transistors (joint venture with National Semiconductor)

Samsung enters electronics industry, through joint ventures with Sanyo and NEC

Seven firms engaged in semiconductor manufacturing in Korea

1970 Kumi Electronics Industrial Complex established

Masan Free Export Zone established

ANAM establishes wholly Korean-owned assembly and test plant

1971 KIST develops/transfers semiconductor fabrication technology

1972 Rohm, Sanyo (Jap) establish semiconductor plants

1973 Sanken establishes semiconductor plant (Masan)

1974 Korea Semiconductor (Hankuk Semiconductor)(KESEC) established as joint venture between KEMCO and US partner, Integrated Circuits International Inc

Stage 2: 1974-1983

1975 KIST identifies semiconductors as top research priority

Samsung buys into KESEC, and forms Samsung Electronics Co. (SEC) KEC (Korean Electronics Corp) formed through joint venture with Toshiba, for manufacture of discrete semiconductors (transistors)

1976 KIET established on Kumi complex, as primary R&D centre for semiconductor technology; enters technology transfer agreement with US firm, VLSI Technology, to establish pilot semiconductor fabrication facility Electronic Industries Association of Korea (EIAK) formed by amalgamation of industry cooperative and export association Daewoo enters electronics business, with formation of Daewoo Electronics, and $20 million plant built in Kumi

Taihan Electric Wire chaebol enters semiconductor industry (technology transfer from Fujitsu)

1977 Korea Telecommunications Corp formed (technology transfer from ITT) Electronics Industry Sectoral Plan (Arthur D. Little) Korea Raw Silk establishes Hansaeng Semiconductor

1978 KIET establishes VLSI pilot plant, through technology transfer from VLSI Technology(US)

KIET establishes `listening post' in Silicon Valley, California

Samsung masters all steps involved in simple LSI consumer chips: design, wafer fabrication, assembly and testing, and takes full control of KESEC Korea Explosives group enters semiconductor industry (technology transfer from National Semiconductor)

1979 Hansaeng Semiconductor wound up

Goldstar Semiconductor established with acquisition of Taihan Electric Wire Group's semiconductor firm

1980 Samsung takes 49% stake in Korea Telecommunications Corp, and forms Samsung Semiconductor and Telecommunications Co. (SSTC) KIET develops 4-bit microprocessor IC

Goldstar Semiconductor produces first ICs from new Kumi plant (technology transfer from AT&T)

1981 Promulgation of Long Term Plan for the Semiconductor Industry KIST develops 4-inch wafer fabrication CMOS technology

1982 Samsung, Goldstar announce major investments in VLSI fabrication; set up `listening posts' in Silicon Valley, CA

Hyundai enters electronics and semiconductor industry; likewise sets up US subsidiary, Modern Electrosystems, in Sunnyvale, CA Samsung enters technology licensing agreement with ITT Goldstar acquires semiconductor operations of Taihan Semiconductor

KIET and three firms (Samsung, Goldstar, Taihan) form consortium to develop ICs for VCRs

KIET starts pilot production of 32K DRAM under technology licensing agreement with VTI (US)

Stage 3: 1983-1989

1983 Samsung produces 64K DRAM, under license from Micron (US) Daewoo enters semiconductor industry

1984 Goldstar enters joint venture with AT&T; takes over ETRI R&D lab Anam creates own R&D lab

1985 Samsung ships first VLSI product (64K DRAM)

1986 US-Japanese Semiconductor Agreement

TI sues Samsung, along with 8 Japanese firms, for breach of patent Intel sues HEI for breach of patent

KIET and KETRI merged to form ETRI

ETRI coordinates joint development of 4M DRAM

1987 ETRI consortium produces 4M DRAM prototype

1988 Samsung, HEI mass produce IM DRAM

Samsung merges semiconductor operations with electronics, to form Samsung Electronics Corp (SEC).

1989 Goldstar Electron formed, taking over joint venture with AT&T, and enters technology transfer arrangement with Hitachi

5-Year plan to establish local semiconductor materials and equipment industry in Korea

1990 GSE ships 1M DRAM licensed from Hitachi Samsung develops 16M DRAM

1991 Korean Semiconductor Industry Association formed Samsung, HEI and GSE mass produce 4M DRAM

1992 Chonan Industrial Complex designated for development of Korea's equipment supply industry

1993 HEI enters joint development agreement with Fujitsu

Samsung enters joint development agreements with NEC, Toshiba

1994 MoTIE announces 3-year program to promote local production of equipment and materials supply

Appendix B Performance Indicators of Taiwan's Top 21

2306 Acer

2308 Delta Electronics

2311 Advanced Semiconductor Engineering (ASE)

2313 Compeq Manufacturing

2317 Foxconn Electronics (Hon Hai)

2323 CMC Magnetics

2324 Compal Electronics

2331 Elitegroup Computer Systems (ECS)

2332 D-Link

2333 Picvue Electronics

Note: Following use dotted lines

2345 Accton Technology

2346 Lite-On Technology

2352 Benq (formerly Acer Communications & Multimedia, ACM)

2357 Asustek Computer

2376 Gigabyte Technology

2377 Micro-Star International (MSI)

2386 Ambit Microsystems

2402 Ichia Technologies

2409 AU Optronics (AUO)

2412 Chunghwa Telecom (CHT)

5387 Pro Mos Technologies

Appendix C List of Top 500 Taiwan Companies in 2002

AAEONTECHNOLOGY	研揚科技	5402	926
ABILITY ENTERPRISE	佳能企業	2374	2,576
ABITCOMPUTER	陞技電脳	2407	7,775
ABO-COMSYSTEMS	友旺科技	2444	3,091
ACBEL POLYTECH	康舒科技	private	8,343
ACCTON TECHNOLOGY	智邦科技	2345	13,119
ACER COMM. & MULTIMEDIA	明碁電通	2352	48,627
ACER DISPLAY	達碁科技	2409	14,840
ACER INC.	宏碁電脳	2306	102,756
ACER LABORATORIES	揚智科技	5393	3,056
ACER NETXUS	連碁科技	private	1,124
ACER SERTEK	宏碁科技	2353	20,464
ACER TESTING	宏測科技	private	1,584
ACER TWP	第三波資訊	5401	2,144
A CORP ELECTRONICS	価鈺科技	5497	2,442
ACTIMA TECHNOLOGY	威碼科技	8013	2,510
ACTI0N ELECTRONICS	憶声電子	5354	2,525
ADDA	協禧電機	private	1,484
ADI	誠洲電子	2304	10,497
ADVANCED CONNECTEK	連展科技	5491	1,186
ADVANCED SCIENTIFIC	偉大科技	private	2,603
ADVANCED SEMICONDUCTOR ENG.	日月光半導体	23n	25,524

ADVANTECH	研華科技	2395	5,426
AFREEY	聯積国際科技	private	3,609
AIPTEK INTERNAT10NAL	天瀚科技	private	1,283
ALCATEL TAIWAN	台湾阿爾卡特	foreign	5,140
ALL WELL TECHNOLOGY	欧威科技	private	!,628
ALPHA MICROELECTRONICS	佑華微電子	private	1,044
ALPHA-TOP	致勝科技	private	16,477
ALTEK CORP.	華晶科技	private	2,347
AMBIT MICROSYSTEMS	国碁電子	2386	11,844
AMTRAN TECHNOLOGY	瑞軒科技	5405	9,672
ANALOG TECHNOLOGY	立生半導体	5436	1,395
ANIMATI0N　TECHNOLOGIES	力砿科技	private	1,027
AOCN ADVANCED CONNECTEK	連展科技	5491	1,186
A OPEN	建碁科技	5447	15,153
APACER TECHNOLOGY	宇瞻科技	private	9,147
APPLIED COMPONENT TECHNOLOGY	聯謄科技	5467	3,885
ARES INTERNATI0NAL	資通電脳	5379	700
ARIMA COMPUTER	華宇電脳	2381	50,374
ARORA	震旦行	2373	20,466
ASE (CHUNGLI)	日月欣半導体	foreign	7,566
ASE MATERIAL	日月宏科技	private	!,794
ASE TESTING	台湾福雷電子	9101	5,134
ASIA　OPTICAL	亜洲光畢	5462	1,338
ASIA WTA L COMPONENTS	奇鉱科技	private	2,216
ASKEY　COMPUTRR	亜旭電脳	2366	9,533
ASUSTEK　COMPUTER	華碩電脳	2357	70,731

ATEN INTERNAT10NAL	宏正自動科技	private	1,612
AUDIX	敦吉科技	5399	2,152
AURORA　SYSTEMS	互盛	2433	2,104
AVERMEDIA　TECHNOLOGIES	圓剛科技	2417	902
AVISI0N	虹光精密工業	2380	9,432
AVTECH　ELECTRO SYSTEMS	陞泰科技	private	!,797
BAOTEK　INDUSTRIAL MATERIALS	建栄工業材料	5340	1,381
BCOM　ELECTRONICS	公信電子	private	1,149
BEHAVIOR　TECH　COMPUTER	英群企業	2341	10,809
BEST EC POWER ELECTRONICS	聯徳電子	private	2,545
BILLION　ELECTRIC	盛達電業	5421	894
BI0STAR MICROTECH INTERNATIONAL	映泰	2399	4,376
BOARDTEK　ELECTRONICS	先豊通訊	5349	2,476
BOURNS ELECTRONICS TAIWAN	台湾柏恩氏電子	foreign	1,133
BRIDGE INFORMAT10N	暉橋資訊	private	1,610
BRIGHT LED ELECTRONICS	値鴻工業	5495	840
BRILLIANCE　SEMICONDUCTOR	連邦科技	private	2,300
BUFFALO　TECHNOLOGY	巴比豫	foreign	3,821
BUTTERFLY　ELECTRONIC	騰元電子	private	1,443
C.P.　TECHNOLOGY	憾訊科技	private	2,288
C.SUN　MFG.	志聖工業	5397	1,064
CADAC ELECTRONIC	祥裕電子	5301	1,220
CAESAR　TECHNOLOGY	鑫成科技	private	1,330
CALLANT PRECISI0N MACHINING	均豪精密工業	5443	1,137
CAMEO　COMMUNICATI0NS	友勤科技	private	2,727
CAREER TECH　(MFG.)	嘉聯益科技	private	1,419

CATCHER　TECHNOLOGY	可成科技	5408	1,186
C-COM	正華通訊	private	1,191
CGS　INTERNATIONAL	天剛資訊	5310	2,104
CHAINTECH　COMPUTER	承啓科技	2425	5,379
CHANLIN　ELECTRONICS	群祥電子	private	1,506
CHANNEL　WELL　TECHNOLOGY	僑威科技	private	1,293
CHANT　WORLD　INTERNAT10NAL	清三電子	2335	1,857
CHANTEK　ELECTRONIC	華特電子工業	5336	1,563
CHEIL　TECHNOLOGY	信優	5452	3,728
CHENBROMICOM	勤誠興業	private	1,360
CHENGFWA　INDUSTRIAL	振発実業	5426	1,406
CHEN　　GUEI　PRECISION	正威精密	2392	4,240
CHENMING MOLD INDUSTRIAL	晟銘工業	private	4,628
CHERISH　TELECOM	千緯通訊	private	2,234
CHICONY　ELECTRONIC	群光電子	2385	4,646
CHIEMEI 0PTOELECTRONICS	奇美電子	private	9,456
CHINP00N　INDUSTRIAL	敬鵬工業	2355	6,214
CHINA TERMINALS & ELECTRIC	中国端子電業	private	1,378
CHENGKUANG　CHEMICAL	慶光化工	private	2,231
CHINO-EXCEL　TECHNOLOGY	華瑞	private	2,631
CHIPMOS　TECHNOLOGIES	南茂科技	private	8,224
CHROMA　ATE	致茂電子	2360	2,538
CHUNYUN　ELECTRONICS	青雲電器	5386	825
CHUNGHWA　PICTURE TUBES	中華映管	5430	42,170
CHUNG HWA TELCOM	巾華電信	2412	186,900
CHUNTEX　ELECTRONIC	中強電子	8715	6,250

CIRCUITECH PRECISION	峻新電脳	private	1,547
CIS TECHNOLOGY	亜慧科技	2326	4,799
CLEVO	藍天電脳	2362	11,574
CMC MAGNETICS	中環	2323	!4,263
CNET TECHNOLOGY	訊康科技	5306	1,117
COMPAL ELECTRONICS	仁賓電脳	2324	74,495
COMPEC MANUFACTURING	華通電脳	2313	20,762
COMPETITOR PRINTED CIRCUIT	競国実業	private	1,189
COMPUCASE ENTERPRISE	偉訓科技	6102	1,288
COMTREND	康全電訊	private	1,263
COROWAN TAIWAN MANUFAC.	歌楽旺企業	foreign	2,143
COSMO ELECTRONICS	冠西電子	5420	618
CRADLE TECHNOLOGY	衛道科技	5458	3,146
CRS ELECTRONIC	豪佳電子	private	1,114
CTS COMPUTER TECHNO.	群翼科技	private	3,540
CX TECHNOLOGY	錯新科技	2415	893
CYBERLINK	訊連科技	5203	491
CYNTEC	乾坤科技	2452	1,217
D&B ELECTRONICS	大覇電子	5304	8,738
DARFON ELECTRONICS	達方電子	private	3,495
DATA SYSTEM TECHNOLOGY	鼎新電脳	2447	1,593
DATA INTERNAT10NAL	達威光電	5432	1,025
DEEVAN ENTERPRISE	帝閒企業	private	1,627
DELTA ELECTRONICS	台達電子	2308	27,543
DELTA NETWORKS	達創科技	private	5,937
DFI	友通資訊	2397	4,582

DII　TAIWAN	美台二極体	foreign	2,092
DI　MRCODATA　SYSTEM	中菲電脳	5403	769
D-LINK	友訊科技	2332	11,975
DUPONTPHOTOMASKSTAIWAN	中華杜邦光軍	foreign	1,126
DYNACOLOR	彩富電子	5489	497
EDIMAXTECHNOLOGY	訊舟科技	5482	968
EFA	憶華科技	private	1,342
ELANMICROELECTRONICS	義隆電子	5433	3,911
ELITE-GROUPCONPUTER	精英電脳	2331	16,896
ELITEMATERIAL	台光電子材料	2383	2,054
ELITESEMICONDUCTORMEMORYTECH.	晶豪科技	private	4,253
ELITETRONELECTRONIC	維迪	5448	5,172
ELYTONEELECTRONIC	音律電子	private	1,377
EMERGINGDISPLAYTECNOLOGIES	全台晶像	5486	1,505
ENLIGHT	英誌企業	2438	5,865
EPISILTECHNOLOGIES	漢嘉科技	5326	3,178
EPOXCOMPUTER	磐英科技	5414	3,937
EPSONINDUSTRIAL(TAIWAN)	台湾愛普生	foreign	3,240
E-TECHINC.	力宜科技	private	2,129
ETEN	倚天資訊	2432	2,030
ETRONTECHNOLOGY	鈺創科技	5351	3,405
EVERFOCUSELECTRONICS	慧友電子	5484	607
EVERLIGHT	億光電子工業	2393	2,719
EVERSPRINGINDUSTRY	云辰電子開発	2390	2,162
EXCELCELLELECTRONIC	百容電子	5394	629
FARADAYTECH	智原科技	5404	2,398

FASTFAMETECHNOLOGY	飛盟国際	private	1,449
FCITAIWAN	台湾康旭	foreign	4,121
FIRSTHI-TECENTERPRISF	高技企業	5439	1,266
FIRSTINTERNATIONALCOMPUTER	大衆電脳	2319	52,495
FORMOSAADVANCEDTECHNOLOGIES	福懋科技	private	1,729
FORTUNEINFORMAT10NSYSTEMS	華経資訊	54!2	2,481
FORWARDELECTRONICS	福華電子	foreign	2,320
FOSTERELECTRIC(TAIWAN)	豊達電機台湾	foreign	1,355
FOXCONNPRECISIONCOMPONENTS	鴻準精密	private	3,865
FRONTIERELECTRONICS	弘電電子工業	private	1,160
GAINWARD	耕宇	private	1,894
GALLOPWIREENTERPRISE	徳臻科技	private	!,287
GARMIN	台湾国際航電	foreign	7,492
GEMTERMINALIND.	建通精密	5416	981
GENERALINSTRUMENTS	通用先進系統	foreign	33,982
GENERALSEMICONDUCTOR	台湾通用器材	foreign	8,900
GENUINE C&C	捷元	5384	8,923
GETMORE PRECISI0N	佳茂精工	5333	1,294
GIATZ00NG	佳総興業	5355	1,092
GIANTPLUS TECHNOLOGY	凌巨科技	private	1,676
GIGA-BYTETECHNOLOGY	技嘉科技	2376	25,589
GIGASTORAGE	国碩科技	2406	1,520
G-LINKTECHNOLOGY	吉聯積体電路	private	2,215
GLOBALVIEW	遠見科技	5477	1,851
GLOTECHINDUSTIAL	徳宏工業	5475	1,345
GOLDCIRCUITELECTRONICS	金像電子	2368	8,202

G00DWILLINSTRUMENTS	固緯電子	2423	1,003
GREATELECTRONIC&INDUSTRY	超豊電子	2441	3,709
G-SHANKENTERPRISE	鉅祥企業	5444	1,101
GVC	致福	2322	9,495
HANNSTARBOARD	潮宇博徳	5469	1,385
HANNSTARDISPLAY	潮宇彩晶	6!16	7,080
HANPINELECTRON	漢平電子	5440	2,020
HELIXTECHNOLOGY	和立聯合科技	5429	1,194
HIGHTECHCOMPUTER	宏達国際	private	4,564
HIPROELECTRONICS	高致電子	private	4,025
HI-SINCERITYMICROELECTRONICS	華所電子	5324	1,484
HITRONTECHNOLOGY	仲碕科技	2419	2,578
HOLTEKSEMICONDUCTOR	盛群半導体	private	4,569
HOLYSTONEENTERPRICE	禾伸堂企業	5423	3,786
HONHAIPRECIS10NINDUSTRY	鴻海精密工業	2317	92,062
HUACHENGTOKOEL 宜 CTRICS	華成電子	foreign	1,506
HUAJUNGCOMPONENTS	華容	5328	1,]87
HWAWOELLAMINATE	華豔電子工業	5481	1,922
ICHIATECHNOLOGY	毅嘉科技	2402	1,046
ト CHIUNPRECISION	一詮精密	5431	791
ICPELECTRONICS	威達電脳	5485	1,559
IML	亜智	5492	842
INWINDEVELOPMENT	迎廣科技	private	2,258
INFODISCTECHNOLOGY	訊礫科技	5428	3,l09
INFOPROGROUP	資訊伝真	8002	514
INFO-TEK	台湾精星科技	private	1,375

INTEGRATEDCIRCUITSOLUT10N	石タ成積電	5473	6,132
MAXEDGEELECTRONICS	力太電子	private	1,864
MEDIATEK	聯発科技	2454	12,862
MEGAMEDIA	佳録科技	2318	2,160
MEILOONINDUSTRIAL	美隆電器廠	5427	1,579
MERCKDISPLAYTECHNOLOGIES	黙克光電科技	foreign	1,832
MERCURIESDATASYSTEM	三商電脳	2427	3,035
MERRYELECTRONICS	美律実業	2439	1,115
MICRO-STARINTERNATIONAL	微星科技	2377	24,074
MICROCHIPTECHNOLOGYTAIWAN	高雄電子	foreign	2,226
MICROELECTRONICSTECHNOLOGY	台揚科技	2314	4,907
MICROTEKINTERNAT10NAL	全友電脳	2305	3,027
MICROTEST	益和	8010	284
MINAIKTECHNOLOGY	銘異科技	private	1,601
MIRLEAUTOMAT10N	盟立	5445	1,631
MITACINTERNAT10NAL	神達電脳	2315	47,312
MITACTECHNOLOGY	神基科技	private	16,641
MONTEREYINTERNAT10NAL	文麦	private	1,144
MOSEL-VITELIC	台湾茂砂電子	2342	26,893
MOSPECSEMICONDUCTOR	統愸半導体	2434	681
MOTOROLA	摩托羅拉電子	foreign	23,O12
MOTOTECH	興建東科技精岳	private	2,205
MUSTEKSYSTEMS	鴻友科技	2361	3,920
MUSTANGINDUSTRIAL	同協電子	5 姤 0	746
MYSONTECHNOLOGY	民生科技	5314	1,463
NANYAPCB	南亜印刷電路	private	13,765

NANYATECHNOLOGY	南亜科技	2408	14,971
N£WSOFTTECHNOLOGY	力新国際	5202	265
NORTHSTARSYSTEMS	慶盟工業	private	1,368
NOVATEKMICROELECTRONICS	聯詠科技	5499	4,164
OPTIMAXTECHNOLOGY	力特光電科技	private	1,302
OPTOMA	中強光電	5371	12,032
OPTOMEDIAELECTRONICS	光徳電子	private	1,061
OPTOTECHNOGY	光嘉科技	2340	4,242
ORIENTFIRSTINDUSTRY	東正元電路	5376	793
ORIENTSEMICONDUCTORELECTRONICS	華泰電子	2329	14,236
PACIFICTECHNOLOGY	太平洋光電	private	2,756
PAN-INTERNATIONAL	広宇科技	2328	7,203
PANJITINTERNATIONAL	強茂	5544	2,179
PANOVERSEASELECTRONICS	匿僑工業	2370	3,078
PAN-RAMINTERNAT10NAL	品安科技	private	1,719
PHIHONGENTERPRISE	飛宏企業	5415	6,561
PHILIPSELECTRONICSBUILDING	建元電子	foreign	134,260
PHILIPSELECTRONICSINDUSTRIAL	飛利浦電子	foreign	64,864
PHILIPSTAIWAN	台湾飛利浦	foreign	16,402
PHOENIXPRECIS10NTECHNOLOGY	全徽精密科技	private	2,320
PHOENIXTECPOWER	飛瑞科技	2411	4,259
PHYCOMPTAIWAN	飛元科技	foreign	4,930
PICVUEELECTRONICS	碧悠電子工業	2333	7,056
PIONEERELECTRONIC(TAIWAN)	百音電子	foreign	2,127
PLOTECH	柏承科技	8005	777
PORTWELL	瑞傳科技	6105	897

POTRANSELECTRONICS	鴻運電子	2378	2,326
POWERCHIPSEMICONDUCTOR	力晶半導体	5346	19,036
POWERQUOTIENTINTERNAT10NAL	勤永国際	private	IO,045
POWERCOM	科風	5476	1,596
POWERTESTTECHNOLOGY	力成科技	private	1,326
PREMIERCAMERA	普立爾科技	2394	9,622
PRIMAXELECTRONICS	致伸実業	2336	11,045
PRIMEVIEWINTERNAT10NAL	元太科技	private	2,284
PRINCO	巨壁科技	private	4,782
PRINTEDWIRE	台湾電路	2435	3,425
PROARCHTECHNOLOGY	光威電脳	private	3,944
PROCOMPINFORMATICS	博達科技	2398	7,002
PRODISCTECHNOLOGY	精達科技	2396	5,804
PROLINKMICROSYSTEMS	蜜聯電脳	5450	2,583
PROMOSTECHNOLOGIES	茂徳科技	5387	20,703
PROTONELECTRONICINDUSTRIAL	普騰電子	private	2,428
PROTOP	普大興業	2410	3,634
PROVIEWELECTRONICS	唯冠電子	foreign	1,054
PROYOUNGBUSINESSINFORMAT10N	普揚資訊	5395	596
PUCKAINDUSTRIAL	百稼企業	private	1,359
PURETEKINDUSTRIAL	世峰	5442	2,190
QUALITEKELECTRONICS	永兆精密電子	2429	1,505
QUANTACOMPUTER	廣達電脳	2382	82,764
RALECELECTRONIC	旺詮	2437	1,235
REALTEKSEMICONDUCTOR	瑞昱半導体	2379	5,361
RECTRON	麗正国際科技	2302	1,311

RF-LINKSYSTEMS	恰安科技	5392	617
REXONTECHNOLOGY	力山科技	private	1,260
RITEK	錸德科技	2349	22,617
RUNTOP	耀群企業	private	2,620
SAMPOSEMICONDUCTOR	上賓半導体	private	2,239
SAMPOTECHNOLOGY	新賓科技	private	12,726
SANYOELECTRONIC(TAICHUNG)	台中三洋電子	foreign	4,512
SCHMIDTSCIENTIFICTAIWAN	実密科技	foreign	1,355
SDI	順徳工業	2351	2,208
SENAOINTERNAT10NAL	神脳国際	2453	ll,627
SERCOMM	中嘉電子	5388	717
SESTMULTINDUSTRY	恒業電子	private	1,994
SHAMROCKTECHNOLOGY	華升電子工業	2354	28,541
SHEAMAYENTERPRISE	十美企業	5372	2,030
SHINFENGLIENTERPRISE	信豊利	private	1,409
SHINKINENTERPRISES	伸金	private	1,118
SHINEMORETECHNOLOGY	翔茂科技	private	1,340
SHUTTLE	浩鑫	2405	4,298
SIEMENSTELECOMMUNICAT10NSYS.	台湾吉悌電信	foreign	11,499
SIGNALITYSYSTEM&NGINEERING	訊利電	5455	655
SIGURDMICRO 厄 LECTRONICS	破格	private	1,035
SILICONAPPLICAT10N	品佳	5407	5,706
SILICONINTEGRATEDSYSTEMS	砂統科技	2363	7,832
SILICONWARE	矽豊	5343	2,176
SILICON-WARgPRECISION	矽品精密	2325	18,846
SILITEK	旭麗	2310	15,911

SIMPLOTECHNOLOGY	新普科技	private	1,376
SINBONELECTRONICS	信邦電子	6106	1,267
SINO-AMERICANELECTRONIC	華美電子	6107	2,133
SINO-AMERICANSILICONPRODUCTS	中美矽晶製品	5483	1,027
SIRTECINTERNATIONAL	協益塑膠	5356	2,806
SITRONPRECISION	旭龍精密	5332	1,085
SIWARDCRYSTALTECH	希華晶体科技	5411	785
SKYNETELECTRONIC	天網電子	private	1,478
SMARTASICTECHNOLOGY	晶嘉半導体	8003	268
SMARTEAM	得捷	5204	312
SOFT-WORDINTERNAT10NAL	智冠科技	5478	973
SOLOMONTECHNOLOGY	所羅門	2359	6;986
SONIXTECHNOLOGY	松翰科技	547i	1,438
SOUTHERNINFORMAT10NSYSTEM	南方資訊	2445	875
SOYOCOMPUT 丘 R	梅捷企業	5364	3,295
SPACESHUTTLEHI-TECK	太空梭	2440	2,571
SPARKLECOMPUTER	族宇企業	private	1,866
SPEEDTECH	宣得	5457	735
SPI£LECTRONIC	全漢企業	private	3,178
SPRINGSOFT	思源科技	5406	319
STARKTECHNOLOGY	敦陽科技	5418	4,443
SUMMITCOMPUTERTECHNOLOGY	皇統光牒	5413	1,632
SUNFPU	松普科技	5488	971
SUNONWEALTHELECTRICMACmNE	建準電機工業	2421	2,765
SUNPLUSTECHNOLOGY	凌陽科技	2401	6,274
SUNRESTECHNOLOGY	精元電脳	2387	2,052

SURECOMTECHNOLOGY	東聖科技	private	1,116
SUYIN	実盈	private	1,400
SYNNEXTECHNOLOGYINTERNAT10NAL	聯強国際	2347	46,776
SYNTEKSEMICONDUCTOR	太欣半導体	5302	672
SYSCOMCOMPUTERENGINEERING	凌群電脳	2453	3,270
SYSGRAT10N	系統電子工業	5309	710
SYSTEX	精業	2343	9,047
T.N.C.INDUSTRIAL	台硝	2372	1,860
TA-ITECHNOLOGY	大毅科技	5396	1,170
TAITUNGCOMMUNICAT10N	台通光電	8011	783
TAICOMDATASYSTEMS	台康資訊	private	2,390
TAIHONGCIRCUITINDUSTRIAL	台豊印刷電路	foreign	3,718
TAILYNCOMMUNICAT10N	台林通信	5353	1,369
TAISLELECTRONICMATERIALS	中徳電子材料	private	3,922
TAIWANARIES	台湾亜鋭士	private	1,770
TAIWANCELLULAR	台湾大哥大	4901	45,186
TAIWANCHEMI-CON	台湾佳美工	foreign	1,594
TAIWANFUTABAELECTRONICS	台湾雙葉電子	foreign	7,018
TAIWANLEADERCOPPERCLADLAM.	聯達銅面基根	private	1,367
TAIWANLIN&TEKELECTRONIC	良得電子	5446	1,186
TAIWANMASK	台湾光軍	2338	2,067
TAIWANMEMORYTECHNOLOGY	台晶記憶髄	5468	2,179
TAIWANMICROPAQ	晶揚科技	private	2,684
TAIWANMURATAELECTRONICS	台湾村田	foreign	3,612
TAIWANPCBTECHVEST	志超科技	private	1,064
TAIWANSEMICONDUCTOR	台湾半導体	5425	1,292

TAIWANSEMICONDUCTORMFG.	台湾積体電路	2330	166,228
TAIWANTAIYOYUDHN	台湾太陽誘電	foreign	3,950
TAIWANTENLON	台湾天龍	foreign	1,710
TAIWANTHICK-FILMIND.	台龍電子	private	1,143
TAIWANTEAC	台湾蓄稚克	foreign	3,043
TAIWANVIDEO&MONITOR	台湾録覇	private	3,456
TAIWANYAZAKI	台湾矢崎	foreign	1,808
TATUNG	大同	2371	84,529
TEAMYOUNGADVANCEDCERAMICS	天揚精密陶姿	5345	1,640
TEANELECTRONIC	智恩電子	private	1,675
TEAPO	智宝電子	2375	1,875
TECOIMAGESYSTEMS	東友科技	5438	2,123
TECOINFORMAT10NSYSTEM	東元資訊	private	5,640
TECOM	東訊	2321	9,550
TEKRAMTECHNOLOGY	建邦科技事業	private	2,142
TELOMTECHNOLOGIES	智基科技開発	private	1,738
TESTRESEARCH	徳律科技	5 犯 6	533
TEXASINSTRUMENTS	徳州儀器	foreign	42,133
THAILIN	泰林	5466	852
THINKINGELECTRONIC	興勤電子	2428	465
TINGLUNENTERPRISE	頂倫企業	private	1,482
TUNGKAITECHNOLOGYENG.	同開科技	5456	1,076
TONGHSINGELECTRONICIND.	同欣電子	private	1,619
TONTEKDESIGNTECHNOLOGY	通泰積体電路	5487	398
TOPCOSCIENTIFIC	崇越科技	5434	2,899
TOPViS10NDISPLAYTECHNOLOGIES	視達科技	private	!,837

TRACESTORAGETECHNOLOGY	和喬科技	private	1,874
TRADEVAN	關貿網路	8001	658
TRANSCENDINFORMAT10N	創見資訊	2451	5,743
TRANSYSTEM	系通	5348	102
TRIPODTECHNOLOGY	健鼎科技	5470	3,286
TSANNKUENENTERPRISE	燦坤実業	2430	7,561
TURBOCOMMTECH	突破通訊	private	9,224
TWINHEADINTERNATIONAL	倫飛電脳	2364	8,393
TWINMOSTECHNOLOGIES	勤茂科技	private	19,940
TXC	台湾晶技	5472	2,192
TYNTEK	鼎元光電	2426	1,399
ULEADSYSTEMS	友立資訊	5378	548
ULTIMAELECTRONICS	大騰電子企業	5325	n,713
ULTRASOURCETECHNOLOGY	奇普仕	5451	4,837
ULYCOMTECHNOLOGY	揚迪科技	private	1,110
UMAXDATASYSTEMS	力捷電脳	2348	7,713
UNICAPELECTRONICSINDUSTRIAL	耀文電子	5307	7,321
UN ト CIRCUIT	鴻源電路板	private	2,744
UNmORMINDUSTRIAL	連宇	5419	637
UNIFOSA	商丞科技	private	1,497
UNIPACOPTOELECTRONICS	聯友光電	5441	10,743
UNIPLUSELECTRONICS	合正科技	5381	2,443
UNITECHELECTRONICS	精技電脳	2414	5,781
UNITECHPRINTEDCIRCUITBOARD	耀華電子	2367	6,566
UNITEDEPITAXY	国聯光電科技	2422	1,602
UNIT 且 DFIBEROPTICCOM.	聯合光纖通信	4903	1,537

UNITEDINFORMATIONSYSTEMS	漢唐訊聯	2404	4,563
UNITEDMICROELECTRONICS	聯華電子	2303	105,085
UNITEDRADIANTECHNOLOGY	光聯科技	5315	1,404
UNITEDTESTCENTER	聯測科技	private	3,516
UNIVERSALMICROELECTRONICS	環隆科技	2413	2,149
UNIVERSALSCIENT 王 FICINDUSTRIAL	環隆電気	2350	39,110
UNIWELLCOMPUTER	志合電脳	private	6,871
VANGUARDINTERNAT10NAL	世界先進	5347	19,346
VATETECHNOLOGY	立衛科技	5344	1,058
VERTEXPRECIS10NELECTRONICS	伴鼎科技	5318	2,968
VIATECHNOLOGIES	威盛電子	2388	30,866
VICTORYCIRCUIT	弘捷電路	610!	1,533
VIDAR-SMS	惟達電	private	4,625
VIEW-QUESTTECHNOLOGIES	鈴訊科技	private	3,537
V-STARELECTRONICS	財轟科技	private	1,081
WAHLEEINDUSTRIAL	華立企業	5453	5,826
WALSINTECHNOLOGY	華新科技	5335	5,323
WEIKENGINDUSTRIAL	威健実業	5463	6,658
WEISHUNENTERPR 王 SE	偉訓科技	6102	1,288
WELLCOMMUNICATION	宏傳電子	5ψ9	2,604
WELTRENDSEMICONDUCTOR	偉詮電子	2436	1,414
WIESONELECTRONIC	驊隆実業	private	1,267
WINBONDELECTROMCS	華邦電子	2344	48,020
WINTECHMICROELECTRONICS	文曄科技	5459	4,676
WINTEK	勝華科技	2384	6,482
WORLDPEACE	世平興業	2416	14,405

WORLDWISERELECTRONICS	欣興電子	5363	8,887
WUSPRINTEDCIRCUIT	楠梓電子	2316	8,157
WYSETECHNOLOGY	台湾慧習	5375	2,847
XACAUTOMAT10N	同亨科技	5490	808
YASHIN	雅新実業	2418	6,054
YAGEO	国巨	2327	7,124
YANGANELECTRONICS	統盟電子	5480	1,881
YETiELECTRONICS	九徳電子	5321	2,996
YOSUN	友尚	2403	II,680
YUANHIGH-TECHDEVELOPMENT	聡泰科技開発	5474	1,422
YUFOELECTRONICS	育富電子	private	2,016
ZENITRON	増你強	5461	4,769
ZER00NETECHNOLOGY	零壷科技	5424	2,942
ZIKOMTECHNOLOGY	宝島科技	5312	1,275
ZINWELL	兆赫電子	5409	2,812
ZIPPYTECHNOLOGY	新巨企業	2420	1,480
ZYXELCOMMUNICATIONS	合勤科技	2391	3,779