

VC's Decision Factor in Semiconductor Investment

By

George Kuo-Liang Hsieh

B.A. Social Science

University of Southern California 2001

Submitted to the Alfred P. Sloan School of Management in Partial Fulfillment of
Requirement for the degree of

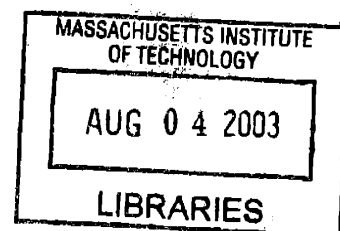
MASTER OF SCIENCE IN MANAGEMENT OF TECHNOLOGY

at the

Massachusetts Institute of Technology

June 2003

©2003 George Kuo-Liang Hsieh. All right reserved



The author hereby grants to MIT permission to distribute publicly paper and
electronic copies of this thesis in whole or in part

Signature of Author: _____

Alfred P. Sloan School of Management

April 30, 2003

Certified by: _____

Joseph G. Hadzima, Jr.
Senior Lecturer, MIT Entrepreneurship Center
Thesis Supervisor

Accepted by: _____

David A. Weber
Director, Management of Technology Program

ARCHIVES

VC's Decision Factor in Semiconductor Investment

by

George Kuo-Liang Hsieh

**Submitted to the Alfred P. Sloan School of Management in Partial Fulfillment of
Requirement for the degree of**

Master of Science in Management of Technology

ABSTRACT

This thesis examines the relationship between the semiconductor industry and venture capital ("VC") industry in China and Taiwan. Taiwan has established an impressive semiconductor industry by encouraging high technology investment for the past two decades; on the other hand, Mainland China is currently emerging as a new and strong entrant with a huge domestic market and resourceful human capital as its support. In the past few years, most of the Taiwanese and Chinese companies were funded by the VC industry that fueled their expansion. Lots of successful investments were made and enormous profits were realized.

Nevertheless, the industry environment remains very capital intensive and technology can be easily disrupted by new generations of wafer fabs, making intelligent investments in the semiconductor industry is unpredictable. From the perspective of the VC firms, this thesis first provides a general description of the semiconductor industry, its historical development, the current state of Taiwanese IC Design Industry and a Porter's analysis of the industry outlook. By interviewing the venture capitalists in the Asia-Pacific region, the thesis analyzes what decision factors VC firms must consider in investing in the semiconductor industry in China

Lastly, the thesis analyzes which characteristics of the Semiconductor Industry/IC Design sector affect how VC firms invest, how the investment process differs when investing in a semiconductor case and how different members of the VC team affect the investment process. By comparing between a generalist VC and a specialist VC, this thesis seeks to determine which firm has a long-term competitive advantage.

Acknowledgements

This thesis is made possible by the support I received from my family and friends and by the guidance I obtained from the colleagues and professors at Massachusetts Institute of Technology (“MIT”), for which I deeply thank them for their assistance and truly appreciate their advice contributed throughout the entire process.

First of all, I like to thank Mr. David Weber and Ms. Jennifer Mapes, the Director and the Assistant Director of the Management of Technology Program (the “MOT Program”), respectively. David and Jennifer have been extremely accommodating to me by providing the directions I need in learning the most from the MIT community throughout the past year. With their undivided attention to deliver the best of graduate education and constant encouragement to gain more perspective out of the classroom, the MOT Program has indeed transformed my scope and taken my vision to a different level.

I also like to thank Mr. Joe G. Hadzima, my thesis advisor, who has spent countless hours throughout the entire process of thesis-writing to coach my ideas and critique my writing. From sharing his ideas with me diligently to analyzing the weakness of thesis truthfully, Joe is the best advisor I could possibly have. By providing constant feedbacks and most importantly, inputting his venture capital experience, I was able to acquire the knowledge required in connection with the completion of this thesis.

Next, I have to thank my parents for their support and love. My parents’ belief in me is the key to how I was able to spend the past year to concentrate in my graduate education and strengthen my professional skills while I should be working in Taiwan. Without their assistance and love, I would never be able to dedicate myself to the MOT Program and to learn how to effectively manage business and technology. I am very grateful of the opportunity they provided and truly appreciate their decision of supporting me to enroll in the MOT Program.

Finally, I want to say, “thank you,” to Michelle, a very special person in my life. With her undivided attention and daily encouragement throughout the entire learning process, the year in Boston has been a very fulfilling and meaningful one.

George Kuo-Liang Hsieh

4/29/2003

Tables of Contents

	Page
Chapter 1 Introduction.....	6
Chapter 2 Description.....	7
Chapter 3 Description.....	8
Chapter 4 Description.....	9
Chapter 5 Description.....	9
Chapter 6 Description.....	10
Chapter 2 The Overview of Taiwanese Semiconductor Industry.....	11
2-1 Quick Overview of History of the Semiconductor Industry.....	11
2-2 Taiwanese Semiconductor Industry and Its Recent Success.....	15
2-3 The Creation of Foundry and its impact on the Industry Value Chain.....	21
Chapter 3 The Current State of the Taiwanese IC Design Industry.....	24
3-1 Definition of IC Design.....	24
3-2 World's IC Design Industry.....	29
3-3 Future Issues for Taiwanese IC Design Companies.....	33
Chapter 4 A Porter's Analysis of the Taiwanese IC Design Industry.....	35
4-1 Five Forces Analysis Model.....	36
4-2 Business Value Chain Model.....	40
4-3 Diamond Model Analysis.....	46
4-4 Five Forces Analysis on Taiwanese IC Design Industry.....	49
4-5 SWOT Analysis.....	51
Chapter 5 Overview of the Taiwanese Venture Capital Industry.....	53
5-1 Different Stages of Investment.....	55
5-2 Brief History of the Taiwanese Venture Capital Industry.....	57
5-3 Timelines for Major Events in the Taiwanese VC Industry.....	63
5-4 Future Outlook for the Taiwanese Venture Capital Industry.....	65

Chapter 6	Decision Making Factors in Semiconductor Investment.....	67
	6-1 Industry Dynamics of IC Design Companies.....	68
	6-2 Investment Process Dynamics of IC Design Companies.....	72
	6-3 VC Dynamics of IC Design Investments.....	77
	6-4 Case Study.....	81
Bibliography	84

Chapter One---Introduction

Research Purpose

In the last twenty years of Taiwan's economic development history, the success of its semiconductor industry has been well documented and frequently studied. The Taiwanese government made a right decision to switch its focus from a labor intensive agricultural and industrial economy into value-added high-tech industry. Taiwan has a world leading edge in industries like information technology, personal and notebook computers, displays, network appliances and semiconductor manufacturing. Most of these successes were due to the government's dedication in building an infrastructure to support industry growth as well as an environment for the VC firms to invest.

When VC firms invest in target companies, the capital injection is only one of the many aspects of their contribution. Venture Capitalists are known for bringing additional values to the target companies by sharing their investment networks, bringing experience in managing a company as well as serving as an endorsement to the public market for company's achievement. In the past few years, Taiwanese VC firms have made significant amounts of investment in the high-tech sectors, especially in the semiconductor industry. According to the Taiwan Venture Capital Association's ("TVCA") 2001 annual report, approximately twenty percent of all VC investments funds were made to the semiconductor industry.¹

This thesis examines both the semiconductor and the VC industry in Taiwan and determines whether VC firms were key to the growth of the Taiwanese semiconductor industry. From the perspective of the VC firms, this thesis analyzes: (i) how the unique characteristics of the semiconductor industry affect VC firms' investment decisions; (ii) whether semiconductor projects are ideal investments for the VC industry; and (iii) how VC firms conducts their investment process when they dedicate their investment into the semiconductor industry.

In addition, this thesis utilizes interviews with executives of six VC firms in the Asia Pacific region. Four of them are "generalist VC firms" and two of them are "specialist VC firms." A generalist VC firm is a full-service firm that invests in all industries, including the semiconductor projects; on the other hand, a specialist VC firm is a boutique firm that dedicates resources to invest in one or two specific industries. This thesis analyzes: (i) the difference between the members of a

generalist VC firm and their counterparts in a specialist VC firms; (ii) how the members of the generalist VC firm and the specialist VC firm invest differently; and (iii) the advantage and disadvantages of both types of VC firms when making investments.

Chapter Two--- The Overview of Taiwanese Semiconductor Industry

This chapter discusses about the history of semiconductor and how important semiconductors are for our everyday lives. A study of the semiconductor industry development in the recent years demonstrates that the semiconductor is here to stay and is continuing to grow. Despite its importance, there is serious short-term volatility in the demand for semiconductor products. The year of 2001 was a brutal year for most of the semiconductor companies: the industry as a whole had a negative growth rate of -31%, the worst in the decade. Depending on the different sectors, Taiwan's semiconductor industry also decreased as much as 20% in 2001.²

Taiwan's semiconductor industry started in the 1970's with the government's strong intention to develop its own semiconductor manufacturing capabilities. The Taiwanese government cooperated with RCA to form a joint venture to develop the semiconductor industry and such joint venture proved to affect Taiwan for decades. Taiwan has many competitive advantages in its high-tech sector. One such competitive advantage is its unique "Vertical Integration Model" in which firms separate themselves in the manufacturing process and focus on their respective areas; however, they work closely together to produce and locate themselves in a close geographical area. The introduction of the "Hsin-Chu Science Park" in the 1980's was key for many high-tech companies to be clustered in one area.³ The charts in chapter two include:

- The Short-Term and Long-Term Growth Trend of Electronic Equipment and Semiconductor Market;
- The World's Semiconductor Demand Separated by the Category of the Usage;
- Taiwan's Unique "Vertical Integration Model" in the Semiconductor Industry, Consisting of More Than 242 Companies in Eight Different Sectors;
- Number of Companies located in "Hsin-Chu Science Park" and Their Revenue; and
- Taiwan Semiconductor Corporation's ("TSMC") Revenue and Net Income.

Many of the successful semiconductor companies were funded by VC firms in the

1980's. These investments generated significant returns for the limited partners of the funds and facilitated the growth of the semiconductor companies. The first foundry in the world, TSMC, received investment from Taiwanese government's VC arm – The Development Fund of Executive Yuan. The foundry was the key to Taiwan's growth in semiconductor industry. After the success of the TSMC foundry, Taiwanese IC (Integrated Circuits) Design companies quickly emerged and were able to compete with Integrated Device Manufacturer (IDM) by working closely with the foundries.

Chapter Three---The Current Sate of the Taiwanese IC Design Industry-

This chapter describes the current state of the Taiwanese IC Design Industry. After the creation of several foundries, Taiwanese IC Design companies began to expand at a rapid pace. As of today, there are more than two hundred IC Design companies in Taiwan, having global market share of 21% and ranked number two in the world.⁴ Most IC Design companies have the following characteristics:

- Require low capital expenditure in comparison to other semiconductor investment projects;
- Focus on the design technology that requires top engineering talents;
- Rely heavily on the foundry for production, and
- Have short life cycles for their IC products.

Aside from the U.S. and Taiwanese success in the IC Design industry development, there are other developments around the world. Europe, Israel, and Mainland China also have companies dedicated into IC product development. Most of the top IC Design companies in Taiwan have already made investments to expand their business into Mainland China. Given China's population and its success in recent economic development, it will certainly play an important role in future of the IC industry. The charts in chapter three include:

- IC Product Categories;
- The Growth of IC Design Sector in the Recent Years;
- IC Design Market Share Distribution Around the World;
- Top Twenty IC Design Companies and Their Revenue Comparison (Four of Top Twenty are Taiwanese Companies);
- IC Application Distribution; and
- Important IC Design Industry Indicator in Taiwan.

Other important issues in the industry, such as System on Chip (“SoC”), are also discussed. These issues will have an profound impact to the future development of the Taiwanese IC Design industry.

Chapter Four--- A Porter’s Analysis on Taiwanese IC Design Industry

Michael Porter’s “five forces” are used to analyze the Taiwanese IC Design industry. The five forces are: (i) the threat of entry of new competitors; (ii) the threat of alternative products; (iii) buyers’ bargaining power; (iv) suppliers’ bargaining power and (v) competition between existing industry competitors.⁵ There are different factors within each force that affect the overall industry outcome. For the Taiwanese IC Design Industry, Mainland China is a potential entrant in the marketplace and its significant educational resources is an important supplier of the human resource for the industry.

Investment from the foundries is another key factor for the growth of the IC Design industry. In the past, foundries were considered to be more important than the IC Design Companies. However, today more and more investments are made to form IC Design Companies and such investments are often made by the foundries. The foundries want to enhance the strategic alliance between themselves and the IC Design Companies. While the foundries fund the IC Design Companies, such foundries can increase their business and profits from these strategic investments. The charts in chapter four include:

- Porter’s Competitive Strategy Matrix;
- Porter’s Five Forces Model;
- Porter’s Value Chain Model; and
- The Industrial Value Chain.

Many opportunities and competitive threats are presented for the Taiwanese IC Design Industry. Companies must be achieving competitive advantage by either lowering cost or differentiating their products.

Chapter Five--- Overview of the Taiwanese Venture Capital Industry

This chapter discusses the historical background and the current state of the Taiwanese VC industry. Following the tradition of Taiwan’s Small and Medium Enterprises (“SME”), Taiwan also has many small and medium size VC firms.

According to the 2001 TVCA study, Taiwan has total of 199 VC firms, making nearly 7000 investments over the last six years.⁶ Such investments serve as an important driver for the growth in Taiwan's high-tech industry. The largest area of these investments is in Semiconductor Industry (16.17%), followed by the Electronic and the Telecommunication Industries (15.24% and 12.91% respectively). In comparison to the U.S. VC industry, in Taiwan currently there is no funding contributed from large government or private pension funds.⁷

The charts of chapter six include:

- The Number of VC Firms in Taiwan and Total Funds under Management;
- Comparison of Taiwan and U.S. VC Funding Structure;
- Structure of Taiwanese VC Limited Partner/Domestic Institutional Investor;
- VC's Total Number of Investments in Each Sector Through Year 2001;
- Stage of Investment and Percentage Analysis from 1996 to 2001;
- Graph of Taiwanese VC Performance Analysis; and
- Milestone in the Historical Development of the Taiwanese VC Industry.

According to the 2001 TVCA annual report, up to the year of 2000, Taiwan's VC industry had both strong growth rates in funds under management as well as investment performance. In 2001, however, due to the technology downfall and government's cancellation of tax saving policy, the funds under management had little increase in the last year. A continuous effort must be done to save the Taiwanese VC industry from the current condition.

Chapter Six--- Decision Making Factors in Semiconductor Investment

This chapter starts by examining Porter's analysis of the industry characteristics of the Semiconductor Industry/IC Design Sector. The analysis demonstrates that investment can be significant if the target project requires large initial capital expenditure and if the target company needs to build the fabrication plant. Due to the commitment required to invest by investing in the Semiconductor industry, most Taiwanese VC firms prefer to invest in IC Design Companies given its lower capital requirement and potential high return.

When venture capital firms make investments into the Semiconductor Industry/IC Design Sector, how would their shareholders, management teams as well as their cooperative networks affect the decision making process?

By interviewing six VC firms in the Asia Pacific region and employing metrics like investment amounts, investment stages, investment sectors, investment in different regions, portfolio and risk management, external advisory, exit strategy, deal source, due diligence and value added perspective, this thesis seeks to determine how VC firms make their investment decisions.⁸ Furthermore, by analyzing the two types of VC firms, generalist and specialist, this thesis concludes that companies that focus in a particular industry have a better opportunity to make earlier stage investment and to generate more returns. Conversely, the risk associated with a specialist VC firm is the concentration of investment in one or two sectors. For instance, if such a sector had a serious decline, it would put the firm's portfolio at risk.

Chapter Two---The Overview of Taiwanese Semiconductor Industry

2-1 Quick Overview of History of the Semiconductor Industry

In 1948 a group of scientists at Bell Labs successfully invented the semiconductor transistor.⁹ Since then, the semiconductor has continued to evolve and the semiconductor is currently one of the most important industries in the world. Through the increasing use of different complex electronic systems, the use of semiconductors in electronic systems has increased from 5% in 1974 to 21% in 1995.¹⁰ Looking through the history of the semiconductor industry, we can observe the features of semiconductor industry are:

- The Semiconductor industry is competing on a global basis
- The industry is maintaining its growth in the long run. However, there are often a volatile short term industry cycles
- Different sectors among the entire industry value chain are vertically integrated and companies are focusing on each sector
- Trade and IP (Intellectual Property) disputes and lawsuits are frequently seen.
- Despite the fierce competition, companies are constantly cooperating and making strategic alliances at the same time.

Semiconductor Companies compete on a Global Basis

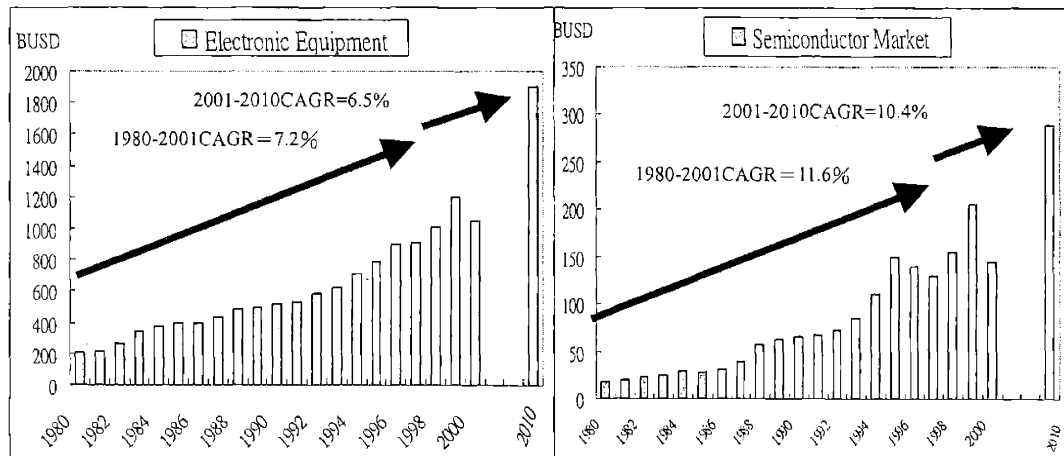
Due to the nature of the semiconductor industry, companies who had leading positions (such as Intel and TI) have achieved great success in selling their product world wide. Top semiconductor companies have well managed supply chain architectures that transport their products very efficiently. There are no regional competitions for semiconductor companies. All semiconductor companies will need to compete on a global basis to succeed.

Industry maintains long term growth and short term high volatility

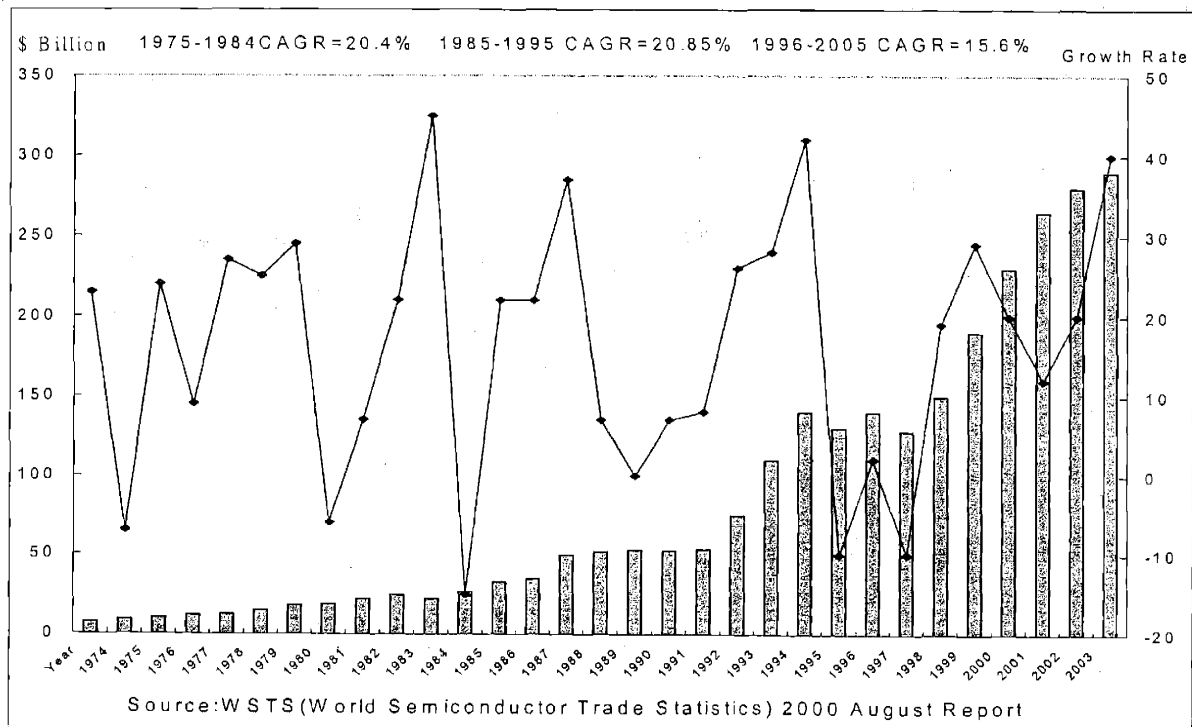
Semiconductors are the most important components in any electronic system. Because newer generations of applications and electronic products are being invented, the demand for semiconductors also continues to increase. Advanced technology to manufacture semiconductors has dramatically improved to provide more features and lower cost. With these continuous improvements of semiconductor products, the industry was able to achieve an average of 11.6% annual growth rate from 1980 to

2001. It is forecasted by ITIS (Industrial Technology Intelligence Service) that the average annual growth rate between 2000 to 2010 will be around 10.4%.¹¹ Due to the world economic recession and overstock on product inventory, the overall semiconductor market has decreased 31% in 2001. The Graph 2-1 and 2-2 illustrates the long term growth and the short term high volatility of the semiconductor industry.

Figure 2-1 and 2-2, Shows the long term semiconductor industry stable growth versus the short term volatility of the industry



Source: IC Insight 2001 Annual Report

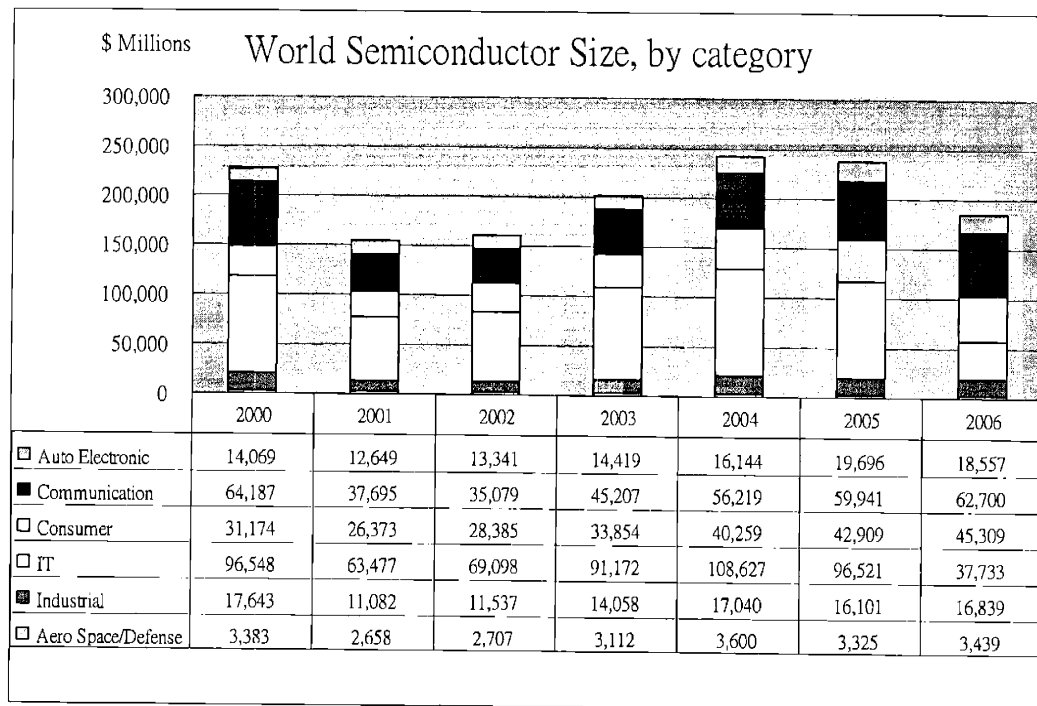


Industry is vertically integrated with companies competing and cooperating

For IDM (Integrated Device Manufacturer) companies, a huge capital investment in fabrication plant is required to produce IC (Integrated Circuits). A twelve inch fabrication plant currently costs around \$3 billion dollars and takes years to construct. It is not possible for any particular company to manage all types of semiconductor products. Therefore, a company often focuses on one particular product and creates alliances with other companies to either expand its product line or to increase manufacturing capacity. An example is Intel's outsourcing of non-microprocessor product to foundry companies or Taiwan Semiconductor's reliance on IC Design company Via to create and market networking chips.

Currently, the personal computer industry is the biggest customer of semiconductors, with a 50% world wide market share in 2001. The communication sector was second largest at 18% market share. Consumer electronics consist of 15% of market share but is increasing faster than other sectors. Industrial used equipment consist of 9% of world's market share and the automotive industry consist 6%, with rest of systems around 2% of market share.¹²

Figure 2-3 Semiconductor Market Share Table



Source: ITRIEK 2002 Semiconductor Annual Report

2-2 Taiwanese Semiconductor Industry and Its Recent Success

In the last twenty years, Taiwan has gradually transformed into one of the world's most important semiconductor economies. Taiwan has adopted the "Vertically Integrated Model" in which companies in each sector are able to focus their own manufacturing process and closely work with other supply chain partners in close geographical distance to have a complete product developed in a very efficient time and cost. With the government's effort to develop an effective environment to facilitate the best foundry company in the world, the world renowned "Hsin-Chu Science Park" was created to host the entire supply chain of the Taiwanese Semiconductor industry. In recent years, there has been much literature in studying the success of the Taiwanese semiconductor industry; these are some of the determinant factors for the success:

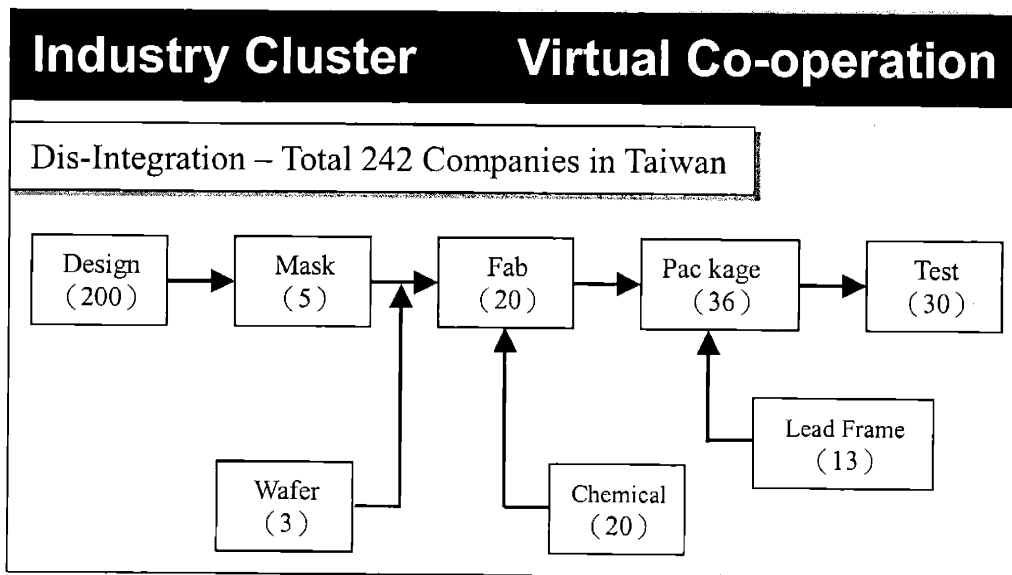
- Taiwan's unique "Vertically Integrated Model" and the foundry have helped the competitiveness of its semiconductor industry.
- Alliance with top technology vendor RCA, successfully utilized technology transfer and emerged into some of the best semiconductor companies in the world.
- The establishment of "Hsin-Chu Science Park" helped different sectors of semiconductor companies to unite together and enhanced the effectiveness of semiconductor supply chain management.
- Sufficient educational resources to develop the top engineers in the world, in both quality and quantity
- The well-compensated stock bonus system has helped the Taiwanese high tech industry to attract some of the best talent in the world.
- A very supportive venture capital industry has helped high-tech companies to expand business, and an effective capital market facilitated investors liquidity for their investments.

Taiwan's unique "Vertical Integration Model"

In comparison with IDM (Integrated Device Manufacture)¹³, most Taiwanese semiconductor companies are vertically disintegrated with each having a specific focus, separating the entire manufacturing process into different stages, starting from design, mask, foundry, testing, and packaging. Without considering all the necessary steps like IDM vertically disintegrated companies can better focus on their core technology, manage their production better and reach an economy of scale in their focus product. With the creation of a foundry in 1986, Taiwan has established a very

valuable industry chain in the high-tech sector. The value of the vertical integration model is that each company in the supply chain is focused and dependent on other partners working together to deliver a better end product. The semiconductor industry often experiences a short term volatile business cycle, otherwise known as “Bullwhip Effect”. The Bullwhip effect causes the demand for semiconductor products to be extremely volatile in short term, which can seriously influence corporate decisions on capital expenditure and inventory control. Vertical disintegrated companies are proven to have better results in those aspects as well as a lower per unit production cost, which dramatically increases the competitiveness over time. The vertically disintegrated model has allowed Taiwan’s foundry to become the no.1 foundry industry in the world, no. 1 in packaging, and no.2 in IC Design with more than 200 fabless design firms.¹⁴

Figure 2-4 Taiwan’s unique “Vertically Integrated Model” in Semiconductor Industry



Source: Made by Taiwan, By CY Chang 2001

Alliance with the Best Foreign Technology to Gain Competitiveness

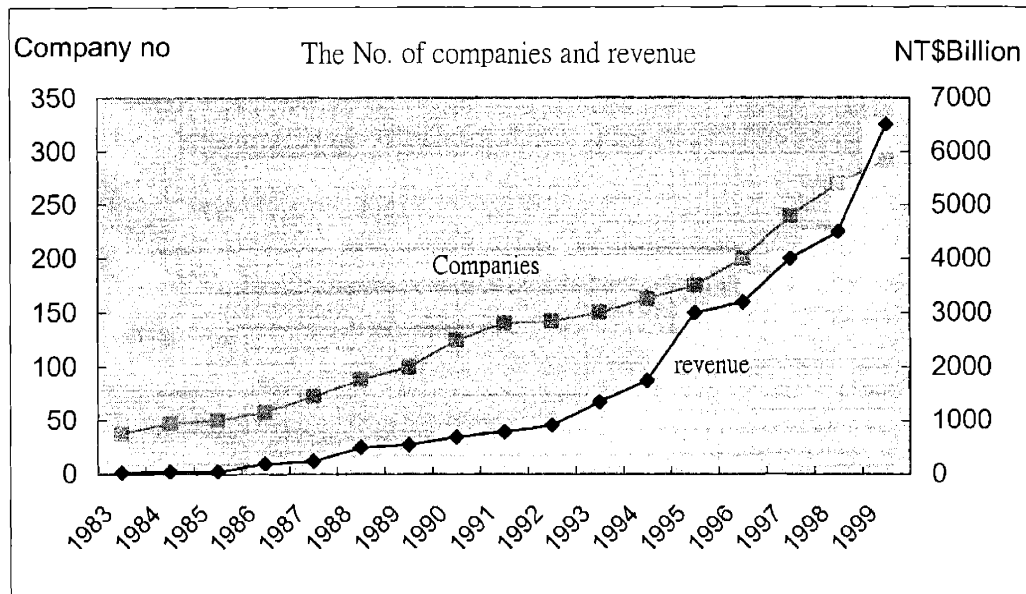
In the 1970’s, the Taiwanese government made a decision to focus on developing the semiconductor industry. A key decision was to import the most advanced technology from U.S. high tech companies. The ITRI (Industrial Technology Research Institute) created a subsidiary division called ERSO (Electronic Research and Service Organization) to better implement the plan to develop Taiwan’s semiconductor

industry. ERSO recruited many Chinese scientists and engineers to return to Taiwan and participate in ERSO projects. Their expertise and experiences in the U.S. helped the ERSO to contact with Technical Advisory Committees in the U.S., cooperate with large U.S. semiconductor companies for joint development, organize the proposal to develop the steps to import design, mask and manufacturing technologies, and provide technical expertise. After a thorough selection process, the ERSO decided to work with RCA to develop semiconductor manufacturing capability adopting CMOS (Complementary Metal Oxide Silicon) technology. In 1979, UMC (United Semiconductor Company) was created, and today is still one of the largest semiconductor companies in Taiwan. While remaining as a professional research institution, ERSO continues to seek the most advanced technology by increasing its internal R&D capability, and by transferring its findings into private sector through means such as licensing, selling of intellectual property, and joint venturing by providing expertise. Many semiconductor companies in Taiwan have and continue to benefit by the effort and the result of ERSO projects.¹⁵

The Creation of “Hsin-Chu Science Park”

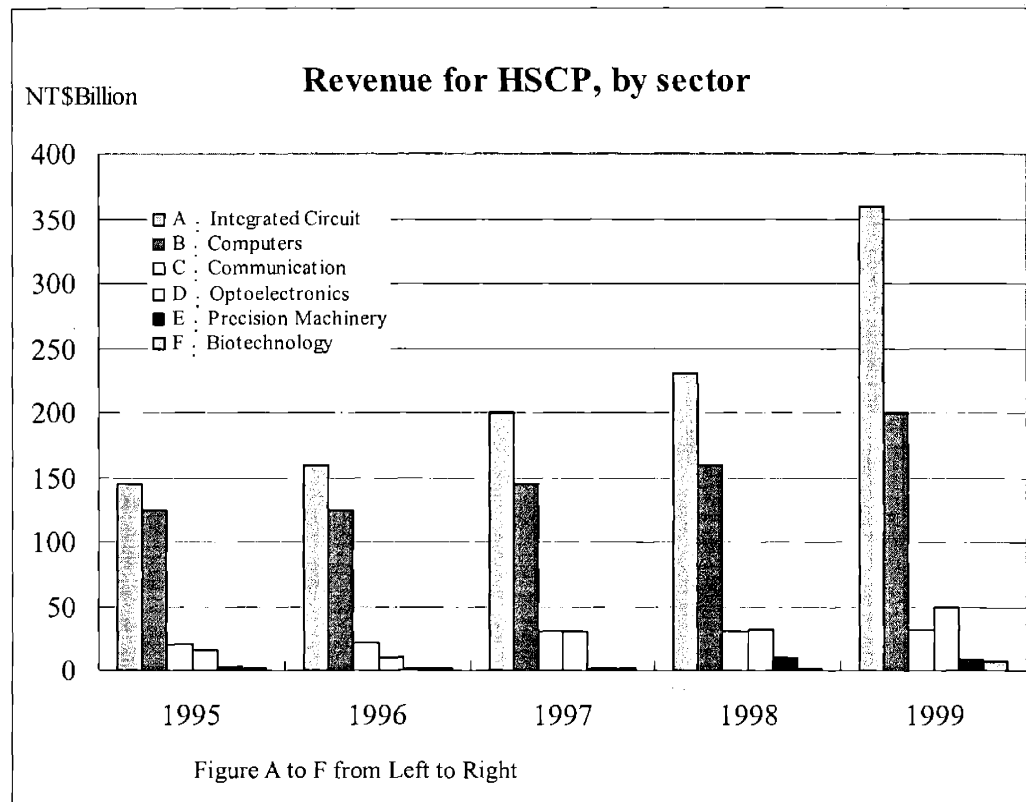
In 1980, in the order to transform Taiwan into a high-tech economy from a labor intensive economy, Taiwanese government decided to build Hsin-Chu Science Park 50 miles south of Taipei. Technology companies with research and development capabilities or manufacturing expertise as well as research institutions that are undertaking technology innovation projects are encouraged to move to HCSP, otherwise known as the “Silicon Valley of Taiwan”. In 20 years, HCSP has successfully emerged into a high-tech clustered environment equipped with all the necessary features including R&D, manufacturing, job opportunity, lifestyle, and leisure. By 1999, a total of 292 high tech companies were located or established at HCSP providing high-income employment opportunity for 80,000 people, with a total investment of approximately US\$180 billion. Semiconductors have been the largest sector of all. At HCSP, in year 1999, the semiconductor industry consisted of 55% of total HCSP revenue of US\$200 billion, with 118 semiconductor companies. The average annual growth rate in HCSP has been 46% over the last twenty years.¹⁶

Figure 2-5 Number of Companies Located in Hsin-Chu Science Park



Source: Made by Taiwan, By C.Y. Chang 2001

Figure 2-6 Revenue generated by companies within Hsin-Chu Science Park



Source: Made by Taiwan, By C.Y. Chang 2001

Sufficient Education Resources

In order to develop a complete value chain of the semiconductor industry, there has to be a sufficient number of semiconductor experts, engineers, researchers and scholars. During the 1960's, understanding that Taiwan's educational structure has not yet able to provide high-tech related education, the government decided to build NCTU(National Chio-Tong University) in city of Hsin-Chu to specialize in electrical engineering education, and research on semiconductor technology and manufacturing. NCTU actively recruits famous scholars and researchers from institutions such as MIT, Cornell, and Bell Labs to conduct teaching, research, and product developments. Today, NCTU is one of best engineering universities in the Asia Pacific area, with the no.1 article publishing rate in IEEE (Institute of Electrical and Electronics Engineers) Approximately 60% of Taiwan's semiconductor companies are managed or were founded by NCTU graduates. NCTU has proven to be significant in providing sufficient education resources for those in Taiwan's high-tech industry.¹⁷

Well Compensated Stock Bonus System helped recruit World-Wide High Tech Experts

Among the developed countries there are different employee incentive plans for workers who dedicate their time in the high-tech industry. Taiwan currently has a most attractive incentive plan which was also an important driver for the success of Taiwan's semiconductor industry. The stock bonus system in Taiwan, which works quite differently from the stock option system in the U.S, has attracted many oversea Chinese engineers as well as world-wide experts in the field to come to Taiwan and explore new opportunities. How the stock bonus work is that at year end, board of directors determine the amount of bonus for different executives. The bonus can be paid in either cash or stock. For managers who earn stock as their bonus, they have huge benefits because their stock is not given according to the market value of the stock, but instead it is given in the company's \$10 par value stock (All of Taiwan's stock has a par value of \$10). So for example, if manager X at TSMC earns NT\$2 Million (US\$60,000) for his year-end bonus and is given the bonus in the form of stock he receives 6,000 shares of stock (U.S.\$60,000 bonus/ by \$10 per share par value. In this case, using TSMC closing price of \$44.9 at 2/21/2003, the manager in this case is getting approximately US\$270,000 of stock in market value. The story does not end here. Only the par value of the stock (US\$10) is taxed by the government, the balance of \$34.9 (\$44.9 market value minus the \$10 par value) is

considered to be capital gain. Taiwan currently has a 0% capital income tax for its citizens as well as foreigners. Although currently there are many discussion about whether Taiwan should follow the U.S. footsteps and change stock option plans or even treat the stock option as compensation expense there is very little doubt that such Taiwan's current policy has dramatically enticed world experts to enter Taiwan's high-tech industry and contribute their domain knowledge to facilitate the growth of Taiwan's semiconductor industry.

Venture Capital and its Capital Market

Taiwan's venture capital industries as well as its capital market are also believed to be major factors contributed to Taiwan's semiconductor success. According to TVCA (Taiwan Venture Capital Association) with its recent survey, from the period of 1996 to 2001, a total of 1096 cases of investments were made in the semiconductor industry, account for 20% of total VC's investments. Although earlier numbers are not available, it is widely believed that there was also a significant amount of investment into semiconductor companies and that great return were generated. In 1982, the Taiwanese government established "The Development Fund of Executive Yuan" in order to invest government money into the semiconductor industry as well governing all the administrative issues regarding to venture capital regulation. Companies such as TSMC (Taiwan Semiconductor Corporation) have been in the portfolios of government owned venture capital. Taiwan's capital market also played an important role. Taiwan's stock market has the number one turnover rate as well top five average trading volumes in the world. (SFC annual report 1997)¹⁸ Such environment provides tremendous opportunity for entrepreneurs to raise funds for business expansion, as well provides investment opportunity for average citizens.

2-3 The Creation of Foundry and its impact with the Industry Value Chain

In 1985, Taiwan Semiconductor Corporation (TSMC) was created as the world's first foundry company. Unlike IDM (Integrated Device Manufactures), a foundry company does not sell its products but rather relies on IC Design customers or IDM to place orders to make chips. Before the existence of foundry companies such as TSMC or UMC, an IC Design Company would need to rely on an IDM to manufacture their products. However, there are some disadvantages for IC design companies to place order to IDM, which in their business nature also competes with IC Design companies:

- Since IC Design companies do not own their own production equipment (“fab”), they need to outsource the manufacture of their products to IDMs. There is little protection on the intellectual property issues or business intelligence for your competitor to quickly understand the competitiveness of your product.
- Semiconductor is an industry with serious short term industry volatility on industry cycle, therefore, orders to fabricate chips may be dramatic and vary depend on the industry cycle. In times where business is booming, IDMs will normally secure their productions first before they can lend out to IC Design companies, therefore there is little protection for IC design companies to secure their demand for their client.

The Success of TSMC and the Quick Turnaround of UMC

The first foundry company in the world, Taiwan Semiconductor Corporation, was established based on a government project in 1985. The ITRI (Industrial Technology Research Institute) proposed to initiate a VLSI (Very Large Scale Integrated Circuits) project to facilitate semiconductor manufacturing capability. ITRI appointed Morris Chang to be in charge and develop the company. Morris Chang is a semiconductor expert with more than thirty years of industry experience, previously a senior executive in Texas Instruments. With government support in funding and technology transfer from ERSO (Electronic Research and Service Organization), TSMC became the world’s company solely dedicated to the manufacture of semiconductors for others. After the creation of TSMC, the market became aware that there is a alternative option in the semiconductor industry where you can now place order to a non-competitor, with better understanding of when will your product be delivered and better protection on the intellectual property. In a few years, the foundry concept became the best option IC Design companies all over the world. The revenue of TSMC (no.1 foundry in the world) has increased from US\$4 million in 1987 to US\$5 billion in 2000, the number of employees increased from 130 to 15,000, a increase of 1200 times in revenue and 100 times in the number of employees.¹⁹

Figure 2-7 TSMC's Revenue and Net Income Chart

Year	Revenue(In USD\$MM)	Net Income(In USD\$MM)
1987	4	-4
1988	33	5
1989	70	16
1990	82	-6
1991	167	19
1992	259	46
1993	466	161
1994	631	193
1995	1,088	567
1996	1,435	707
1997	1,532	625
1998	1,507	458
1999	2,263	759
2000	5,156	2,062

Source: Made By Taiwan, By C.Y. Chang 2001

UMC's Major Turnaround

United Semiconductor Corporation was the first semiconductor company in Taiwan. Starting as an IDM (Integrated Device Manufacturer), UMC had its own manufacturing plant and design division for its proprietary product. Although UMC is a well-run company with largest revenue in all of Taiwan's semiconductor company, it is still a small operation compared to the largest IDM (Integrated Device Manufacturer) around the world, which resulted in slower growth rate due to the competition around the world. After the foundry model was established, the senior leader at UMC understood that it was an opportunity the company should not miss. The company decided to switch the company's business model to foundry as well. It was a big challenge for the company given that 70% of company's revenue was from its IDM (Integrated Device Manufacturer) businesses. After careful consideration, the company initiated a major corporate restructuring---To switch the manufacturing plant to foundry orientated, and spin off its design departments to four independent IC Design companies in joint ventures with top U.S. IC Design companies. Within months after the spin-off, UMC formed AMIC Technology, Novatak, ITE Technology, and Mediatek, of which became independent successes in the IC Design sector. As for

the company's foundry business, UMC was able to achieve a growth of 20 % higher than its old IDM business. Such strategy was extremely successful because by joint venturing with existing U.S. companies, UMC could quickly rely on its partners to provide demand for the foundry business; from the perspective of U.S. Design companies, they were also glad to work with foundry rather than IDM due to a non-competitive cooperation between UMC and U.S. Design companies.²⁰

The success of the foundry model has created a new window of opportunity for many engineers in Taiwan to start their own IC design companies. With R&D and marketing capabilities and without the investment of a huge fabrication plant, many semiconductor industry experts in Taiwan have formed their own design companies. Currently there are a total of over 200 IC design companies in Taiwan, accounting for about 21% of world's IC design market share.

Chapter Three---The Current Sate of the Taiwanese IC Design Industry

3-1 Definition of IC Design

An IC Design company, or a “Fabless” is a semiconductor company without a fabrication plant, focusing on both technology and product innovation.²¹ They operate in a unique business environment within the Taiwanese semiconductor industry where the foundry company business model creates opportunities for highly skilled engineers to enter the semiconductor industry without encountering huge capital expenditure. A typical IC design company focuses upon technology innovation and marketing capabilities, with business strategies aimed at R&D and manufacturing or foundry, forming alliances to ensure prototype IC design specifications become a tangible product. IC design companies have the following typical characteristics:

- Virtual FAB
- High-technology expertise
- Low capital entry and high return
- Rely heavily upon foundries
- Short IC product life cycle

The Concept of “Virtual FAB”

The term “Virtual FAB” was first introduced by Mr. Morris Chang, Chairman and CEO of the Taiwan Semiconductor Corporation. Otherwise known as the “Father of the Foundry Industry”,²² he pointed out that in order for Taiwanese companies to compete in the global semiconductor industry, it would be unwise to adopt the Integrated Device Manufacture (IDM) model due to Taiwan’s Small and Medium Enterprises (SME) culture. Instead, Taiwan should adopt a vertical integration model where each company focuses on a specific sector of the semiconductor manufacturing process. With the establishment of the world’s top foundry companies in Taiwan, many pure design companies have emerged from within the new business environment. There are benefits for both design and foundry companies: for the design company, they are not burdened with the yearly depreciation of a multi-billion dollar fabrication plant. Likewise the foundry can improve their manufacturing process by the increased number of orders submitted by the design companies, and can regulate their prices depending on the health of the economy.

High-technology Expertise

There are many design and non-design companies within the Taiwanese semiconductor industry. Non-design packaging, testing, mask and foundry companies focus on the competitiveness of their manufacturing process, requiring large amounts of investment capital. In order to meet the evolution of the manufacturing process and the increasing demand of product functionality from clients, companies must continue to innovate and deliver new generation products to remain competitive. The IC design industry is technology-intensive due to the tremendous R&D efforts of highly skilled engineers required for the successful development of new IC products.

Low Capital Requirement and Heavy Reliance on Foundries

Compared to other sectors of the semiconductor industry, IC Design companies have little need for huge capital expenditures on Property, Plant and Equipment. Most of a design company's costs are in human resources for engineers and management. The unique features of low capital and high return have attracted many venture capitalists to invest in design-only companies. In terms of actual production after the design stage, design companies need to rely on their partners to manufacture and deliver the finished products. When the industry is booming and the demand for production at the foundry level is high, IC design companies need to count on foundries to prioritize and manufacture their product ahead of other design companies. When there is lower industry demand, foundries have less negotiating power over the design companies.

Short Product Life Cycle

In recent years, Integrated Circuits have tended to have shorter and shorter product life cycles. The frequency of new product generation depends on the market demand and the introduction of new IC (Integrated Circuits) products. Whenever a new product is introduced, the older generation product is soon discontinued and eventually becomes obsolete. Hence IC design products are highly disruptive, with extremely short product cycles with new applications introduced according to the function demands of the new system.

Integrated Circuits are categorized according to their system functions. There are four major categories of Integrated Circuits - Information IC, Consumer IC, Microprocessors and Communication ICs.²³

Figure 3-1 Category of IC Design Chip

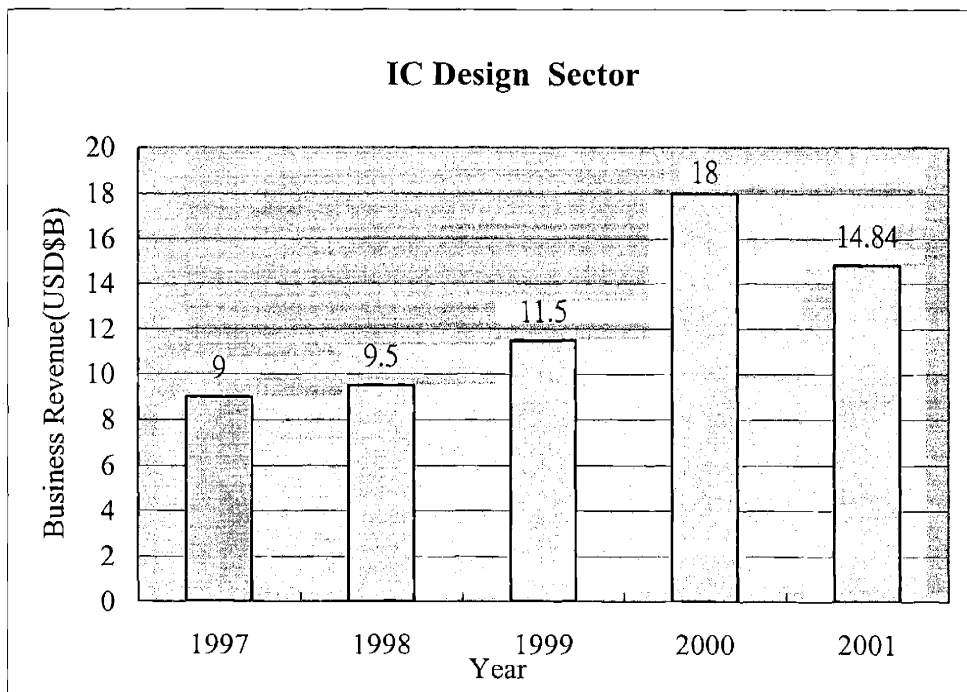
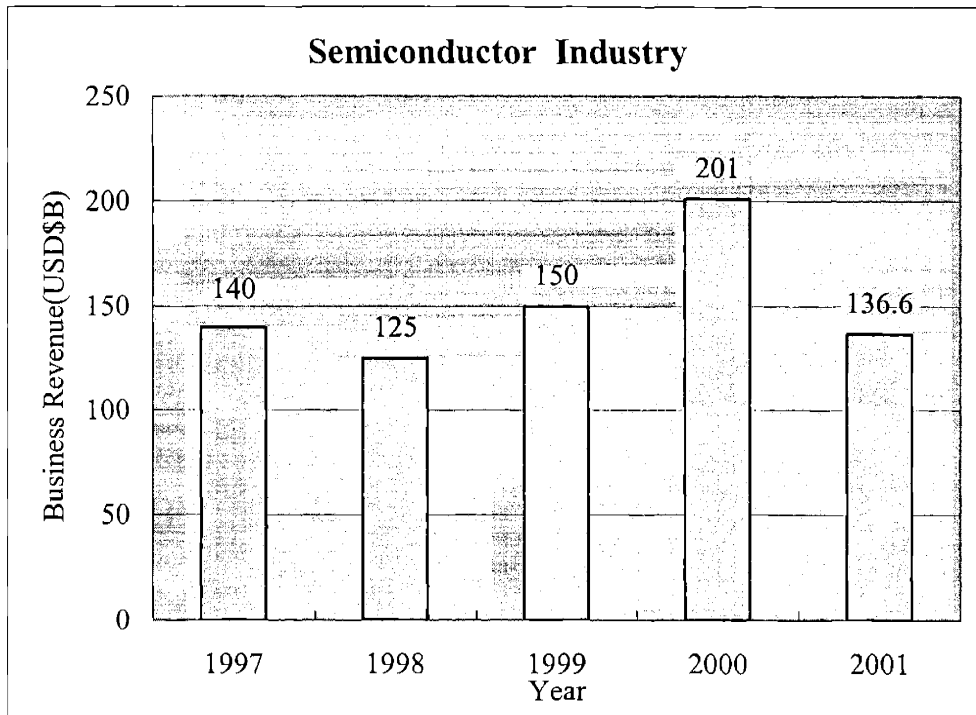
Category	Scope	Product
Information IC	PC	CPU, Chips, Audio, Video, Modem
	Accessories	CRT,LCD,HDD,CD-RW,DVD-Rom, Flash Card, Printer, Scanner, Keyboard, Mouse, Joystick
	Transmission	USB,IDE,PCI,IEEE1394,RS232,IEEE1284
	Memory	DRAM, SRAM, Flash
Consumer IC	Voice	voice record,MP3,CD recorder
	Image	LCD,PC camera, DSC
	Handset equipment	Translator, PDA (Personal Digital Assistant), CCD
	Family terminal	Set-top box9(STB), Games
Communication IC	LAN	10M/100M Ethernet, Hub, Switch, Router, Gateway
	Wireless LAN	Bluetceth,IEEE802,Home PNA,GSM,CDMA

Source: Information Technology@Taiwan, By C.F. Wang 2000

Major Global IC Design Industries

2000 was one of the most successful years ever for the semiconductor industry. However, global economic recession in 2001 caused many semiconductor companies to reduce capital expenditures, lay off workers and even shut down fabrication plants. For the first time in the history of the semiconductor industry, 2001 saw an overall negative growth rate of -32%, with a figure of -21% for the IC design sector, indicating the lesser impact on an innovation driven design industry compared to the overall semiconductor manufacturing sector.²⁴

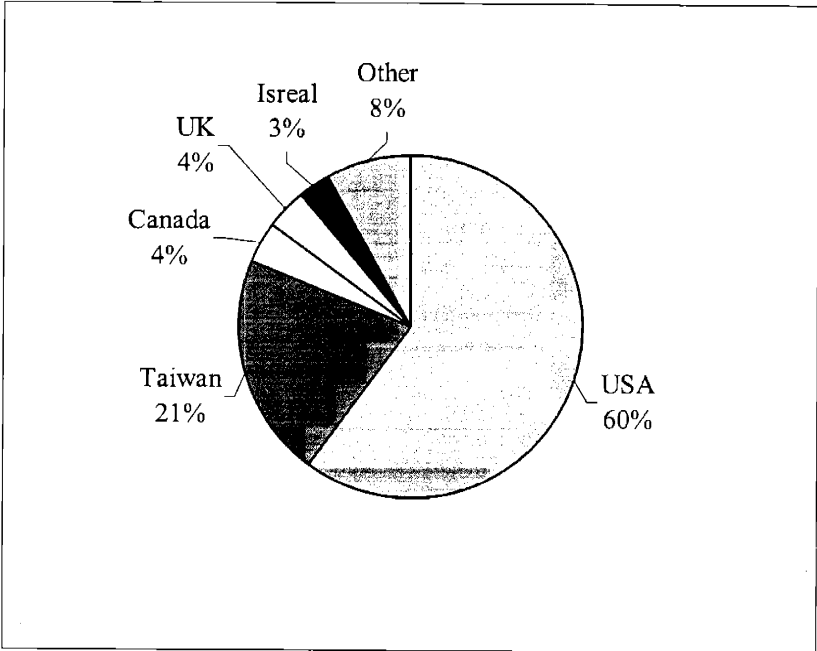
Figure 3-2 Semiconductor Industry and IC Design Sector Growth Trend



Source: Information Technology@Taiwan, By C.F. Wang 2000

There are currently more than 1,000 IC Design companies worldwide, with more than half based in the United States. Taiwan currently has the second largest IC Design industry, with more than 220 firms accounting for around 21% of global market share. Aside from the U.S. and Taiwan, Israel, the EU, South Korea and Mainland China have all dedicated resources towards developing their domestic IC design industry. The U.S. still dominates, leading the way in terms of product innovation and design technology, while Taiwan's combination of low cost and high expertise is highly competitive. Emerging design industries such as Israel and the EU are well known for their expertise in the Internet and communication sectors. Figure 3-3 shows the structure of IC design companies around the world.²⁵

Figure 3-3 Global IC Design Company Distribution



Source: ITRIEK 2002 Semiconductor Industry Annual Report

3-2 World's IC Design Industry

U.S. IC Design Industry

In the early days of the IC design industry in California's Silicon Valley, before the existence of foundries, companies could only place orders to Integrated Device Manufacturers (IDM). However, this system did not facilitate a well-supported environment for business development due to the competition between IDM and design companies. In the years since the establishment of foundry companies such as Taiwan Semiconductor Corporation (TSMC) and United Semiconductor Corporation (UMC), the number of U.S. design companies has increased dramatically. The U.S. is also the world's largest market for all semiconductor products. The U.S. IC design industry leads the world largely due to its advantage of close geographical proximity to the marketplace, along with Silicon Valley's reputation for attracting the world's top talent. The abundant venture capital support and the environment for innovation have created many wealthy experts in this field and has seen the establishment of many successful design firms such as Qualcomm, Nvidia, Xilinx, Broadcom and Altera, with 16 of the top 20 design companies ranked in 2001 being from the USA. (Four from Taiwan)²⁶

Figure 3-4 2001 Top 20 IC Design Companies and their business comparison

Top 20 Fabless 2000 and 2001 Revenue Comparison (In USD\$B)

Ranked	Company	2001	2000	2000/2001 GR	Product	country
1	Qualcomm	1,235	1,250	-1.2%	wireless	USA
2	Nvidia	1,206	735	64.1%	PC Graphics	USA
3	Xilinx	1,150	1,565	-26.5%	PLD	USA
4	VIA	1,012	984	2.8%	PC Chips	Taiwan
5	Broadcom	962	1,132	-15.0%	Networking	USA
6	Altera	839	1,376	-39.0%	PLD	USA
7	Cirrus Logic	534	739	-27.0%	Multimedia	USA
8	ATI	480	711	-32.5%	PC Graphics	USA
9	Media Tek	456	411	10.9%	Optical Storage	Taiwan
10	Sandisc	366	601	-39.1%	Flash	USA
11	Qlogic	357	318	12.3%	SCISI/Fibre Channel	USA
12	PMC Sierra	323	694	-53.5%	Networking	USA
13	Lattice	295	568	-48.1%	PLD	USA
14	SST	294	490	-40.0%	Flash	USA
15	ESS	271	303	-10.6%	Multimedia	USA
16	Globespan Virata	270	348	-22.4%	Networking	USA
17	Marvell	252	132	90.9%	Networking	USA
18	Realtek	216	194	11.3%	Networking	Taiwan
19	Legerity	210	260	-19.2%	Networking	USA
20	Sunplus	197	201	-2.0%	Consumer	Taiwan

Source: ITRIEK 2002 Semiconductor Annual Report

European and Israeli IC Design Industry

European companies are third behind the US and Taiwan in terms of the world's IC Design market share. The creation of the European Monetary Union has led to a more supportive environment for venture capital investment in European start-up companies. While acknowledging the stiff global competition in becoming a high-tech R&D and manufacturing center, EU governments have been aggressive in initiating better tax and lending policies to facilitate the high-tech industry, leading to similar pan-European models from Bavaria to Cambridge. In terms of national expertise, Israel has an advantage in Internet and wireless communication IC products, the U.K. is known for its development in Radio Frequency, ARM, and RISC technologies, while Finland and Sweden design companies have focused on developing communication IC products due to their world renowned handset industry. The main European design companies include Galileo, AudioCodes, and VideoLogic.²⁷

Taiwan IC Design Industry

The number of Taiwanese IC design companies has grown tenfold in the last decade, largely due to a comprehensive semiconductor value chain (in particular the Hsin Chu Science Park), geographical proximity to foundry manufacturers and abundant educational resources providing top engineers. Over 50% of Taiwan's PC market is made up of product systems such as chipsets, displays, scanners, motherboards, mouse, and keyboards. Having to supply the necessary IC products locally and at low cost, the Taiwanese IC design industry has more advantages than its foreign competitors. In 2001, Taiwan's market share in IC design products reached a record high of 21%, with four of its top IC design companies also ranked in the global top 20 (Via Tech, Mediatek, Realtek and Sunplus). In terms of product categories, roughly 65% of revenue generated is related to PC industries, which is to be largely expected since Taiwan also has one of the world's largest PC Original Equipment Manufacturing (OEM) sectors. However, there has also been a percentage increase in revenue in Internet and communication chipsets. Many Taiwanese design firms have begun to cooperate with Silicon Valley companies, increasing their technology capability with top U.S. firms in order to maintain their position as market leaders.²⁸

Figure 3-5 IC Application Distribution

	Information IC	Communication IC	Consumer IC	Others	Total
ASSP	64.0%	11.5%	14.7%	1.7%	88.0%
ASIC	1.7%	2.6%	3.3%	0.5%	12.0%
Total	65.7%	14.1%	18.0%	2.2%	100.0%

Source: ITRIEK 2002 Semiconductor Annual Report

Although 2001 was one of the most difficult years for the semiconductor industry, many new IC design companies were set up, seeking emerging markets in System on Chip (SoC) design services, wireless communication and multi-media. By the end of 2001, there were a total of 215 IC design firms, 25 of them listed, generating total revenue of USD\$4 billion. Of these companies, 49% were export-orientated, with 29% of exports bound for China and Hong Kong, indicating the close relationship with the electronics industry in mainland China. In addition, as indicated by the chart below, R&D spending increased in relation to 2000, indicating a long term strategy for Taiwanese IC design companies to enhance their technology level and stay competitive within the entire semiconductor value chain.

Figure 3-6 Important IC Design Industry Indicator

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001
No. of Companies	64	65	66	72	81	115	127	140	180
Revenue(USD\$B)	117	124	193	218	363	469	742	1,152	1,220
Growth Rate	36.0%	6.0%	56.0%	13.0%	67.0%	29.0%	58.0%	55.0%	6.0%
Import/export percentage	46:54	65:35	61:39	64:36	52:48	57:43	62:38	59:41	51:49
CapEx/Revenue	14.0%	5.5%	3.7%	6.0%	8.5%	4.1%	6.5%	6.0%	7.8%
R&D Expenses	9.5%	10.0%	12.2%	9.5%	8.8%	9.4%	8.9%	9.3%	10.1%

Source: ITRIEK 2002 Semiconductor Annual Report

IC Design in Mainland China

Chinese IC design companies have not had the support to develop the industry in comparison with Silicon Valley and Taiwan due to the foundry business being still at the early stages of development and the current U.S. limitation on 0.18mm

manufacturing technology exports to China. In recent years, the Chinese government has aggressively expanded its IT and software industries, resulting in a fast growing market. In terms of cooperation with Taiwanese design firms, the top ten Taiwanese design firms have already established their China operation or R&D center, mainly focusing on the potential of the world's largest market in terms of low-end IC products. There is no doubt that Taiwan is working closely with China, and competing while cooperating.²⁹

3-3 Future Issues for Taiwanese IC Design Companies

With Moore's Law continuing to prove its validity, the evolution of semiconductors continue to move at a rapid pace, with different sectors in the semiconductor industry being challenged by issues that could impact the entire value chain of the business. From the IC design perspective, there are few issues that need to be noted which will shape the future:

- System on Chip (SoC)
- Intellectual Property
- Shortage in design experts
- Greater Capital Expenditure for IC design firms³⁰

System on Chip (SoC)

With the evolution of semiconductor manufacturing technology, the concept of System on Chip (SoC) has developed, defined as integration of different chips handling different functions and placed on a single chip. A single chip can now handle different functions such as processing, memory and output/input while maintaining high quality performance. SoC has a very different design layout from traditional IC which only needs to consider the function and specification of a single function chip during the manufacturing process. Many more factors such as heat, power and other layout and design functions must be considered during SoC design. Thus the complexity of designing SoC is much higher than that of designing a single function chip.

Intellectual Property in Chip Design

While SoC has become the prevailing trend in the IC design industry, the priority of both IC design companies and Intellectual Property (IP) providers is how to utilize IP in designing effective chips. IC design companies want to use the most effective tools in designing their chips and IP providers hope to become the main IP supplier for IC Design companies in order to generate more revenue for their existing products. There are many different types and levels of IP, from the basic level such as Standard Cell, Data Path, Memory Compiler, and converters between analog and digital, or more complex IP such as DSP core and RISC Core. One of Taiwan's leading IP providers is Faraday Inc., which currently supports 0.13MM technology and is part of the UMC group. An important decision for any IC design company is which IP to adopt.

Shortage in Design Experts and Collaborative Environment

The increasing demand for System on Chip, has led to the subsequent demand for experts in this field. While it takes multi-domain expertise to complete a SoC design, such as analog and digital technologies, software and hardware technologies, it becomes increasingly difficult for one single company to undertake all the design processes required in a SoC. In addition to purchasing an existing Silicon Intellectual Property from companies such as Faraday Inc., companies also cooperate with each other through M&A or strategic alliances to combine different designs and deliver a better end product. It is common for different design companies to work on a joint design process project. In order to facilitate better work between different parties that might be in more than one location, future design processes should consider multiple parties and geographical locations. Effective design tools and environment must be facilitated in order to increase efficiency, including a common data base, which can provide synchronized updates for project development, and a collaborative and concurrent style so that different parties can work on the same project at a maximum efficiency level. With the advent of the Internet, even small design companies without an international proprietary network can utilize the worldwide web to work with their colleagues in different geographical locations and complete a joint assignment. For example, many design companies have set up operation in the U.S., Taiwan and China, where the U.S. west coast office is in charge of IC specification and the system architecture design is closer to the market, while the Taiwanese engineers complete the actual circuit design and foundry manufacture.

Greater Capital Expenditures

IC design companies are a unique example high-tech industry innovation. A typical IC design company does not need to build a fabrication plant and focuses only on chip design, whose products can be sold on the market within two to four years, with high-growth potential and disruptive to market incumbents. IC design is often known for its limited risk, high return business nature. However, with higher demand for complex IC products, companies often need to increase their capital investment to hire more professionals, facilitate multiple locations for R&D, marketing and manufacturing purposes, and continue to invest in Intellectual Property and Electronic Design Automation (EDA). It is thus becoming increasingly difficult and more costly for IC design companies to compete in the marketplace.

Chapter Four---A Porter's Analysis on Taiwanese IC Design Industry

Michael Porter's work on competitive strategy and analysis provides a useful framework for understanding the semiconductor industry and the venture capital investment opportunity and strategies for creating and realizing economic value in this sector.

The competitive strategy matrix formulated by Michael Porter was based upon two main directions of competitive strategy – competitive field and competitive advantage, has produced the three general competitive strategies below.

1. Cost Leadership: refers to the manufacturing of standard products and the obtaining of product cost advantage through economy of scale.
2. Differentiation: refers to the manufacture of products with special functions that satisfy customers (such as high quality, innovative design, brand name, good service reputation, etc).
3. Focus: refers to the focusing on one part of a customer group, geographical range, and marketing channel or product line. Focus can also be divided into two types – differentiation focus and cost leadership focus.

Fig. 4-1 Porter's Competitive Strategy Matrix

		Competitive Advantage	
		Low Cost	Differentiation
Competitive Range	Advertising	Cost Leadership Strategy	Differentiation Strategy
		Using only cost as the competitive focal point	Professional differentiation strategy

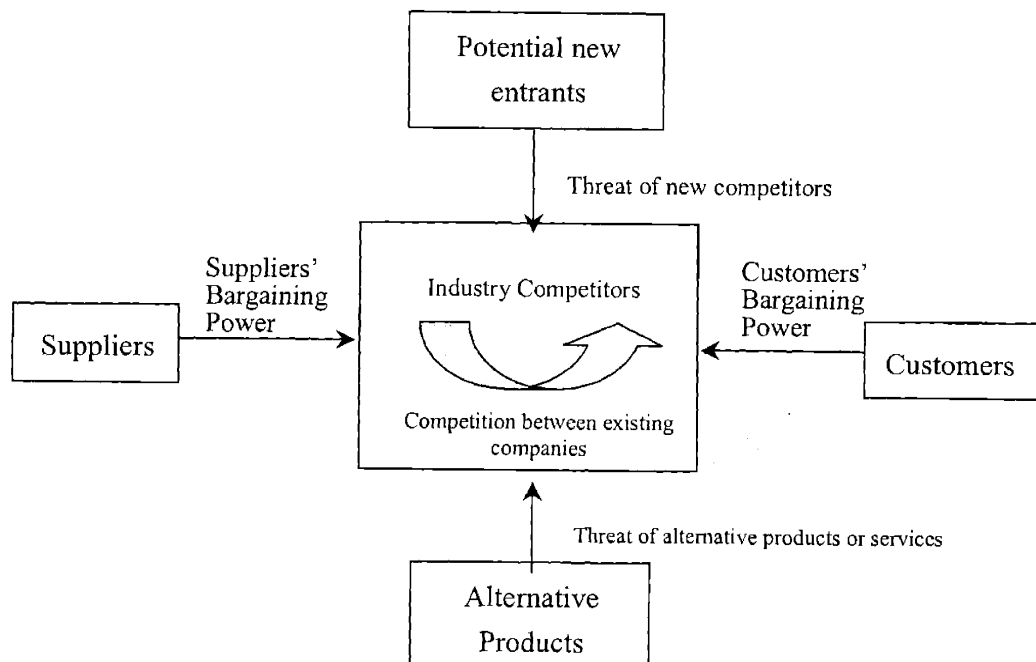
Source: Competitive Advantage, by Michael Porter 1985.

4-1 Five Forces Analysis Model

Industrial structure strongly influences the methods of competition between businesses and decides on which strategic methods they can utilize. Due to these

influences, management should fully analyze and understand the target industry before drawing up an enterprise competitive strategy. The Five Forces Analysis Model was put forward by Michael Porter (9) in the 1980's as a structure for industrial analysis. The so-called Five Forces refers to five kinds of competitive strength: the threat of the entry of new competitors, the threat of alternative products, buyers' bargaining power, suppliers' bargaining power and competition between existing industry competitors.³¹

Fig. 4-2 Five Forces Model



Source: Competitive Strategy, By Michael Porter. Free Press 1998

In addition to deciding the industry competitive situation, these five kinds of competitive power also decide the probable level of profit for that industry. In addition to understanding the current industry structure, the Five Forces Analysis can also compare the position, advantages and disadvantages of the enterprise itself with the target industry, in order to draw up an appropriate competitive strategy.

Porter also analyzed the measure variables that influence the strength of the Five Forces:

1. Factors influencing the entry of potential competitors:
 - a. Economy of scale - including each function of the enterprise, such as manufacturing, purchasing, R&D, marketing and service economy of scale.
 - b. Product differentiation – the degree of customer identification and loyalty towards product brands.
 - c. Capital requirements – huge investment in R&D, production and marketing can also constitute a hindrance to entry.
 - d. Switching costs – all costs caused by a change in supplier, including personnel re-training costs, costs of increasing auxiliary equipment and the costs and time in modification of new capital resources to adapt to the existing environment.
 - e. Acquisition of distribution channels – the more restricted the product wholesale or retail channels, the closer the relationship between the original factory and these channels and the higher the entrance barrier.
 - f. Unfavorable cost factors unrelated to scale – such as technology uniqueness, preferential and convenient acquisition of raw materials, favorable location, government subsidies, learning curves or experience curves.
 - g. Government policy – conditional license issue, restrictions on acquisition of raw materials or pollution control legislation, etc. Companies also employ strategies such as market and product expansion, vertical integration, having special abilities or assets “waiting for best offer” are all potential competitors.
2. The threat factors of alternative products are ever-present, which restricts the investment return rate for that particular industry, especially:

- a. Products improving the product price and demonstrating functional differentiation.
 - b. The manufacture of alternative products by the “high-profit industry” leads to more rapid development of this influence.
3. Factors affecting the customers’ bargaining power:
- a. The industry is monopolized by a few centralized large-scale purchasing customers.
 - b. Product purchasing takes up a large part of overall costs.
 - c. Standardized products do not possess differentiability.
 - d. Low switching costs.
 - e. Low profits.
 - f. Buyers exhibit “backward integration” trends.
 - g. The influence of the product on the customers’ final product or service is not great.
 - h. Customer’s ample capital has more bargaining chips.
4. Factors influencing the suppliers’ bargaining power are:
- a. The product sales are controlled by only a few companies.
 - b. The product need not compete with other alternate goods.
 - c. The buyer’s industry is not an important market for the supplier.
 - d. The product is the buyer’s key input material.
 - e. The product possesses differentiation or has already formed high switching costs.
 - f. The suppliers exhibit “forward integration” trends.
5. Factors influencing the structure between existing competitors are:
- a. The competing factories are either numerous or very large in scale, and the addition of overseas investors can possibly lead to two evenly matched sides or conflict between them.
 - b. There is slow industry growth, leading to a fierce battle for competitive market share.
 - c. Pressure caused by the relationship between high fixed or storage costs and added value.
 - d. The product lacks differentiability or low transfer costs.
 - e. Large increase in capacity destroys the industry supply and demand equilibrium.

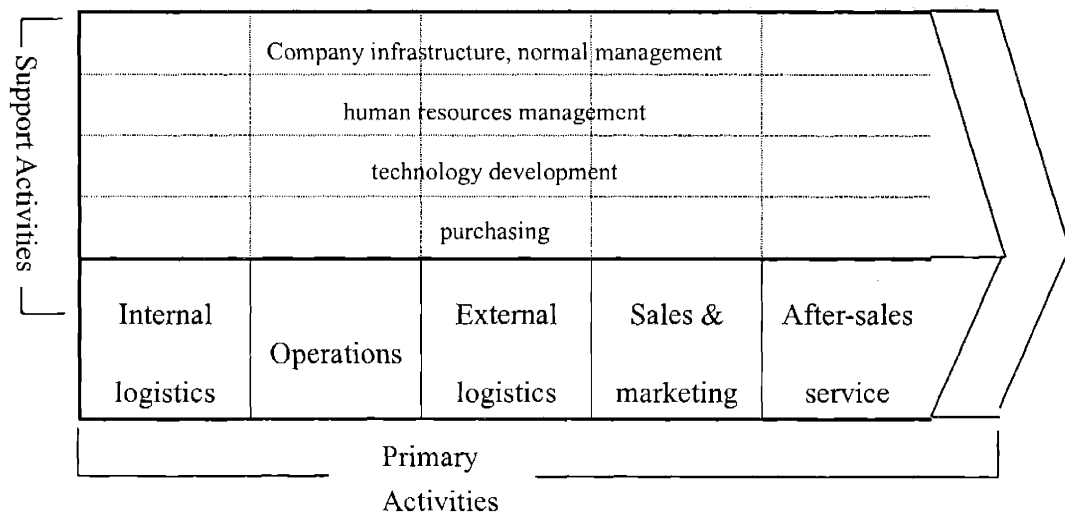
- f. For Multi-purpose competitors, different strategic intentions create more variables.
- g. High risk strategy companies not only expand rapidly but are also willing to sacrifice profit.
- h. Companies with high exit barriers causing a competitive defeat put up with the pain until they take extreme measures.

Apart from the five competitive forces above, Porter also referred to the fact that in many industries where the government is not the buyer, they are often the supplier, even using legislation, subsidies or other policy measures to influence industry competition, and directly or indirectly influencing many facets of the industry structure.

4-2 Business Value Chain Model

Porter also discussed the value chain model, explaining how to increase business competitive advantage through value chain activities and information (fig. 2-3). The value chain activities can be divided mainly into primary activities and supporting activities, where primary activities covers all basic business activities from raw material input, production, delivery, marketing and after-sales service. Supporting activities covers all activities that subsidize the primary value activities, including purchasing, technology R&D, human resources management and business infrastructure.

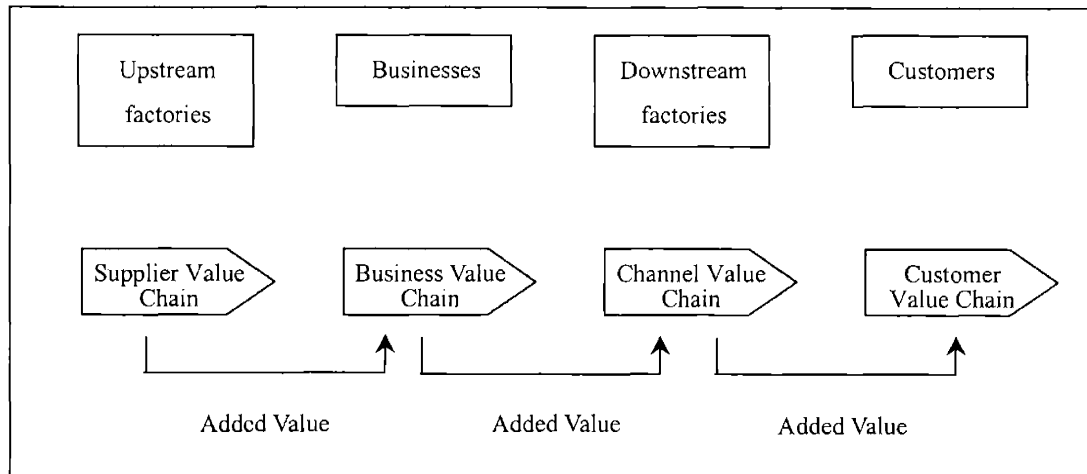
Fig. 4-3 Porter's Value Chain Model



Source: Competitive Advantage by Michael Porter. Free Press 1985

The value chain system is formed through the interconnection of each kind of activity and thus competitive advantage does not occur due to just one single activity, but through optimization and the coordinating mechanism between activities. The broad sense of the value chain also includes upstream suppliers and downstream customers which can provide businesses with another opportunity to gain a competitive advantage through the linking of businesses with supplier and customer activities. Porter's Value System or Industrial Value Chain is shown in fig. 4-4.

Fig 4-4 Industrial Value Chain



Source: Competitive Advantage, by Michael Porter. Free Press 1985

Although there are various definition to define the component of industry, but includes research and development, spare parts manufacture, manufacturing technology, brand names, promotion and after-sales service, etc. Within certain industries, order handling and storage will also possibly become an important part of the industry value chain.

1. Strategic Dimensions

The field of application for IC products is extremely broad. By having more than two hundred firms, currently Taiwan's IC Design companies are still based on "deeply ploughed" niche markets and adopt a cost leadership strategy. They divide up the product market according to the company's core technology capability and avoid direct confrontation with large design companies. From another perspective, it is clear that design companies are aware of concentrating product risk, gradually extending their product line

towards differentiation development.

2. Technology Development

Survey results clearly indicate that Taiwan's design companies consistently feel that the development of future technology will be in System on Chip, RF Wireless Communication Chip, LCD Driver IC, consumer IC chips and Bluetooth chips. With the huge demands of the three application markets including PC, communications and information appliance, domestic design companies are actively involved in technology R&D in these markets, and are already involved in taking up positions in the market.

On the other hand, domestic design companies base the acquisition of technology on their own R&D since the core design technology is vital to the design companies and very closely related to the company's market competitiveness. Secondly, strategic alliances, merger and acquisition, and purchasing technology from overseas allows for technology exchange, the accelerating of technology integration and innovation through the expansion of product lines. The apparently low aspirations of the Industrial Technology Research Institute (ITRI) towards technology acquisition demonstrates the large increase in the technology capability of the private sector which no longer needs to rely on technology migration from the ITRI as in the past. The previously unpopular cooperation between industry and academia due to the lack of enthusiasm from business has improved in recent years. Industry and academic institutions have established research groups in order to further raise the standards of Taiwan's industrial science and technology.

3. Supporting Industries

As for supporting industries, design companies believe in maintaining good cooperative relationships with chip manufacturers, with the further acquisition of stable capacity being a vital factor. On the other hand, with the steadily growing importance of System on Chip (SoC) and the importance of IC design companies' control of the timetable for the introduction of new products, the support of IP and EDA factories is thus clearly vital, as they can reduce the SoC development period and speed up introduction of products onto the market. Domestic IC design companies also have a spirit of specialist division of work and take into consideration

the huge investment funds required for the establishment of chip plants. Considering the increased operating risks, they are rather unwilling to set up chip plants either in through joint investment with foundries or by themselves.

4. Business Strategy and Structure

Once IC design factories have reached a fixed operating scale, they then begin to expand their product line, reducing the breathing space for small-scale design companies. This indicates that design factories are aware of this situation, gradually focusing on company expansion and transformation, moving towards areas of new technological trends and maintaining their competitiveness. IC Design industry is known for long design time frame yet short product cycle, with each new generation product going obsolescence in twelve to eighteen months. As the IC Design industry is knowledge-intensive, design companies are willing to spend more in R&D in order to develop more competitive core technologies and utilize Taiwan's flexible, fast-pace culture to anticipate the opposition's moves and swiftly place the product on the market. Personnel mobility is also a problem for design companies, and so they use methodology to establish a component inventory and reduce the risk of personnel mobility. This factor is recognized as being very important for the maintaining of competitive advantage. Furthermore, the drawing up of product specifications is also seen as vitally important since invariably the use of follower strategy cannot maintain competitiveness in the long term. Only the drawing up of specifications in conjunction with global design firms can firmly grasp the technology trends, and raise product added value.

5. Human Resource Support

Taiwan's industry has had manufacturing expertise for a long time, and thus has not placed so much importance upon personnel training in product marketing. When faced with internationalization and global competition, the industry generally felt that international marketing personnel were not critical, and the expansion of products onto the international market was more difficult. Due to the serious head-hunting situation within the industry and the tendency of employees to jump ship and set up their own

business, with not enough to go round, industrialists are very worried about the lack of R&D personnel and generally feel the lack of qualified R&D design personnel is a real problem.

6. Sales & Marketing

Industrialists recognize the importance of establishing their own brand name because once the knowledge-based IC design industry releases a chip with superior functionality onto the marketplace it immediately becomes the center of attraction. A high degree of reputation (recognition) could bring considerable profits to the chip designer. As the life cycle of IC products is rather short, it is important to obtain market insight and high product standards during the early stages. Therefore, all design houses have established sales points all over the globe in order to grasp sales channels and market information for the release IC products ahead of their competitors, enabling their products to quickly enter the mainstream at the earliest possible stage and thus earn maximum profits.

7. Government Policy

Intellectual property protection is vitally important to the knowledge industry. With such protection, it is recognition to the design houses in their innovation and invention. In addition, from the firm's perspective, it is natural they would hope the government would provide related tax incentives in order to lessen their costs and cultivate talent in the relevant fields in order to resolve the problem of a shortage of skilled workers. The design houses are also positive towards the establishment of SIP (Silicon Intellectual Property) and believe it could bring this industry with SIP related industrial, technological, legislative, and market trend development information so as to synchronize with the global industry and enabling domestic manufacturers to develop their product innovation and increase the added value for chips.

Recent hot topics in the industry are the westward migration into Mainland China and WTO entry, with manufacturers particularly anxious to open up the China market. On the one hand, the people in Mainland China and Taiwan speak the same language and are of the same race, thus reducing problems associated with communication and culture. Furthermore,

Mainland China has an enormous market as well as a cheap, talented workforce. Early stage positioning and cooperation with Mainland China would greatly enhance Taiwan's competitive advantage in the field of IC design and rival the multinational giants. However, the barrier at this moment is still current government legislation, which requires considerable relaxation. It is generally felt that the competitive advantage gained through WTO entry is not so important to design houses, as domestic manufacturers have already enjoyed government protection for so long. There is concern over the lack of preparation in facing the sudden global competition and that the size of the industry cannot rival the large companies.

The impact of basic public utilities such as water and electricity would be minimal, since IC design houses do not require a huge amount of electricity and water; however such basic infrastructures might affect the related downstream industries they support.

4-3 Diamond Model Analysis

In his book “Competitive Advantage”, Porter proposed the diamond model to analyze the competitiveness between the country and foreign nations. This study applies Porter’s diamond model by summarizing the industrial literature and analyzing the survey result in order to find out the criteria of competitive advantage for our IC design industry. Below is an explanation of the competitive advantage our country constructed for the IC design industry based on 6 facets including key talents, prerequisites, entrepreneurial strategy and structure and competitors, related industry, and supporting industry.³²

1. “Factor” Conditions

- a. Having technical manpower of superior quality.
- b. Relatively cheap labor and production costs compared to Europe, U.S., Japan, and South Korea.
- c. Ease in gathering funding and accessing capital resources.

2. Demand Conditions

The downstream product market such as information, communication, and consumer system manufacturers in Taiwan are also OEM manufacturers for European, U.S., and Japanese major companies. Their products mostly have a significant share in the global market and therefore have the characteristics of huge IC demand.

3. Firm strategy, structure and rivalry

- a. Once Taiwanese IC design houses achieve a certain level of business, they gradually expand their operations and require their development and expansion to have more resources. They adopt the methods of acquisition or strategic alliance to secure further technology sources in order to bolster their superiority in technology.
- b. The domestic upper, medium, and lower stream semiconductor industries are closely related to each other and IC design houses can customize their products based on customers’ requirements as they have the advantage of flexible design. Adding the support of

methodology in the enterprises, it can furthermore create the competitive advantage of speed in Time to market.

- c. Domestic design houses aggressively invest more R&D capital and concentrate in upgrading product development capability.

4. Related and supporting industries

- a. The upper, mid, and lower stream industry is becoming more complete through close proximity to foundry and IDM plants. Under the industrial structure of division of work, product support can be obtained immediately which therefore increases the speed of delivery and cost advantage.
- b. EDA manufacturers can support the IC industry product design speed of and increase the competitive advantage in time to market custom products.
- c. Close proximity to the downstream customer product market can increase customer service and provide functional planning for new products.

5. The role of government

- a. Further increases in competitiveness through tax incentives and assistance to domestic manufacturers in technology transfer for IC design houses.
- b. Drives the establishment of a Silicon IP consortium as a platform for technology exchange between manufacturers and explores product innovation as well as increases the added value of chips.
- c. Aggressive participation in entering the WTO and helping Taiwanese manufacturers in the exploration of new markets on the basis of fair competition. Also drives foreign investors to establish plants in Taiwan and encourages the mutual exchange of domestic and foreign technology.

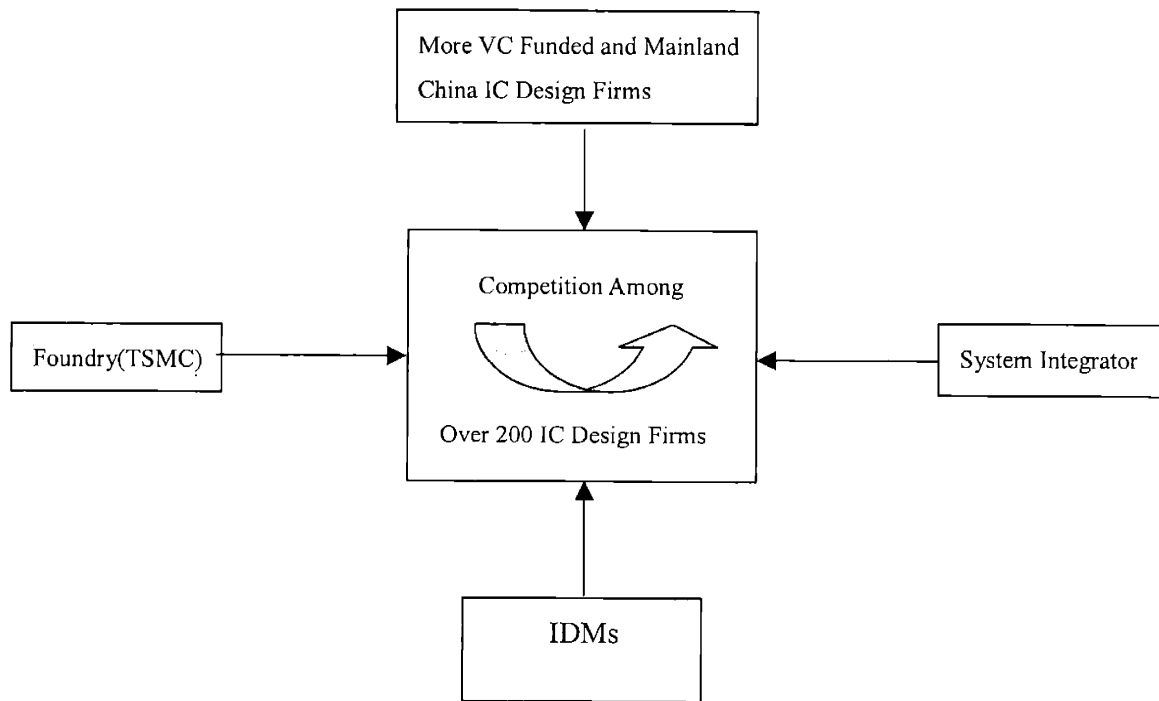
6. The role of chance

- a. Although PC growth has stagnated, semiconductor demand from wireless communication applications together with blue tooth

technology, information appliances and network applications, is expected to create another wave of brand new system products.

- b. Fast growth in TFT-LCD and mobile phone STN-LCD will trigger drastic increases in controller and driver IC's.
- c. The market is looking for products with more functions, lower costs, and shorter marketing lead-time, etc. The future lies in SOC integration chips, with SOC maturity expected to result in an explosive market.
- d. In terms of market size, globalization and hiring of engineering talent, Mainland China is by no means the market worth exploring. Taiwanese design houses could increase their competitive advantage through access to the local technical support and marketing and sales by combining with the local mid/lower stream resources or even by hiring local design talent at relatively cheap cost and yet with good quality.

4-4 Five Forces Analysis on Taiwanese IC Design Industry



The five forces analysis is an industrial structure analysis tool developed by Porter, which includes potential threats from new entrants, the threat of alternative products, buyers' bargaining power, suppliers' bargaining power, and competition between existing competitors. In the analysis of the adaptability of our domestic industrial development in IC design using the diamond model theory, this study applied the five force analysis proposed by Porter to further understand our competitive advantage in the IC design industry as a reference for the industry. Below is an explanation of the five competitive strengths.

1. The threat from potential new entrants

The semiconductor industrial infrastructure in Mainland China is currently being established at a fast pace. If the grouping effect reaches maturity, the Mainland China IC design industry will make use of local mid and lower stream industries and the proximity to the market and pose a threat to Taiwan.

2. The threat from alternative products

Several of the downstream system manufacturers have already established IC design departments for the design of in-house IC chips, and have also secured the chips with needed functions through IP providers. Therefore, under the attack from both sides, this poses a threat to the IC design industry in terms of alternative products.

3. Buyers' bargaining power

- a. Manufacturers engaging in low-level, mature product design have lower bargaining power with their customers.
- b. Manufacturers who engage in high-level product design (such as SOC), are the originators of product specifications or who can quickly release product designs with superior functionality have higher bargaining power with customers.
- c. Design manufacturers with branded products have higher bargaining power with customers.

4. Suppliers' bargaining power

- a. The suppliers' bargaining power depends on the marketing environment. During good years, the production capacity of suppliers (Foundry) is very tight and the design company's bargaining power very low. When the market is weak, the foundry's production capacity is smaller and therefore design companies can have more bargaining power.
- b. IC design houses having strategic partnerships with foundries tend to have higher bargaining power.
- c. As foundry makers expand their facilities, the bargaining power of IC design companies also increases.

5. Competition between existing competitors

The capital entrance barriers for the IC design business are clearly lower than for other IC-related industries, thus manufactures seeking smaller niche markets are rapidly emerging. However, as domestic IC design houses gradually increase in size, there is less room for these smaller

design houses to survive. Hence products developed by these smaller design houses must have a certain level of technical competitiveness and require a shorter time to market in order to compete with existing larger IC design houses.

4-5 SWOT Analysis

From the above discussion, a complete SWOT (Strength, Weakness, Opportunity and Threat) analysis for our domestic IC design business was conducted. Below is an explanation of the analysis in terms of strength, weakness, opportunity and threat from outside the industry.³³

1. Strengths

- a. The industry is highly flexible and quick to adapt to the environment.
- b. Strong competitiveness due to the proximity of professional foundry makers, assembly and testing houses supporting the IC design houses.
- c. Huge demand of the downstream application industry.

2. Weaknesses

- a. Insufficient skilled workers with experience of international marketing and design techniques.
- b. Require further reinforcement of innovation and ability in designing specifications.

3. Opportunities

- a. Early deployment and grasping of key technologies in new emerging communication sectors (RF and bluetooth technology), networking, and information appliances.
- b. High future demand for LCD means it is vital to enter the TFT-LCD driver IC chips related market.
- c. Building high entrance barriers and high value-added System on Chip technology (SOC).
- d. Facing the vast market in Mainland China, it should be easier to establish sales channels and engage in cooperative projects with local talents.

4. Threats

- a. Foreign IC design houses tend to use “Patent infringement litigation” with the threat of intellectual property rights.

- b. China will become Taiwan's greatest rival once the clustering effect of semiconductor industry in China is in formation and stimulates the development of IC design business.

Chapter Five---Overview of the Taiwanese Venture Capital Industry

Venture Capital is money provided by professionals who invest alongside management in young, rapid growing companies that have the potential to develop into significant economic contributors.³⁴ Venture Capital is an important source for start up companies.¹ V.C. focuses on different stages of newly established enterprises, by making financial investments as well as bringing technical, operational, and managerial expertise. Taiwan's venture capital industry has been present for more than twenty years, funded mostly by domestic corporate institutions, conglomerates, public companies, banks and insurance companies, as well as domestic and overseas wealthy individuals. This is in contrast with the venture capital industry in the U.S., where over 60% of funding comes from large pension funds and endowments from universities and other non-profit organizations. (According to TVCA 2001 annual report, in Taiwan 40% of funding comes from government pension funds and 21% comes from endowments) These are also the areas where the VC industry in Taiwan should continue to explore given the tough conditions of the industry today.

Generally speaking, venture capital from Taiwan has the following characteristics:

1. Investment in newly established, fast growing start-up companies (mostly in the technology sector).
2. Providing portfolio companies with assistance in product development, technical support and channel marketing.
3. Investment typically undertaking high risks for very attractive returns.
4. Investment in companies with preferred shares and, in some cases, hands-on involvement with day to day operation.

In order to set up a venture capital fund, one must file an application with The Development Fund of Executive Yuan, Ministry of Finance. This is the governing entity for all venture capital in Taiwan (Oversea VC excluded). The minimum commitment capital per venture capital fund is NTD\$200MM (USD\$6M), approval takes weeks of process and review by the MOF, in which the capability of the management team is examined to ensure the fund will be properly managed and the source of funding is examined to determine if it comes from a legitimate source.³⁵ In the 1980s, in order to encourage industries to commit more funds into the VC industry, the government imposed a 20% tax reduction policy on all venture capital investments. All the tax amount realized from venture capital investment (mostly dividends, since

there is no capital gain tax in Taiwan yet) is entitled to a discount of 20%. Given the long commitment period of the funding, as well as Taiwanese companies unfamiliarity of the venture opportunity in the high-tech space, such tax reduction policy was an important driver for industries to commit the initial funding to VCs.

Due to the high-risk nature of investing in start-up companies, there has been a consistent effort for venture capitalists to diversify their investments. These diversifications could be in different industries, different sectors within an industry, different regions or different stages of investment. The current Taiwan government regulations limiting each venture capital to a maximum of twenty percent share holding per company are another effective way of diversifying investments.³⁶

5-1 Different Stages of Investment

The Taiwan Venture Capital Association (TVCA) has classified venture investments into five different stages - seed stage, start-up stage, expansion stage, maturing (mezzanine) stage and restructuring stage.³⁷ A seed stage fund usually requires seven years or more in the investment period; Start-up stage and expansion will take few years in the investment period. Mezzanine stage investment period typically requires less time, ranging from nine to eighteen months. Each of these stages is defined as follows:

Seed Stage

This is the earliest stage of a business concept, where generally a company is not yet established and the business concept or product is only roughly available. The capital is provided in order to prove the possibility of putting the concept into reality. This stage is funded by innovators themselves as well as wealthy individuals enthusiastic about the business concept. Most venture capital tends to be involved at a later stage

Start-Up Stage

This is the stage where initial prototype product development is complete and ready for implementation and scale up for the production stage. At this stage, funding is used in the hiring of key employees, buying manufacturing equipment and product marketing. This is a high-risk stage, with a very high failure rate amongst most start-up companies. Bank loans at this stage are not readily available due to the large capital expenditure needed and the absence of a business track record, thus venture capital is critical to success.

Expansion Stage

At this stage, with the business operating smoothly, further growth is promoted through expansion in both the product line as well as the volume of production. The company is still some way from its Initial Public Offering (IPO), therefore an appropriately timed injection of venture capital is necessary, and also brings in technical and managerial expertise to further facilitate the company's growth. This is a stage when many venture capitalists prefer to become involved, when business goals are clear and risk is relatively low compared to the two earlier stages.

Mezzanine Stage

This is the maturing stage of corporate development, where the company is only one year or less from its IPO and the timing is right to invite reputable institutional investors to increase its business recognition, which is essential for good listing requirements. Many conservative venture capitalists like to invest in these later stages in order to minimize any potential risk. The returns for this round of investments are typically lower than the earlier rounds and are, in many cases, determined by the conditions of the public trading market. Funds raised in this round are used to better improve the financial structure of the firm in preparation for IPO.

Restructuring or Turnaround Stage

This is where the company has failed in running a successful operation and gone into bankruptcy and restructuring. The funds will usually act as a turnaround catalyst, bringing in both capital and industry experts, taking over managerial responsibility and aiming to steer the company in a better direction. Many LBO (Leveraged Buy Out) funds in the U.S. and Europe are known for their turnaround capability, while Taiwan currently has no such type of funds due to the lack of turnaround expertise and the large capital required per venture partners.

5-2 Brief History of the Taiwanese Venture Capital Industry

The idea of "Venture Capital" originated in the U.S. and, after proven success, soon spread to Europe, Japan, and Taiwan. In 1983, the Executive Yuan of the Republic of China (ROC) on Taiwan established an agency to govern and regulate Taiwan's venture capital industry. The Executive Yuan development fund served as the government's own VC source as well as the regulating body for VC firms under the Ministry of Finance (MOF). In 1985, the Chiao Tung Bank and the Executive Yuan development fund jointly invested in several venture capital firms engaged in partnership with famous international capital companies such as H&Q, Walden and Advent. This investment of government funds in other venture capital funds as well as individual companies lead to the creation of the Taiwanese venture capital industry. By 1996, there were a total of 48 venture capital firms established, with most of them specialized in technology investment.³⁸

Taiwan's VC industry has experienced unusually high growth in the last five years due to the booming nature of Taiwan's IT (information & technology) industry. By the end of 2001, there were a total of 199 venture capital firms in Taiwan, managing a total of NT\$134 billion, a dramatic increase compared to 1996 when there were just 48 firms managing NT\$25 billion. In 2001, due to the continuing recession in the world's high-tech sector, Taiwanese VCs made total of 614 investments in the amount of \$6.4 billion. Cumulatively, there has been a total of 6957 investment over the last six years (Figure 5-1).³⁹

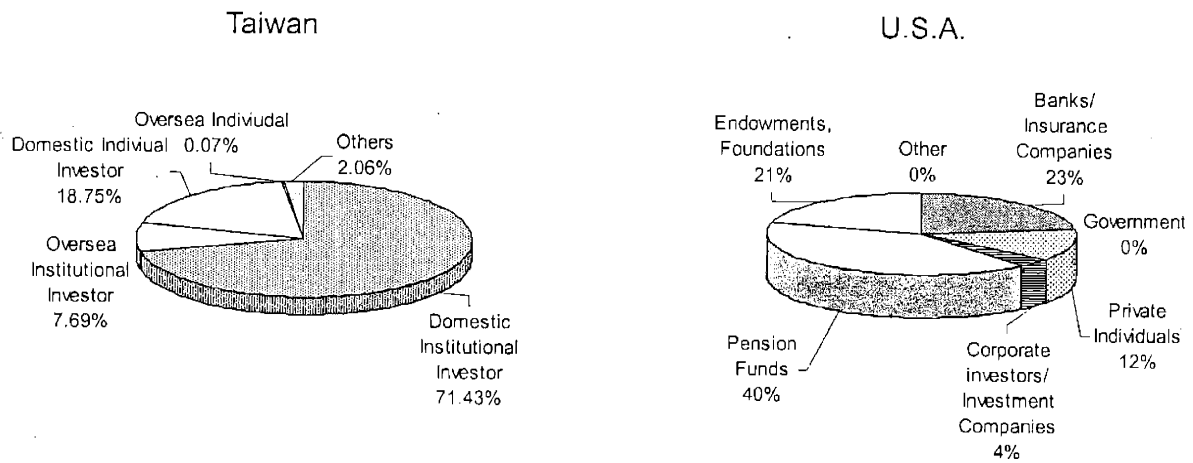
Figure 5-1, the Number of Venture Capital Firms and Total Funds Managed

	1996	1997	1998	1999	2000	2001
Total # of VC firms	48	76	114	160	192	199
New VC Firms in the year	14	28	38	46	32	7
No. of firms change industry	1	4	7	7	7	11
No. of firms delay setup	0	0	0	0	15	12
No. of firms actual running	47	72	107	153	170	176
Growth Rate	38.24%	53.19%	48.61%	42.99%	20.26%	4.12%
(In NTD\$MM)						
Total Capital Under Management	254.60	426.31	729.32	1034.25	1280.76	1341.07
New Raised Capital(NTD\$MM)	67.57	171.71	303.01	304.93	236.52	60.31
Growth Rate	36.15%	67.44%	71.08%	41.81%	23.84%	4.71%
Average fund per firm (NTD\$MM)	5.42	5.92	6.82	6.76	6.96	7.62
Investment Analysis (In NTD\$MM)						
Total case of investments	1158	1839	2994	4493	6343	6957
Total amount of investment	286.37	435.22	651.13	947.06	1255.09	1336.55
Investment Cases	471	951	1155	1499	1850	614
Investment Amount	88.13	176	215.91	295.92	308.03	81.46

Source: TVCA 2001 Annual Report

In terms of shareholder structure, the domestic institutions are the leading investors, with more than 70% of holdings, followed by domestic individual investors with 18% and foreign institutional investors with 7.6% of holdings.⁴⁰ Among the domestic institutional investors are high-tech companies, large corporations in the traditional sector, banks, insurance companies, securities firms and investment corporations. Unlike in the U.S., large pension funds and endowments are not yet permitted to invest in venture capital firms. Were Taiwan's huge pensions system allowed to invest in venture capital it would be a significant source of funds in the further expansion of the Taiwanese venture capital industry.

Figure 5-2 Comparison of Taiwan and U.S. VC Funding Structure

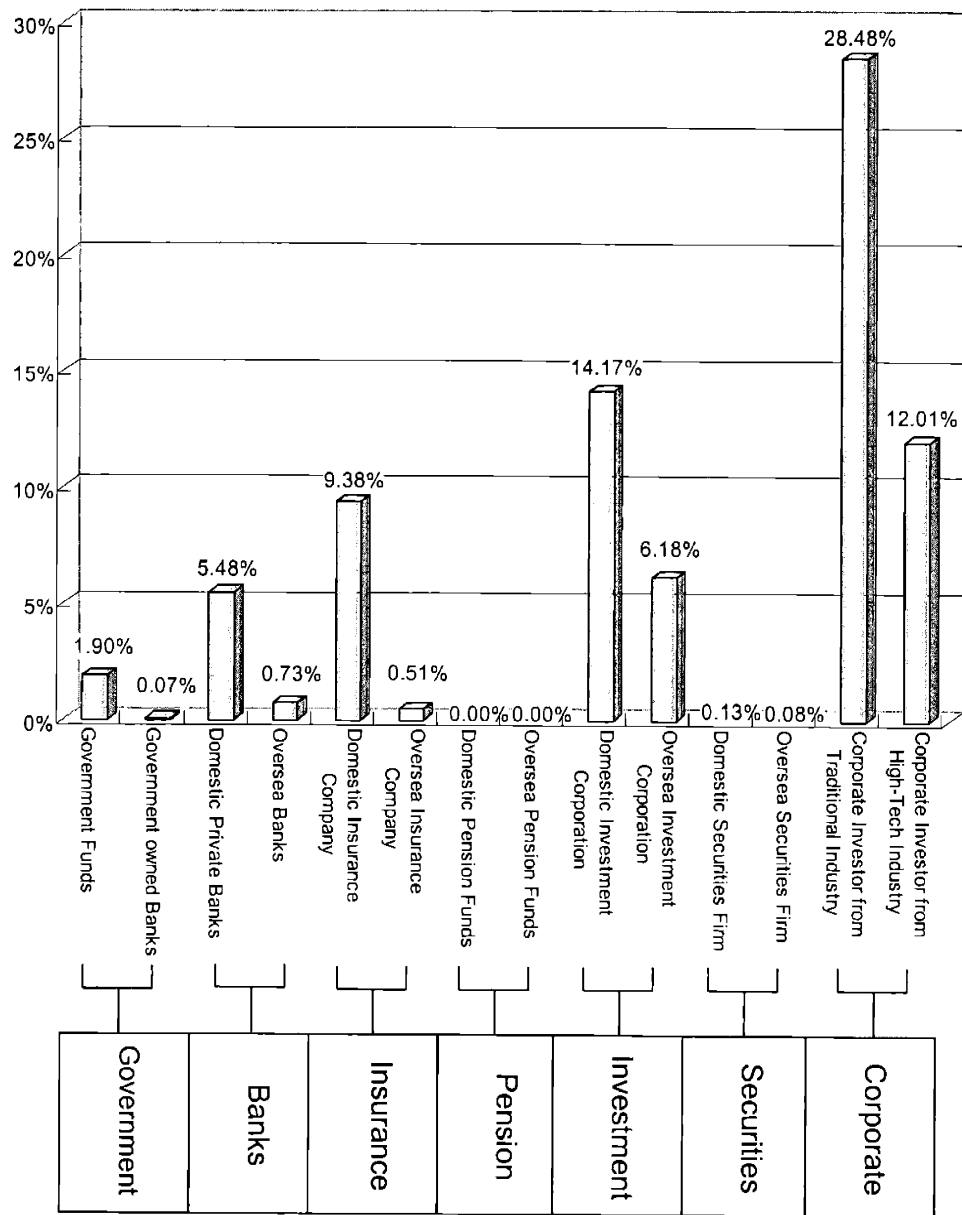


Taiwan Shareholder structure investor	Domestic Individual Investor	Domestic Institutional Investor	Oversea Individual Investor	Oversea Institutional Investor	Others	Total
Percentage	18.75%	71.43%	0.07%	7.69%	2.06%	100%

U.S.A. Shareholder structure investor	Banks / Insurance Companies	Government	Private Individual	Corporate Investors/ Investment Companies	Pension Funds	Endowments Foundations	Other	Total
Percentage	23%	0%	12%	4%	40%	21%		100%

Source: TVCA 2001 Report

Figure 5-3 Structure of Taiwanese VC limited partner/domestic institutional investor



Source: TVCA 2001 Report

In terms of investment areas, the semiconductor, electronics, information and telecommunication industries are ranked in the top four with market shares of 16.17%, 15.24%, 14.23% and 12.91% respectively. Taiwanese venture capitalists are fond of investing their funds across the different sectors within the world-renowned domestic semiconductor industry. From design to foundry, packaging and testing, venture capitalists continue to invest in each part of the entire value chain. Certain venture

capitalists adopt a sector-focused strategy, specializing their portfolio investments in a single sector such as design, while more and more VCs have positioned themselves as experts in investing in IC Fabless design firms. Other investment firms have adopted the diversification strategy, attempting to invest in companies across all five different sectors in the semiconductor manufacturing process, creating synergies and alliances between their portfolio companies. In an aggressive year such as 1996, venture capital investment in the semiconductor industry exceeded 20% all venture capital investments.⁴¹

Figure5-4 VC's Total Number of Investments in Each Sector, From 1996 to 2001

	Seed Stage	Start Up Stage	Expansion Stage	Mezzanine Stage	Restructuring Stage	Total	Percentage
Information	46	177	465	282	20	990	14.23%
Software	51	189	286	59	5	590	8.48%
Internet	22	159	94	33	1	309	4.44%
Electronics	36	170	567	265	22	1060	15.24%
Semiconductor	112	314	479	213	7	1125	16.17%
Telecommunications	107	208	416	154	13	898	12.91%
Advanced Sensing System	4	3	10	5	0	22	0.32%
Pollution Control	3	5	4	3	0	15	0.22%
Precision Machinery & Automation	6	13	91	80	0	190	2.73%
Advanced Materials	3	22	36	25	1	87	1.25%
Specialty Chemicals & Pharmaceuticals	4	13	13	2	0	32	0.46%
Health Care	4	17	20	4	0	45	0.65%
Aerospace	0	2	14	2	1	19	0.27%
Resources Exploitation	0	12	9	2	0	23	0.33%
Opto-Electronics	74	240	268	99	1	682	9.80%
Biotech	35	75	83	27	1	221	3.18%
Technology Services	3	12	23	8	0	46	0.66%
Other Major Technology	9	32	107	47	2	197	2.83%
VC Industry	38	37	34	11	0	120	1.72%
Traditional Manufacturing Industry	12	33	107	130	4	286	4.11%
Total	569	1733	3126	1451	78	6957	100.00%
Investment Percentage	8.18%	24.91%	44.93%	20.86%	1.12%	100.00%	

Source: TVCA 2001 Report

In terms of different investment stages, Taiwanese venture capital tends to invest primarily in the expansion and start-up stages, where the percentage of expansion stage investment ranges from 42.1% to 55.2% and start-up stage investment ranges from 17.8% to 35.4%. Generally speaking, venture capital tends to be more aggressive in earlier stage investments when the economy is performing well, and tends to be more conservative during economic downturns and requests for shorter investment cycle. As previously discussed, Taiwan continues to have only a very small percentage of investment in the turnaround stage due to the lack of capital and expertise to specialized investments in company turnaround.

Figure 5-5 Stage of Investment and Percentage Analysis (1996-2001)
Amount in NTDSMM

Year	1996		1997		1998		1999		2000		2001	
	Amount	Per cent age	Amount	Per cent age	Amount	Per cent age	Amount	Per cent age	Amount	Per cent age	Amount	Per cent age
Seed Stage	889	10.1%	725	4.1%	2013	9.3%	1851	6.3%	2406	7.8%	564	6.9%
Start Up Stage	1569	17.8%	4227	24.1%	5450	25.2%	7435	25.1%	10110	32.8%	2887	35.4%
Expansion Stage	4863	55.2%	8651	49.3%	9947	46.1%	13014	44.0%	12972	42.1%	3441	42.2%
Mezzanine Stage	1429	16.2%	3730	21.2%	4015	18.6%	7080	23.9%	5042	16.4%	1242	15.2%
Restructuring Stage	63	0.7%	229	1.3%	166	0.8%	212	0.7%	273	0.9%	13	0.2%
Total	8813	100.0%	17562	100.0%	21591	100.0%	29592	100.0%	30803	100.0%	8147	100.0%

Source: TVCA 2001 Report

Recent Performance

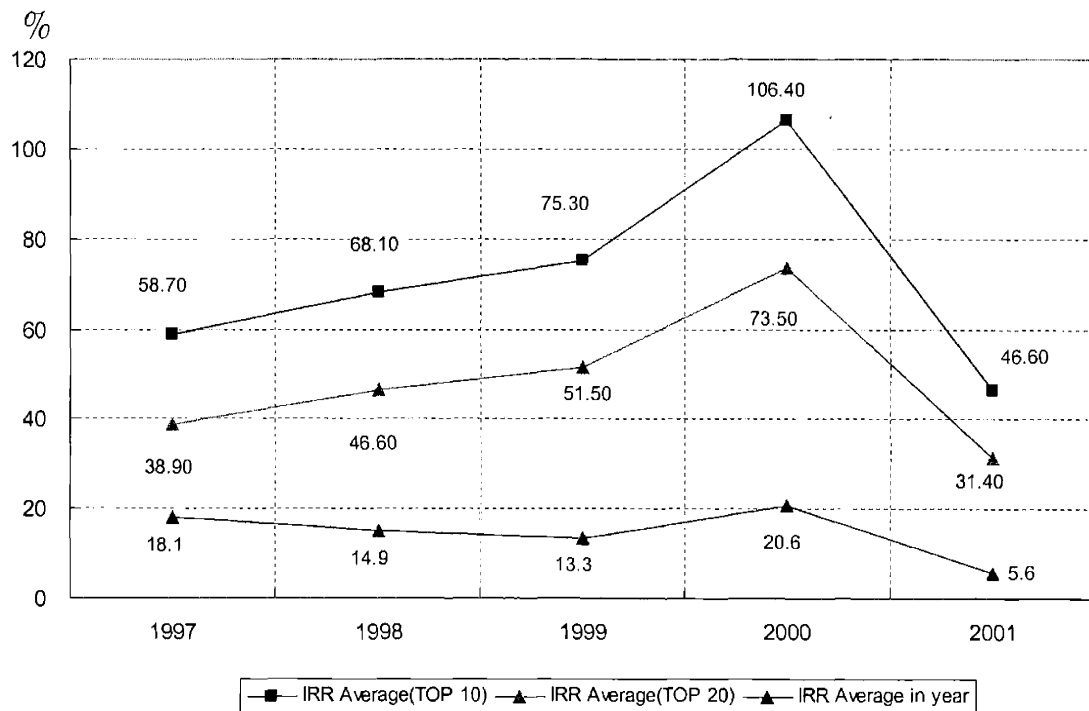
In terms of Taiwanese venture capital performance from 1997 to 2001, a few interesting figures are presented for discussion. The average performance for the entire industry starts from a low of 5% investment return rate (IRR) in 2001 to a high of 20% IRR in 2000, with an average over five years of around 13.9%. Considering the high risk nature of the venture capital industry, 13.9% is not an historically satisfactory performance. However, if we look at the figures for the top ten or twenty performers in the industry, the results become much more attractive. The top twenty performers have an IRR ranging between 31.4% and 51.5% per year between 1997 and 2001, averaging around 48.3%. The IRR range for the top ten industry performers extends from 46.6% to 106.4%, averaging 71%. Thus the statistics disclose the large variations in performance between well-run and average venture capital firms.

Figure 5-6 Performance of Taiwanese VC Firms

	1997	1998	1999	2000	2001
IRR Average (TOP 10)	58.7%	68.1%	75.3%	106.4%	46.6%
IRR Average (TOP 20)	38.9%	46.6%	51.5%	73.5%	31.4%
IRR for all firms (Average)	18.1%	14.9%	13.3%	20.6%	5.6%

Source: TVCA 2001 Report

Figure 5-7 Graphs on Performance Analysis



Source: TVCA 2001 Annual Report

5-3 Timelines for Major Events in the Taiwanese VC Industry (In Five Stages)

Seed Stage

- 1973: Government sets up the Industrial Technology Research Institute (ITRI) to conduct technology research and transfer to private enterprises.
- 1980: The Executive Yuan of the ROC on Taiwan establishes the Hsin-Chu Science Park to create a cluster community for high-tech manufacturing companies.
- 1981: Venture capital a huge success in Silicon Valley, California.
- 1982: Mr. K.T. Lee from the Ministry of Economic Affairs initiate plan to establish Taiwan's VC industry after a research trip to the U.S.
- 1983: Senior government advisor on VC project Dr. Ramo proposes a tax exemption policy for venture capital investment, a key factor for subsequent industry success.
- 1984: First VC established in Taiwan, with co-investment from Acer Computer and Continental Construction Inc.

Start-up Stage

- 1986-7: Leading international VC firms such as H&Q and Walden set up businesses in Taiwan with co-investment by Taiwanese corporations.
- 1988: Golden Gate Venture Capital was established Dr. Wang of the Wang Computer, a symbol for oversea Chinese entrepreneurs to return to Taiwan and give back to their country.
- 1989: Taiwan stock market reaches 12,000 pts; the capital flow enables establishment of more VC. Leading domestic firms such as WK Technology Fund are established.
- 1990: Government proceeds with the second policy phase to encourage VC funding through the "Industry Up Moving Act" and maintaining tax reductions for VC investor.
- 1991: World economic recession, Taiwanese high-tech and semiconductor companies such as TSMC, Winbond, and Macronix receive funding from Taiwanese VC firms.
- 1992: Creation of the Taiwan Venture Capital Association (TVCA), with W.C. Ko, Chairman of WK Technology Fund, as chairman.
- 1994: The Executive Yuan Development Fund approves a total of 29 VC firms,

managed by 19 different groups.

Expansion Stage

- 1995: The second Chairman of TVCA is Ding Hua-hu, the Chairman of Chien Kung VC group.
- 1996: there are total of 47 venture capital funds managed by 29 different groups. Ho-Tung Venture Capital is the first group to be listed in Singapore.
- 1997: Taiwanese VC investment in U.S. high-tech industry reaches a new high.
- 1997: Executive Yuan decides on a policy to focus on domestic bio-tech investments.

Maturing Stage

- 1998: Number of Taiwan's VC firms reaches 100, with total managed assets of NT\$72.9 billion, managed by 57 different groups.
- 1999: Ministry of Foreign Affairs invites 30 APEC member countries to attend conference on "Venture Capital and New Enterprises", showcasing Taiwan's venture capital success.
- 1999: APEC conference in New Zealand, Taiwan initiates agenda discussion on the success of domestic venture capital and high-tech industries.
- 2000: Executive Yuan cancels the tax reduction policy for investment in the venture capital sector, allowing securities firms to invest in venture capital.
- 2000: There a total of 169 VC firms managed by 74 different groups, with total assets under management of NT\$128 billion.
- 2001: Recessions in the global economy and high-tech sector cause venture capital investment to drop to its lowest level in six years.
- 2001: Executive Yuan considers listing of venture capital firms.⁴²

5-4 Future Outlook for the Taiwanese Venture Capital Industry

Pension Fund Investment in Venture Capital

The majority of pension funds adopt a conservative strategy. However, in order to achieve any total annual return target, many government funds tend to invest in venture capital in order to increase the return on their portfolios. In the U.S. venture capital industry, sufficient funding comes from government and private pension funds, while endowments have helped the industry to develop tremendously. According to the 2001 annual report of the U.S. Venture Capital Association, 40% of U.S. venture capital funding comes from government pension funds. In Taiwan, the total value of government pension funds is around NT\$500 billion, which is approximately 400% of the total combined venture capital funds available in Taiwan. Thus allowing Taiwanese government pension funds to invest in venture capital will help the VC industry significantly. Opponents of the proposal are worried about investing in such high-risk investments. However, given the example of U.S. government pensions, in which the VC gets sufficient funding and pensions achieve a higher return rate, it can become a win-win situation for both parties. Taiwan's venture capital industry has been performing consistently well in the last six years and if government pension funds choose the right firm to work with, the risk shall be limited.

Continuation of the Tax Reduction Policy

In the early stages of Taiwanese venture capital development, the 20% tax reduction policy was an important factor in the industry's success. In the last twenty years, the actual total tax reduction was only NT\$5 billion, but it was a strong incentive for different category of investor to contribute funding to the venture capital industry, and invest in more than 300 high-tech companies listed on either the Taiwan Securities Exchange (TSE) or OTC markets. After the cancellation of the policy in 2000, combined with the global economic and high-tech recessions in 2001, Taiwan's venture capital industry faced its toughest ever conditions, with only a 3% increase in actual money under management, compared to an annual average growth of 25-30% in previous years. The cancellation of the tax reduction policy sends a clear signal that the government has stopped encouraging the industry and wealthy individuals to invest their money with venture capitalists and create value through their expertise. NT\$5 billion is only a small fraction of the total taxation. In order to consistently provide incentives to invest in venture capital, the government should resume the tax saving policy for venture capital investors, along with other incentives that could

stimulate the currently weak VC industry.⁴³

Summary

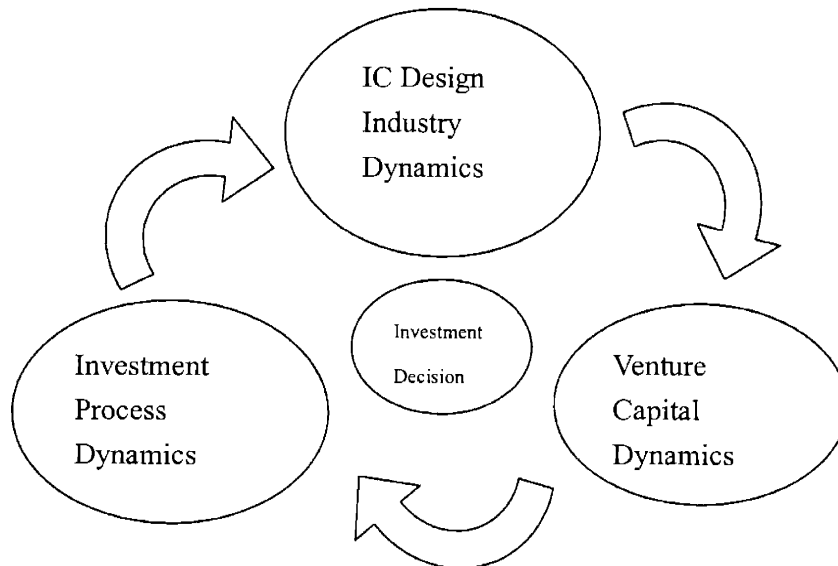
Success for Taiwan's high-tech and venture capital industries has gone hand in hand, with the funding and expertise provided by venture capital and private equity helping many high-tech and semiconductor companies to establish and grow during Taiwan's information and technology era. The well-run high-tech companies, after achieving global success in dominating many IT sectors such as personal computers, laptops, semiconductors, communications and displays, have given back to the venture capital industry by continuing to invest in many of the venture capital funds. This level of success could not have been achieved without close cooperation between the two industries. The continuing global economic and high-tech recessions have had a severe impact on many aspects of both the high-tech and VC industry. In order to achieve the next level of success, the VC and high-tech industries must work closely together, allowing mutual investment and expertise sharing, creating a new synergy between the two industries.

Chapter Six--- Decision Making Factors in Semiconductor Investment

Research Purpose

This study examines venture capital (VC) investment strategy with regards to the semiconductor industry, with particular emphasis on the IC design sector. There has been little VC research focusing on investment aimed at a specific sector, especially the relationship between the semiconductor and VC industries in Taiwan. Due to the difficulty of obtaining thorough and accurate statistical data, it is unclear whether the VC industry has generated significant profits by investing in the semiconductor industry over the past twenty years. Through interviews with venture capitalists in the Greater China area, within Taiwan and Hong Kong and mainland China this study will determine the reasoning behind their investment behavior by looking at their IC design investment strategy objectives and assessing any similarities or differences in their individual approaches. This chapter will begin with the industry dynamics of IC design as determined by the five forces analysis in chapter four, followed by an understanding of how different factors shape the industry and an analysis of different factors in the investment process. Finally, an analysis of VC shareholders, management teams and their cooperative external network shall determine their effectiveness in semiconductor investments.

Three pillars of the investment process



Source: Clockspeed, Charlie Fine 1998.

6-1 Industry Dynamics of IC Design Companies

Importance of Relationship between Fabless and the Fab

It is important for chip fabrication plants to maintain good relationships with the IC design companies they supply. Most IC design companies rely on IDM or foundries to secure chip production due to the high cost of building a fabrication plant. However, if the market is good and demand is heavy, it can be difficult for design firms to secure production and thus the stability of chip production has always been an important factor within a design company's strategy. The close supplier-client relationships allow for the implementation of strategic initiatives between both parties. Many fabless design companies ask foundries for investment and invite them to become part of the team, while other foundries have utilized their capital to invest in venture funds specializing in IC design investment. After the design companies obtain funding and commence chip production, their foundry investor will automatically become the design company's supplier. Such a strategy has been adopted by foundry companies such as UMC Capital Inc., the venture capital arm of United Semiconductors Corporation, which actively invests in design companies that could become future UMC clients.⁴⁴ The largest foundry in the world, Taiwan Semiconductor Corporation (TSMC), also has an investment arm. When investing in an IC design company, it is important to examine whether the company investor or management team have enough experience in dealing with foundries. In order to better ensure the stability of production during periods of high demand, it would be beneficial if members of their investor or management teams came from a foundry background.

Design Firm R&D Capability

There are several ways of acquiring the technology required to design new, high performances chips, including internal Research and Development, strategic alliances and acquisition of new technologies, and technology transfer from research institutions. Of these, internal R&D is highly valued as a company's core-competence. Due to the short, volatile chip market cycles, many newly introduced chips will often become obsolete within a matter of twelve to eighteen months. Once competitors have caught up and introduced similar functions into their own products, the price of the chip will drop significantly and rapidly. Thus market leadership is essential in maintaining consistent high profit margins. When determining a firm's R&D capability, it is important to assess the management team and their track record, the

technology and scope of products they were previously exposed to, and their awareness of future trends in the marketplace. This is not to say that people with no previous track record can not design a chip better than an experienced engineer, but rather that a higher probability of success exists where the design capabilities of senior engineers are combined with their instinct of predicting what the market will adopt in the future generation of chip markets.

Intellectual Property (IP) and Electronic Design Automation (EDA)

There is little doubt that the future of the chip market lies in System on Chip (SoC). Most design companies in Taiwan do not have their own IP (Intellectual Property), therefore it is important to purchase the right IP (Intellectual Property) from IP suppliers in order to speed up the design process. Due to the dynamics of the semiconductor industry, where the U.S. is the main market but within which it is more costly to maintain operations, it is more efficient for design companies to have offices in both the U.S. and Taiwan and, in some cases, a cost-effective R&D center in China. Considering both the complexities of future chip requirements and a working environment which allows different offices to coordinate and design concurrently, future design companies will need to address the issues of IP and EDA to ensure that speed and complexity of new product is well considered.

The Weakness in Global Product Marketing Experts

Taiwan is known to have a strong manufacturing capability but is relatively weak in global marketing. Taiwan may have top engineers with the ability to develop the most cutting edge products, but without a global product marketing strategy and effective channels, it is difficult to sell the product on a worldwide basis. Although many Taiwanese firms such as BenQ and Asus are quite aggressive in establishing global recognition for their products, it takes longer for them to obtain market acceptance. While considering these factors, the IC design company's product marketing capability is extremely important for the success of the company. When making an investment in an IC design company, it is vital to examine closely the company's strategy in terms of its product marketing and how it intends to sell to a large and profitable market, as well as assess the product marketing team and their track record to determine whether they have enough experience in selling to an increasingly competitive market. Whereas engineers can graduate from good institutions and learn how to design good chips, global product marketing skills are only gained after years of dealing with international companies. In addition, once product marketing experts

become a valuable market commodity, the turnover rate for these specialists tends to shift quickly. Within such a competitive environment, companies should also have a reliable plan to effectively recruit and maintain key staff.

Establishment of the Company's Own Brand

At present, four of the world's top twenty IC design companies are from Taiwan, with the success stories of companies such as Via and Mediatek inspiring many talented professionals in Taiwan to start their own design companies. In order to become a top global IC design firm, it is crucial to design and develop your own brand. There are many companies in Taiwan and the U.S. that can design chips with similar functions, however, the engineering technology behind chip design is not the only factor to be considered - brand recognition can lead to better business profit margins. Therefore, it is important for companies to have an effective marketing strategy and set up subsidiaries for marketing purposes to ensure the company possesses an effective global marketing channel.

Patents Strategy

Patents are important for all semiconductor and high-tech companies; with the number of patents a company holds usually being a measure of the company's technology competence level. When making a venture investment in the semiconductor industry or IC design sector, investors will examine the following:

- The number of patents the company owns.
- The type of patents the company owns and how they are aligned with company strategy.
- The specialists who designed the patents, and their contribution to the company.

Companies can utilize their existing patents in many ways:

- Sue any companies who infringe their product patents and seek substantial compensation.
- Sell their patents at a high price to other companies, and earn new income streams with very high profit margins (Almost zero cost of goods involved).
- Form strategic alliances, trading their patents or co-developing a product using

existing patents, and share profits.

Patents can be used both defensively and offensively within corporate strategies, while a good design company should have a number of patents and a plan to fully utilize them. There are frequent patent trade and litigation disputes within the semiconductor industry, thus it is vital for any company in the field to have an proprietary patent strategy.

Penetration of the Greater China Market

Most of the Fortune 500 companies have already developed a plan to enter the vitally important China market, while nine of the top ten IC design companies in Taiwan have set up subsidiaries or R&D centers in China. Every company has their own interpretation of the opportunities in China, which they include in their business plans, while investors in the IC design sector need to carefully evaluate their plans for entering the China market. While China might have a huge domestic market for low-end chips and provides quality engineers at a lower cost, there are certain risks associated with doing business in China. Companies who intend to take advantage of the lower labor costs and set up an R&D center need to examine whether the center can work closely with their Taiwan or U.S. offices, determine if they can communicate with each other and co-develop the same quality of product, or the company can provide a concurrent design environment that allows engineers to work across different geographical regions. Companies who want to market their chips in China need to make sure they have sufficient sales and marketing capability. Although China is now a member of the WTO and allows foreign companies to openly compete in the domestic market, it is widely known that Chinese companies possess certain advantages through better cultural understanding and imperceptible protection from the government. Many foreign companies who wish to enter China often run up against surprise factors, such as the socio-political differences and existing foreign exchange controls. Companies should prepare a comprehensive plan for entering the China market as part of any future business development.

6-2 Investment Process Dynamics of IC Design Companies

This study will look at the ten major processes in VC investment - **Investment Amounts, Investment Stages, Investment Sectors, and Different Regions, Portfolio and Risk Management, External Advisory, Exit Strategy, Deal Source, Due Diligence, and Value Added Perspective.**⁴⁵

● **Investment Amount**

The typical investment amount for a semiconductor project will depend on the type of project. An IC Design investment is a much smaller amount than an investment which involves building of a fabrication plant. The investment amount will also depend on the valuation of the company, which directly ties to the company's past performance. Given the 20% limitation for each venture capital firm, VC firms typically invest from USD\$1 million to USD\$3 million per project, depending on whether the company is a start up company or a more mature firm. Investments in other sectors of semiconductor industry are typically larger, running from USD\$5 million to USD\$20 millions. The most distinguishable difference is whether the project requires a huge capital expenditure. If the company's use of funds is only to recruit engineering, marketing, and managerial talent, the cost will be significantly less than if the company needs to build a plant.

● **Investment Stage**

According to the definition set by the NVCA (National Venture Capital Association), there are total of five different stages for a venture capital investment. The stages are:

1. Seed Stage
2. Start-up Stage
3. Expansion Stage
4. Maturing(or Mezzanine) stage
5. Restructuring Stage

Semiconductor investments exist in almost every stage. In terms of investment preference, different VCs will have different strategies towards their investments. VC firms which are "Generalist" have tended to focus more on the expansion stage and mezzanine stage investments; "Specialist" VC firms will have more interest in looking at early stage investment. The difference between "Generalist" and

“Specialist” is primarily on the management team, which will be discussed in the next chapter.

- **Investment Sector and Regions**

Taiwan currently has more than three hundred semiconductor companies, 70% of which are fabless design companies formed in the last few years. Most of the Taiwanese semiconductor companies have VC firms as their shareholders. In the period of 1990 to 1995, most of the investments focused on either IDM (Integrated Device Manufacturer) or foundry. Most of the VC firms who invested during the time have made good returns from these investments given the high growth in the 90's. In terms of future prediction, there will be more design companies formed in the next few years, but the industry has also become more competitive as the number of design firm increases. China will certainly be a new emerging market in the next ten years. Currently there are many VC firms who invest heavily in new foundry companies in mainland China. It is obvious that the design company investment will start to increase after the foundry industry in China has reached a optimal level to assist the growth of mainland design companies. Therefore, we will be seeing more of semiconductor investments in China in the future.

- **Portfolio and Risk Management**

After VC have made their investment in a semiconductor company, they will normally obtain a board seat or an observer seat in the board. Most VCs manage their portfolios by actively participating in the board to ensure the profitability of their investment. In the buy-out scenario, the fund management team is even more active and will be involved in day to day operation. By attending board meetings, VC firms will make sure their portfolio companies hit the target for their sales, product development, R&D effort, and profitability. Aside from board participation, VC firms may also insert key members into the management team to ensure the operation is well run. In fact, many term sheets for VC investment will specify the conditions of an investment, in many cases requiring the introduction of new management team members to the company. It is an important approach to conduct their risk management other than participating in the company from the board of directors level.

External Advisory

The semiconductor industry is both capital intensive and technologically competitive.

VC firms who made their investments realized they are in an industry with high volatility and high risk in nature. Most VC firms will play an external advisory role to better understand their positions in an industry. The advisory role can be in forms of paid consultants, friendly network generated by the venture capitalist, accounting firms, and experts available for existing portfolio companies. Each role can have a positive impact towards VC firms in making good judgment. Inversely, it can also mislead the VC firms to make bad investments. External Advisory is important for VCs to make their investment decision, especially for firms who are “Generalists” in semiconductor investment.

Exit Strategy – Investment Realization Strategy

In order to realize an investment and make profit from it, VCs will have to take their portfolio company public via an IPO or have the company acquired through a merger. Most Taiwanese IC Design companies would prefer to list on either TSE (Taiwan Stock Exchange) or OTC (Over the Counter). Currently there are about 70 semiconductor companies and 35 IC Design companies listed in these two markets. Due to Taiwan’s unique SME (Small and Medium Enterprises) culture, company CEOs will have a stronger preference to take their company public rather than being bought up with profit. However, due to the increasing competitive environment in the semiconductor industry and IC Design sector, a company is not likely to achieve a very high valuation and P.E. ratio without some unique selling point. For VC firms which specialize in IC Design investments, there has been activity in seeking the possibility to consolidate their portfolio companies to increase company size and broaden their product. Due to the nature of an IC Design company which focuses on people and requires little capital expenditure, it makes it easier to consolidate IC Design companies than other semiconductor firms in other sectors.

Deal Source

Deal Source is an extremely important factor for venture capital firms. Every VC firm has worked hard to come up with a method to generate the best deal source. Typically a deal can be generated by the effort of its shareholders, or “limited partners”, especially for limited partners with a technology background. Deals can also be generated by its existing management teams, or the “General Partners”. Most general partners have years of experience in the high-tech industry or financial investment field. Their previous experience allows them to find the opportunities that could create huge returns. It is also the responsibility of “General Partner” to find the

investment project for the venture.

Another effective way to generate deals is through the “Cooperative Network” for venture capital firms. This is a unique network shared by a group of venture capitalists with close relations. By understanding each other’s need and interest in a particular type of investment, they will often share their investment opportunities with one another. For example, an Asian regional fund can often team up with a local Taiwanese venture capitalist to share in their investment opportunity. Given their shared interest in investing in the semiconductor industry, the Taiwanese venture capitalist can share opportunities in the IC Design Company given their in-depth knowledge of Taiwanese engineers and their product marketing skills; The Asian regional fund, however, can share their newest foundry opportunity in mainland China as well as some IC Packaging and Testing opportunities newly emerging in Korea. By working together effectively, both VC firms can build a portfolio within in the semiconductor value chain, and diversify their risk at the same time. The collective efforts of shareholders, management teams, and the cooperative network will help the VC firm to find the best future opportunities in the high-tech space.

Due Diligence

Prior to an investment, venture capitalists will conduct a series of due diligence reviews before committing their capital. The list is to ensure the validity of the business project and determine whether the current business or operation have enough capability to continue its mission as described in the business plan. The Due Diligence process can be very detailed and costly. Some of the items include:

- Examining whether the market of the new product addresses the company’s future growth area.
- Looking at the possibilities of the company achieving sufficient market share in the new space
- Company’s technological advantage to become the leader in the sector
- An assessment of key people within the management team and whether they can perform well in their position.
- Interviews with the suppliers and customers of the company, to reduce the potential uncertainty the company may have from these two forces
- An investigation of the company’s main competitors, to ensure the company’s competitive advantage within the sector
- Conducting a valuation analysis to compare public companies in the similar

space and to determine whether financial goals can be achieved. In many cases, conservative numbers are applied to neutralize the high beta in the technology sector.

The due diligence list also focuses on the market, product, technology, and financial perspectives. It is an important approach to make sure the venture capitalists make the right decision for their investment in the company.

Value Added Perspective

One of venture capital's attractions to entrepreneurs is their value-added features other than capital injection. VCs can provide value to their portfolio company by bringing managerial, financial, and technological expertise to help the growth of the company. In the cases of semiconductor or IC Design investment, VCs can often bring important value to their portfolio companies in different perspectives. For certain foundry backed venture capital firms, their value-added investment means bringing in a close relationship with the foundry themselves, which is critical from a production perspective; for other VC firms which own semiconductor companies in their portfolio, their investment value-added can be expertise in bringing new customers and new talents to the start up company. Generally speaking, a VC firm can add more value if it has more exposure investing in the semiconductor/IC Design space.

6-3 VC Dynamics of IC Design Investments

Any study of the venture capital factors in IC Design investments must take into account the following three variables, each of which can affect the decision process from different perspectives:

1. The Shareholders: also known as the “limited partners” of the venture capital firm, represent the investor sources including domestic and overseas individuals, domestic and overseas institutions, business enterprises and government agencies. Currently, government pension funds and endowments are not yet seen as main sources of venture capital funding in Taiwan. The different shareholder backgrounds represent a potential VC network, with shareholders typically providing the following functions:

- Introducing investment cases or making referrals.
- Providing technological expertise.
- Bringing in other investors to co-invest and diversify the risk.
- Utilizing their networks and bringing in more professionals to work for their venture capital firm

This study will look at the shareholder perspective and how it can contribute to the investment strategy of IC design companies.

2. Management Team: the management team includes investment professionals, general fund partners, as well as other board members. Their educational backgrounds as well as their professional experience will bring important changes to a venture capital firm’s investment strategy with regard to IC design firms. Many of the VCs specializing in semiconductor investments have professionals coming from the semiconductor industry, while other VC firms will recruit semiconductor experts to participate in their investment or advisory boards. In order to specialize in semiconductor investments, most VC firms have developed their own strategy in order to find the best investment opportunities in this field. This study will determine how some of the VC firms become involved in the semiconductor industry through their key management teams.

3. Venture Cooperative Network (VCN): VC firms actively maintain broad cooperative networks in order to continue looking for investment opportunities. One most frequently used network is to work closely with other VC firms to build co-investments and diversify the risks, while other venture capitalists work with

portfolio companies to find new investments. By working with their existing portfolio companies, VC firms will have faith in the information the company provides. Other cooperative networks include government agencies and research institutions such as the Industrial Technology Research Institute (ITRI) and the Electronic Research and Service Organization (ERSO) in Taiwan, who advise venture firms to invest in new and disruptive technologies by making their research results available. Many VC firms have benefited from working with such research institutions. This study will look into how cooperative networks have a strong impact on VC semiconductor investments and how they can be better improved.⁴⁶

Interview Results

To understand the dynamics of VC investment a structured set of interviews was conducted with venture capitalists in the Asia Pacific region, focusing on their previous investment experiences in the semiconductor industry. These are the results for different members of VC teams and their impact on the investment decision process.

- **Investment Amount**

The Management Team tends to have a strong impact on the decision regarding the proper investment amount of a project. Shareholders have less or no impact this area. Cooperative Network, when making syndication, could have some potential impact on the amount of investment. For example, when a company only needs \$5 million for its round B investment and three VC firms are considering the investment, the VCs will have to work with each other to right amount for all three firms.

- **Investment Stage**

The Management Team composition tends to have a strong impact on the investment stage decision. Shareholder and Cooperative Network tend to have less impact on this area. Among the Management Teams, if the team members are more technology focused, the firm has a higher probability of investing in earlier stage investment. If the venture firm is considered a “generalist” VC firm and has more team members in finance/strategy expertise, the firm will tend to invest in later rounds and shorten the investment cycle.

- **Investment Sector and Region**

The Management Teams also have a strong impact on the decision about the investment sector and region. However, Shareholder and Cooperative Network could have an impact on this area as well. Many of the Taiwanese limited partners request that their VC invest a portion of the funds into U.S. high-tech industry, mainly Silicon Valley. The Management Team also relies on their cooperative network to conduct an investment that is beyond their expertise. Therefore all three parties could have impact towards the sector and region of an investment case.

- Portfolio and Risk Management

The responsibility of portfolio and risk management is mainly on the VC Management Teams, they have the professionals and they will participate in the portfolio company through the board of directors. The Shareholder and Cooperative Network of VCs have very little influence in this area

- External Advisory

Many VCs will often employ external advisory as part of their investment decision process. The Shareholders often are ones that make the decision to hire these external consultants, to provide an assurance on the success of the venture capital. When the Management Team feels their domain expertise is not sufficient to cover enough investment areas, they will also consider hiring external consultants. Therefore Shareholder and Management Team will both have an impact on the policy towards external advisory role.

- Exit Strategy

The typical exit strategies for a portfolio company are either IPO or a company acquisition. The Management Team will have a strong impact on this area, Shareholder and Venture Cooperative Network tend to have no impact on decision of an exit strategy.

- Deal Source

Deal source is an important topic for venture capital investment. This was stated in all of the interviews with venture capitalists, everyone sees deal source as an important factor. Shareholders, Management Team, and Cooperative Network will all have

impact towards the deal source of the VC firm. For the Shareholders, if their background comes from a high tech industry, or if the Shareholder is a foundry company itself (such as UMC Capital in Taiwan), then they will have much more influences on deal source than a shareholder with traditional industry background.

- Due Diligence

The Management Team is mainly responsible for the due diligence of an investment. However, the Venture Cooperative Network could have an impact as well. The venture capitalists will sometimes rely on their Cooperative Network counterparts to judge an investment. If the venture capital firm investing in a company's previous round of financing has a good reputation, the later stage VCs will tend to have a positive view towards the investment project.

- Value Added Perspective

Depending on the industry background of the Shareholders, they can often have strong impact on the value added perspective of a company. For example, Intel Capital is very active in Asia and the rest of the world. Companies who received investment from Intel Capital can often have access to the network of the biggest semiconductor company in the world, which is tremendously valuable. The Management Team can add value by bringing in its industry expertise to help the portfolio company in finding strategic partnerships as well as marketing partnerships. Therefore Shareholder and Management Team are both important factors for adding value to a portfolio company.

6-4 Case Study: Generalist versus Specialist

We can differentiate the ventures capital firms which were interviewed view; into two categories: A VC firm which invests in all type of industries, technology and traditional industry; and VC firm which dedicate most of their efforts in investing in semiconductor/IC Design space. We call the first type a “Generalist” VC firm due to its wide interest in investing in different sectors, as long as it promises growth and a high IRR (Internal Rate of Return); and we call the second type “Specialist” VC firm because the firm’s strategy is to focus its investment in the semiconductor industry and apply most of the firm’s resources to achieve this goal. The following analysis shows how both type of firms are different in investment strategy, team member expertise, and value proposition to invested companies.⁴⁷

Generalist

Just as the phrase describes, a “Generalist” venture capital firm will consider investment in many different industries. Most of the investments are evaluated using general principles or guidelines. As long as opportunities exist and a business can be built to last, the firm will consider an investment in it. Due to the difference of nature in investment, they will typically invest in a larger project than a small firm. For example, telecom service providers and Internet infrastructure companies are projects only a generalist VC could consider, investing in projects which are built to last, and grow continuously as the civilization progress. The management teams are often from banking industry or consulting firms instead of a specific technology background.

A Generalist VC often has the following features:

- A larger investment amount, which focuses on the trend and the opportunity of an new industry
- Focuses on the potential growth space of a new or an existing business, making sure the industry won’t be disrupted very quickly
- Tends to have a longer investment cycle than a high-tech start up firm. For example, an investment in telecom service provider might take years to achieve payback, but terminal value is high given the business can last for decades.
- Management Team with sufficient financial and strategic management skills, rather than technological capabilities.
- Provides less value added perspective from the management team, given the human resources of the VC firm are limited.

Specialist

The key word for specialist VC firm is “Focus”. Specialist VCs will tend to place most of the investment into one or two particular industries. By making repeated investments in the same industry, the venture capital firm slowly builds up extensive knowledge about the industry. There are plenty of advantages when becoming an industry expert. Their efficiency within the investment process will slowly appear. The VC firm can utilize the experience in previous investments to further evaluate the future business opportunities in the same sector. In certain cases where industry expertise has reached a certain level, the VC firm can identify the missing component in the industry value chain, and work with entrepreneurs to establish a company to focus on such product, and make a fortune of it. Companies, who receive investment from specialist VCs, usually receive more benefits and assistance from the VC firm to help the business grow. A typical specialist VC firm often has the following characteristics:

- The investment will be focused more on the application usage of an industry, rather than infrastructure.
- The portfolio companies will be more inter-related. The VC will tend to invest to build a value chain among the invested companies within the same industry.
- After making the investment, the VC firm is very active in managing or assisting the company, providing added value by bringing more connections to the company.
- Many of the management team members technological backgrounds, with years of experience in the high-tech industry.
- Tends to invest in smaller and early stage company, looking to bear more risk and achieve higher multiple returns

One example in the semiconductor space is UMC Capital Inc. While being the investment arm of foundry company UMC (United Semiconductor Corporation), UMC Capital tends to look at IC Design companies as the focus of the investment. By making more investment in the IC Design sector, these invested companies can become the customers of UMC and create value in both ways (financially and strategically). When presenting to the invested company, UMC Capital is also in a better position to negotiate by leveraging the foundry operation. However, the risk of being a specialist VC is the risk of putting all eggs in the same basket, if the industry has a dramatic down turn, then the risk would be too high given all the portfolio companies are in the same industry.

Conclusion

The character of the semiconductor and IC design industries will enable venture capital to become more involved and specialized in investing in the semiconductor industry. As discussed above, foundries can cooperate with IC design companies in different ways - they can act as an investor (the foundry itself or through its VC entity) as well as a supplier. An IC design firm can be more competitive if it can include foundries among its investors or can form close strategic alliances. Foundries need the revenue from design firms just as much as design firms need production assurance from the foundries. The close relationship between the two parties has been a significant factor in the success of today's semiconductor industry in Taiwan.

Venture capital also utilizes its existing portfolio companies as consultants in finding new investments. In many cases, VC shareholders with a semiconductor background will act as deal sources and assist the VC firm in finding new investment opportunities. In cases where none of the VC shareholders have a semiconductor background, the burden is placed upon the VC management team to find the proper industry investment opportunities. The management team is also important for the rest of the investment decision process, which is mostly responsible for the performance of the fund. In general, if a VC firm lacks investment experts with extensive experience in the semiconductor industry, that VC firm will be considered as generalist and will have different perspectives than VC firms specializing in semiconductor investments.

In conclusion, three different dynamics of IC Design industry will continuously become factors to affect venture capitalist decisions in investing in semiconductor and IC Design industry.

Bibliography

1. C.Y. Chang. **Made by Taiwan: Booming in Information Technology Era.**
World Scientific 2001
2. Charlie Fine. **Clockspeed.** Perseus Books 1998
3. Y.M. Lee. **The Story of Semiconductor.** New7 2001
4. C.F. Wang. **The Information Technology Industry@ Taiwan.** Wealth 2000
5. C.Y. Yo. **The Savvy Investor's Guide to IC Stocks.** Wealth 2000
6. M. Hsiao. **Robert Tsao and the UMC Empire.** Common Wealth 2000
7. G.Y. Chang. **Semiconductor Manufacturing Equipment.** Wunan Press 2001
8. C.H. Sun. **The Semiconductor Manufacturing and Processing Guide.** CHWA
Press 2001
9. Michael E. Porter. **Competitive Advantage.** Free Press 1985
10. Michael E. Porter. **Competitive Strategy.** Free Press 1998
11. ITRIEK. **The 2002 Semiconductor Industry Annual Report.** ITRI 2002
12. James J.M. Fang. **The competitive advantage : a case study of Taiwan's
semiconductor industry.** 2002
13. Davis, Shurronne Young. **Understanding innovation, national competition, and
government responses to technological innovations : the case of the United
States and Japanese semiconductor industries** 1998.

14. Chou, Chaur-Ming. **Dedicated IC foundry--an assessment of strategy and prospects for contract manufacturing in semiconductor industry.** 1995.
15. Y.M. Zhang. **The Competition factor and reason of success for Taiwanese IC Packaging Industry.** 2001.
16. Y.S. Yen. **How does Taiwanese Semiconductor Company creates Value?.** 2000.
17. Y.C. Lu. **Analysis for Semiconductor Industry in Mainland China.** 2000.
18. Y.S. Chen **The Performance Analysis for Taiwanese Venture Capital.** 1997.
19. C.S. Wang. **The Evaluation Method for High-Tech Investments.** 2000.
20. **Taiwan Venture Capital 2001 Annual Report.** TVCA 2001.
21. **Securities and Future Commission 2001 Annual Report.** Ministry of Finance, R.O.C. 2001

Footnotes

-
- ¹ According to p.40 of TVCA 2001 annual report, semiconductor investment account for 18.68% of total VC investment.
- ² According to Chapter 6-2 of thee ITRIEK. The 2002 Semiconductor Industry Annual Report, the world semiconductor industry had a negative growth rate of -31%
- ³ The “Hsin-Chu Science Park” was established based on the objective of developing Taiwan’s high-tech industry and was introduced in p. 80 of “Made by Taiwan.”
- ⁴ Taiwan’s IC Design industry has a market share of 21% and is ranked No. 2 in the world. Such statistics were provided in p. 207 of the “The Savvy Investor’s Guide to IC Stocks.”
- ⁵ The five forces industry analysis was introduced in chapter one of “Competitive Strategy By Michael Porter 1998.
- ⁶ According to P.38 of TVCA 2001 Annual Report, a total of 7000 investment were made from 1996 to 2001.
- ⁷ The different categories of investment can be found in P.41 in the TVCA 2001 Annual Report
- ⁸ The Analysis was done by telephone interviews six venture capitalist in the Asia Pacific region. Names are not provided due to the further generalist/specialist analysis.
- ⁹ The creation of semiconductor in Bell Lab was found in Chapter six of “The Story of Semiconductor” YM Lee 2001
- ¹⁰ The growth in electronic system and semiconductor industry is introduced in the 2001 IC Insight Annual Report.
- ¹¹ Growth rate of the semiconductor industry in the past ten years was found in p. 14 of “How do Taiwan Semiconductor companies create value?” by Y.S. Yen 2000
- ¹² The use of semiconductor by different categories is analyzed in Chapter 3-1 of ITRIEK – 2002 Semiconductor Industry Annual Report.
- ¹³ The term “Integrated Device Manufacturer” was introduced in P.199 of “The Information Technology Industry@ Taiwan” CF Wang 2000
- ¹⁴ The ranking of top Foundry and IC Design industry is introduced in chapter one of “Made by Taiwan” CY Chang 2001
- ¹⁵ The CMOS technology transfer project was completed in late 1970’s, which is discussed in p. 46 of “Made by Taiwan” by C. Y. Chang 2001.
- ¹⁶ The no. of firms resided in HSCP can be found in P.324 of “Made by Taiwan” CY Chang 2001
- ¹⁷ The number of IEEE articles posted by NCTU scholars can be found in Chapter Nine of “Made by Taiwan” by C. Y. Chang 2001.
- ¹⁸ Taiwan’s capital market had an annual turnover of over 600% (In year 1997) which is discussed in SFC (Securities and Future Commission) Annual Report 2001.
- ¹⁹ The success of TSMC and annual growth number can be found in P.176 of “Made by Taiwan” CY Chang 2001
- ²⁰ UMC’s turnaround strategy and spinout of its design firm can be found in p. 75-77 of “Robert Tsao

and the UMC Empire” by H. Hsiao 2000.

²¹ Terms, such as “Fabless and Virtual Fab,” is introduced in p. 186 of “Made by Taiwan” by C.Y. Chang 2001.

²² Mr. Morris Chang is known as the “Father of Foundry” and his story is introduced in p. 173 of “Made by Taiwan” by C.Y. Chang 2001.

²³ The different categories of IC Design product is discussed in p. 189 of “The Information Technology Industry@ Taiwan” by C.F. Wang 2000.

²⁴ According to Chapter 6-2 of the ITRIEK – The 2002 Semiconductor Industry Annual Report, the global semiconductor industry had a negative growth rate of 31% and Taiwanese IC Design sector had a negative growth rate of 21%.

²⁵ The market share for major IC Design companies in the world can be found in Chapter 3-8 of ITRIEK – 2002 Semiconductor Industry Annual Report.

²⁶ The comparison of the top 20 fabless companies can be found in Chapter 3-8 of ITRIEK – 2002 Semiconductor Industry Annual Report.

²⁷ The top European and Israeli fables firms is introduced in Chapter 4-15 of ITRIEK – 2002 Semiconductor Industry Annual Report.

²⁸ The information on the Top Taiwanese IC Design companies is introduced in Chapter 8-2 of “The Information Technology Industry@ Taiwan” by C.F. Wang 2000.

²⁹ The opportunity and risk factor of mainland semiconductor industry can be found in “Analysis for semiconductor industry in mainland China” by Y.C. Lu 2000.

³⁰ The key issues for the future development of IC Design Industry can be found in Chapter Ten of ITRIEK – 2002 Semiconductor Industry Annual Report.

³¹ The five forces model can be found in Chapter One – Structural Analysis of Industries of Competitive Strategy by Michael Porter 1998.

³² The diamond analysis can be found in “How Can Taiwanese Semiconductor Companies Create Value?” by Y.S. Yen 2000.

³³ The SWOT analysis model can be found in chapter three of “Dedicated IC Foundry” Chou 1995

³⁴ The definition of “Venture Capital” can be found in the website of National Venture Capital Association.

³⁵ The procedures for setting up a venture capital firm can be found in P.10 of the TVCA 2001 Annual Report.

³⁶ According to TVCA 2001 Annual Report, the Taiwanese government currently only allows each venture capital firm to invest up to 20% of company’s share on each VC’s individual investment.

³⁷ The definition of different stage of venture capital investment can be found in p. 52-56 of TVCA 2001 Annual Report.

³⁸ The history for the Taiwan venture capital development can be found in Chapter Ten of “Made by Taiwan” by C. Y. Chang 2001.

³⁹ An investment case is defined as an investment by a venture capital firm in a company. Of three VC firms each invest in two financing round of a company that is six investment cases. (3 firms x 2 rounds).

⁴⁰ The institutional holding of venture capital funds can be found in p. 23 of TVCA 2001 Annual Report.

⁴¹ According to p. 46 of TVCA 2001 Annual Report, 97 semiconductor investment cases were made, consisting of 20.6% of the total investment for the year.

⁴² The milestone of Taiwan venture capital industry can be found in p.106-P.109 of 2001 TVCA Annual Report

⁴³ The discussion of pension fund and tax policy can be found in P.112-115 of TVCA 2001 Annual Report

⁴⁴ The strategic implication of UMC Capital was obtained through discussion with venture capitalist in Asia Pacific Region.

⁴⁵ The investment process dynamics were obtained through interviewing with various venture capitalists.

⁴⁶ The dynamics of venture capital teams were obtained through discussion with various venture capitalists.

⁴⁷ The Generalist/Specialist analysis were derived from analysis after completing all six interviews with VC firms in Asia Pacific Region.