INTERNATIONAL JOURNAL OF BUSINESS, 9(4), 2004 ISSN: 1083-4346

Measuring Government's Industry Development Strategy Using Balanced Scorecards and Resource-based Theory – A Case Study of Taiwanese Semiconductor Industry

Day-Yang Liu[a] and Lon-Fon Shieh[b]
[a] *National Taiwan University of and Technology, liudy@mail.ntust.edu.tw*
[b] *National Taiwan University of and Technology, 7803@moeaidb.gov.tw*

ABSTRACT

This study will start with a general review of related literature published in the past, and develop a set of tools that can simultaneously establish the strategies and goals for government industry development initiatives. Then it will make comprehensive analysis and exploration, considering the resources that the government must invest in different areas, and the required supporting policies and incentives. Finally, the study will make an empirical case study on the government's role in developing the Taiwan semiconductor industry based on quantitative and qualitative information.

The analysis of the key success factors in the Taiwan government policy measures, shows that the most influential policy measures for industry development include a policy for developing technological professionals, subsidies for R&D on technology and products, and the development of an Industrial Park, industrial districts and process and export zones.

JEL: H0, L5, O2

Keywords: Balanced scorecard; Resource-based theory; Semiconductor industry

I. INTRODUCTION

For the past forty years, the Taiwan semiconductor industry has been under the direction of government related policies. The measures and strategies for the development of the industry are extremely important to the development of a supply chain for the upper, mid, and downstream of the industry. This paper shall discuss how Taiwan established this supply chain and what the industry development policies and strategies are.

As the extension of his fundamental competitive strategy, Michael Porter（1985）proposes his global strategy, corporate strategy and national competitiveness strategy. In his study of "national competitive advantage," he tries to explain the source of an enterprise's or a country's competitiveness using his own "diamond model." In analyzing the success models of the ten most dominant countries in the world and those of hundreds of industries, he discovers that The Nation plays an indispensable role in the process of establishing competitive advantage. More than any other factor, "industry structure" strongly influences and even determines the rules of the game in the competition among nations (or the potentially feasible strategies for it). Porter's five forces model is put forward in his book *Competitive Strategy*. It mainly aims at analyzing the major factors of the competition of enterprises, including industry competitors, potential entrants, suppliers, substitutes and buyers. In his value chain analysis model of "competitive advantage," the value added existing in the upstream and downstream of industries is clearly defined. But when we look at competition at a higher level to make comparisons among countries, we try to answer this question through analysis: what kind of role should the government play in creating the comprehensive national industry competitiveness?

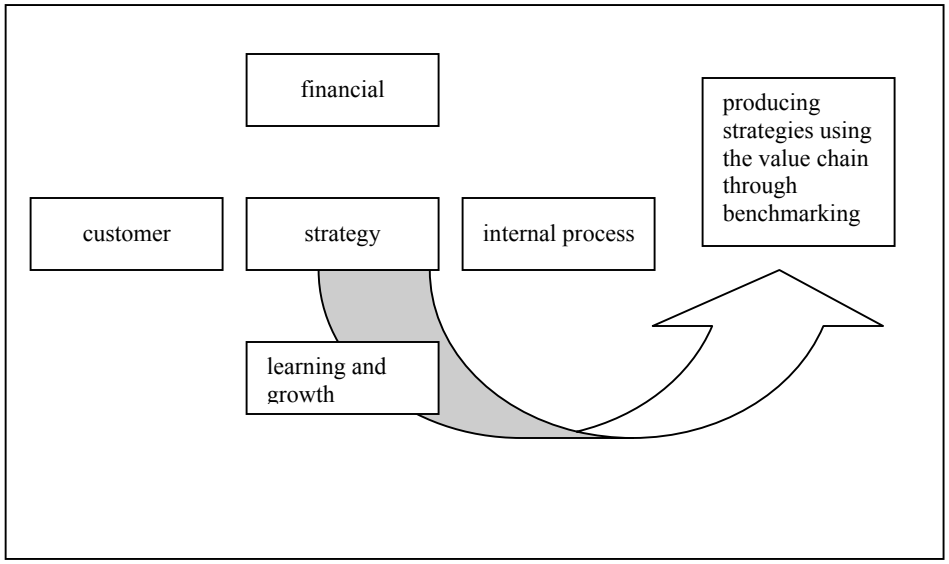
In our study, we find two extremes in a national competitiveness strategy spectrum. On one end, the United States government puts the foremost priority on maintaining the competitive environment for industries. On the other end, the South Korean government takes complete control in guiding the development of industries. Located somewhere in this spectrum, the government of Taiwan intervenes in the development of industries on certain conditions, but tries to maintain a fairly competitive environment at the same time. This study tries to explore the influence of related government policies and measures on guiding the development of industries.

Quality function deployment (QFD): When applied to product design, customer expectations (are transformed into substitutable characteristics in engineering as early as in the designing stage (Atkinson 1990; Theodore 1993). The method is also applied to the management of corporate policies for two purposes. One is to integrate the capacity of various departments in a company to enable cross-departmental cooperation thereby reducing technical restrictions. The other is to provide precise recommendations for improvement to ensure the thorough implementation of corporate goals (Lockamy & Khurana, 1995). Because it is shaped like a house, the analysis tool for quality function deployment is also referred to as a "the house of quality."

Balanced scorecard: Originally proposed by Kaplan & Norton (1992, 1993, and 1996) in Harvard Business Review for performance evaluation, the system has

since been shaped into a powerful tool for strategic management of enterprise competitiveness. The system helps companies develop strategic goals and indicators for evaluating performance through four perspectives (including financial, customer, internal processes and learning and growth) to complement the traditional total reliance on financial indicators. The system also helps the company make strategy management and performance evaluation by adopting the perspective of balancing the "long-term and short-term," the "past, present and future," the "internal and external," and "financial and non-financial" aspects of the enterprise. The indicators of the four aspects in the balanced scorecard are explained in the following and illustrated in Figure 1.

Figure 1
A strategy-focused framework



1. Financial: this includes indicators such as cash flow, profitability, return on capital, etc., all interlinked through performance evaluation.
2. Customer: this includes indicators such as price competitiveness, market share, customer satisfaction, etc.
3. Internal processes: this includes indicators such as the reward system, project management and safety.
4. Learning and growth: this includes indicators such as continuous improvement, research and development and services, workforce motivation and preparations, etc.

The balanced scorecard becomes a tool for executing company strategies because it uses the value chain, determines company strategies through benchmarking, and develops indicators for performance. This is done based on the four perspectives explained above to achieve the company's desired goals. The success of using the balanced scorecard depends on the support of higher-level managers in the company.

In reviewing the literature related to the balanced scorecard, Zou Yu-Jing (2000) discovered two obstacles to planning and designing balanced scorecards. First, studies in the past only used the key success factors recognized by the managers according to their experience. The absence of a complete set of strategy analysis tools resulted in the poorer validity of the strategies in representing that case due to incomprehensive considerations. Second, although there should be a causal relationship between the strategic goals and measurements of performance in the balanced scorecard, studies in the past never proposed a set of systematic analysis tools for linking the causal relationship between the four aspects. As such, the explanation of a causal relationship between the strategic goals and measurements in the aspects are not convincing.

In order to solve past problems in designing the balanced scorecard, the author constructs a modified balanced scorecard analysis framework as well as the analysis techniques and method pertaining to it. As the first step, common and general concepts of customer value proposition are applied. Second, Porter's analysis of the five forces model is applied to explore the influence of the five active forces in the industry structure on the company's choice of strategies. Third, through the value chain analysis proposed by Porter, the existing resources and competitive advantages inside a company are confirmed. Finally, these three aspects are analyzed and considered simultaneously to formulate strategies. In the process of strategy analysis, (1) the performance that drives the financial aspect, (2) the key success factors in the customer aspect, (3) the internal process aspect and the learning and growth aspect, and (4) their performance measurement, will all emerge one after another. With that, a balanced scorecard in which strategies, concrete actions and performance measurement are all closely interlinked is formed.

Due to the international attention to the development of Taiwanese semiconductor industry, there are a remarkable number of articles discussing its key success factors. For example, Tsai Ming-jie (2000), chairman of Media Tek Inc. and Ali Corporation in Taiwan, believe that the main factors in the success of the Taiwan semiconductor industry include government support in the early years, the vision and insistence of high-leveling government leaders and project leaders, complete technical transfer of IC technology in the upstream and the downstream, choice of targets for technical transfer, deep localization of technology, speed of research and development of new products, entry to niche markets, economy of scale, the flexibility of small and medium enterprises, the subculture of ITRI around the time of its inception, time to market, low fraction defective, the insight of the industry environment, etc.

The study by Xyu Zuo-sheng & Qiou Yi-jia (2000) suggested that there are 22 key factors in the success of Taiwanese semiconductor industry: its ability to maintain the grasp on diversified technology, advantage in market leadership, capability in legal matters and management, advantage in domain economy, innovative ability in component design, innovative ability in production, ability to perceive and develop the

quality of research staff, etc.

Lin Chin-huang (2002) used technology, market and capital as the three factors for the basis of categorization in his exploration into the success of the semiconductor industry. The technology factors include the ability of production technology, the ability of product innovation, the ability to lead the determination of specification, and the result of talent development. The market factors include the cluster effect of industry structure, degree of economy of scale, the advantage in production and management, and the interaction of the upstream and the downstream. The capital factors include the facilitation of government policies, the support of domestic market demand, the assistance of the financial industry, and the reinvestment of its profitability.

An analysis by Chen Wu-tung (2002) of the factors in the success of IC enterprises, suggested that the success of the chip foundry industry lies in sufficient production capacity, advanced production technology, competitive pricing, short time required for product delivery, real-time online inquiry system, and integrated service during the entire production process. Success for the IC design house lies in its ability to innovate its product line, the speed of pushing out new products from its pipeline, the successful competition for niche market, and the support of the chip foundry industry with its production capacity.

Yang Tze-jiang (1998) argued that the semiconductor industry is characterized by its technology-intensive and capital-intensive nature, requirement for well-rounded and highly competent teams, and the leap-frog pace of technological evolution. Meanwhile, he suggested that Taiwan enjoys the following competitive advantages: (1) Financial: the availability of relatively abundant finances to support the development of the industry; (2) Flexible production system: the industry has a horizontal division of labor that with quasi-vertical characteristics makes it highly flexible; (3) Human resources: appropriate government industrial policies and the role of ITRI in talent development and training and the promotion of technology transfer; (4) Management: the ability to deal with complicated and real-time management issues. Its competitive disadvantages include poorer technological innovativeness, lack of international marketing and distribution channels, insufficient protection for intellectual property rights, etc.

In researching past-related literature, this study finds that the balanced scorecard system has its limitations, even though it combines goals, actions and performance evaluation. The basic restraint is the fact that resources are limited for all governments and enterprises. Therefore, this study attempts to combine the concept of goal management with the theoretical foundations of balanced scorecards and strategy theories to develop a new theoretical model. The model will simultaneously produce strategies and provide performance evaluation. Thus, it can provide explanation for the government's competitive strategy when it participates in the development of industries, and it will be used to design a set of tools for performance evaluation. This study is based on the empirical research on the Taiwan semiconductor industry, whose success story has won admiration worldwide.

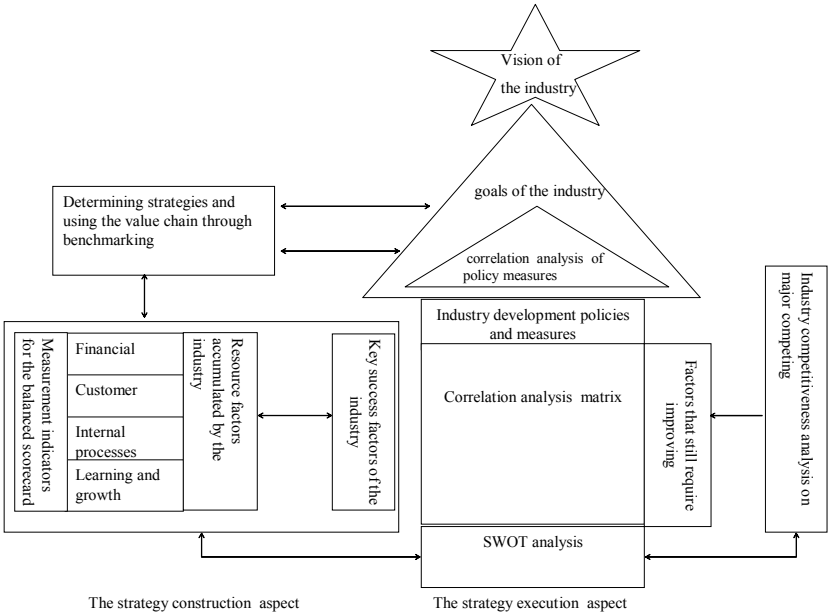
This study will start with a general review of related literature published in the past, and develop a set of tools that can simultaneously establish the strategies and goals for government industry development initiatives. Then it will make

comprehensive analysis and exploration, considering the resources that the government must invest in different areas, and the required supporting policies and incentives. Finally, the study will make an empirical case study on the government's role in developing the Taiwan semiconductor industry based on quantitative and qualitative information.

II. ANALYTIC MODELS FOR INDUSTRY COMPETITIVE STRATEGY

The traditional theoretical models of competitive strategy analysis are heavily biased toward enterprises, mainly concentrating their analysis on companies. However, studies in the past find that governments play a crucial role in actual practice. Therefore, this study attempts to construct a theoretical model of competitive strategy analysis, which may provide governments with tools for contemplating and analyzing the issues. The model is founded on the concepts of goal management and benchmarking, using balanced scorecards and "house of quality" as tools. Since the major objective of this study is to establish the policies of optimum quality, the tool shall be called "house of policy quality." These ingredients combine to construct a comprehensive and feasible theoretical model as shown in Figure 2.

Figure 2
Industrial competitive strategy model



A. Model Specification

There are mainly two aspects in this system. One is the strategy construction aspect: balanced scorecards are used to link the major factors in an industry's success with resources, and to analyze the value chain of the industry. Benchmarks are determined according to the process of industry development in leading countries to produce industry development strategies. The other is the strategy execution aspect. Here, the experience of major countries is used to construct the roof of the house of quality, determining the positioning and goals of the industry's development. A comparative SWOT analysis is made on the key factors in an industry's success, and on the resource factors accumulated by the domestic industry. An industry competitive study is also made on major competing countries against this country to gain insight of the real condition of the domestic industry. Finally, the relationship between the factors of an industry's success and policies and measures is analyzed using correlation analysis matrix to provide reference for new industry development policies and measures.

Although the balanced scorecards system provides a new idea that combines goals, actions and performance measurement, in practice it lacks a strategic focus to provide direction for strategies of action and performance measurement. Therefore, this study tries to strengthen the balanced scorecard at its weak point. First, the core of the system is defined as generating development strategies and finding market positioning using Porter's value chain and through benchmarking. Then the key factors for the success of industry development are determined using the four aspects of the balanced scorecards and the resource-based theory. In other words, the strategy theories in Porter's value chain and the four aspects in the balanced scorecard will serve as the major framework. The interaction and mutual adjustment of the theories can produce the most suitable industry development strategies and policy measures of action plans, helping industries to establish their resources. Then a comparison is made between industry resource theory and the key factors in an industry's success, in order to provide a rough idea of what industry resources should be established, and what the key factors in the success of the industry are.

Second, the strategy execution aspect mainly involves how to transform goals into execution. When an industry's vision and goals are set up in a process as described in the previous section, the following step should be to use the strategies developed through the value chain to derive the major factors in the industry's success. Then, industry development policies and measures are developed accordingly. Next, a correlation analysis is made using correlation analysis matrix to determine the degree of the relationship between various policy measures and the key factors in the industry's success. The result can show whether it is possible for the policy measures to achieve the key success factors of the industry, and to successfully accumulate industry resource factors, which the government may use as reference for resource allocation. Meanwhile, the industry competition analysis and SWOT analysis among main competing countries are conducted, to analyze the condition of the domestic industry, and find out what has yet to be improved or what requires improvement. By doing that, we can examine some issues such as: are the industry development policies and measures currently available sufficient? Is it necessary to develop new policy measures? The correlation analysis on

policy measures is conducted to look into policy measures and find out whether the government has invested enough resources. This analysis also helps to answer the following questions: are the policy measures mutually complimentary or substitutable, and are they sufficient for achieving the goals of industry development? Do some policy measures still require improvement? Has the government's resource allocation reached its optimum?

Depending on analysis tools and various theoretical foundations of management science, this analysis model makes continuous examination back and forth. This is done to find out whether the four aspects have reached their optimum, so that when any necessity for improvement is found, improvement measures can be taken right away. The examination constitutes of answering the following questions: have the strategy construction aspect and the strategy execution aspect reached their optimum state? Have the strategies and positioning determined through the use of value chain and the four aspects of the balanced scorecard reached their optimum? Have the industry resource factors, the key success factors of the industry, and the industrial policy measures reached their optimum? Answers to those will be indicators of whether the entire system has reached its optimum.

B. Model Analysis

1. The strategic model construction aspect

In the strategy construction aspect, an analysis is first made using Porter's value chain to clearly define where the value lies in the up-stream, mid-stream and down-stream of the industry. Then, according to the level of an enterprise's division of labor in the value chain and their orientation (low-cost or differentiation), the competitive strategy of the industry is determined.

In choosing competitive strategy for an industry, it is not always true that only a single strategy can be used. Depending on the circumstances, sometimes the use of mixed strategies is also possible. Governments should begin with selecting the most promising and competitive industries of their countries, and determine whether it is necessary to narrow down on product selection. Or governments may also choose to develop industries with good market potentials. When they choose industries with development potential, they should look for the countries in market-leading positions among competing countries in this industry. The government should pick out the ones that can properly represent the industry to serve as benchmarks based on which development strategies are designed. While strategies are being designed, governments should also determine the development positioning of their countries' industries and their ultimate development goals. They should also determine what type of competitive strategy should be developed. In the meantime, the balanced scorecard is used to develop and analyze the key industry success factors in the financial, customer, internal, and learning and growth perspectives. The core competitiveness that is also planned to be established in the future, and will be an industry resource in the future.

To determine the key factors of industry success, one can learn from the experience of predominant countries in the industry in question by consulting experts,

or reviewing literature in that field. The findings should be adjusted according to the specific conditions of the home country to generate useful results, which are in turn transformed into indicators of industry success. These indicators can serve as the basis for determining the ultimate goals of strategy development and for evaluating performance. Quantitative indicators are used whenever possible, while qualitative ones are used for supplementary functions. Use the indicators for comparison with the current condition to analyze the industry resources currently owned by the competing countries. This will also help to determine the future industry resources as a result of government assistance through policies. From this information, it is possible to derive the actual key factors of industry success of different countries, and decide which policies to promulgate to achieve the industry development goals.

2. The strategic model application aspect

In the strategy execution aspect, the main objective is to produce related policies to strengthen industry resources and establish key industry success factors, thus achieving the goals of industry development. Competition analysis tools (including SWOT analysis and major competitor analysis) are used to determine the key industry success factors in different countries that need improvement. Using the "house of policy quality" tool mentioned above, the degree of correlation between policy measures and various key industry success factors is determined. An analysis of the degree of correlation between the policy measures in the roof can locate the policy measure of highest correlation and make it the main industry development measure. But considering the limitation of resources, the priority of execution should be placed upon the policy measure of highest correlation among the key factors that call for improvement most urgently. This will make the performance of execution more announced in achieving the industry development goals.

To put these into practice, the balanced scorecard system should be used as the framework of actions. The key success factors are sufficient to achieve the goal of establishing the resource-base of the industry. The actual actions taken will be the industrial policy measures. The condition of resources at the government's disposal must be taken into consideration to achieve the maximum effect through the most effective use of resources.

III. CASE STUDY

Started in the 1970s, the Taiwan semiconductor industry has become one of the world's major players through more than three decades of development. Now it has become one of the four major countries in the world manufacturing IC products. The IC industry in Taiwan has created many enterprises of worldwide renown, including MediaTek and Via in the IC design industry, TSMC and UMC in the chip foundry industry, and IDM and Winbond in the integrated component manufacturing industry. The accomplishments of these companies have contributed to the importance of Taiwan IC industries in global IC industries. This study plans to explore the development model of the Taiwan semiconductor industries and their competitive strategy, based on the

industry strategy analysis model described above, and explore the reasons for the success of the Taiwan semiconductor industry from a national industry competition perspective.

Table 1
Analysis of the current status of Taiwanese semiconductor industry on the supply side

UNIT：Million of US dollars

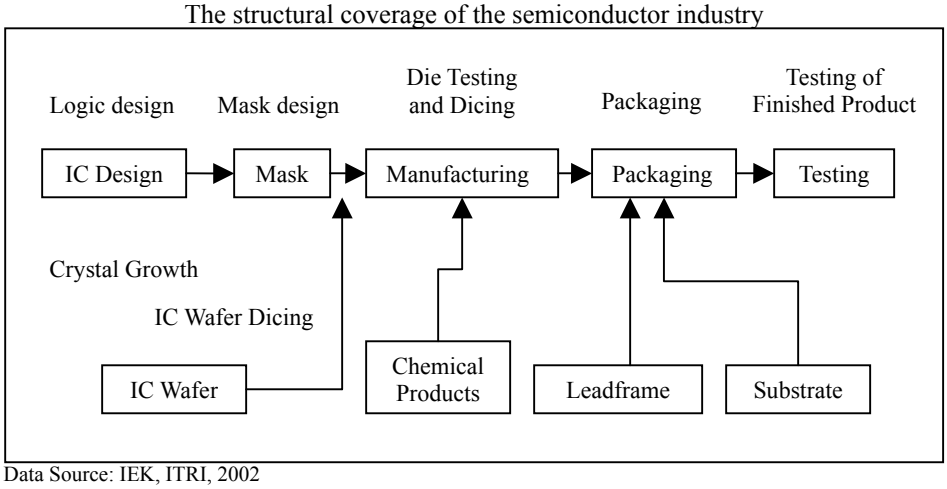
	Production	Global market share	Global ranking	Leading countries
Self Brand name IC	6,512	5.5%	2	US, Japan, Korea
DRAM	1,896	16.9%	3	Korea, US
SRAM	244	6.4%	4	Japan, Korea, US
Mask ROM	400	56.7%	1	Taiwan
Design Industry	3,616	25.9%	2	US
Manufacturing Industry	8,966	7.4%	4	US, Japan, Korea
Professional Contract Manufacturing	6,070	72.9%	1	Taiwan
IC Packaging Industry	2,285	30.4%	1	Taiwan
Testing Industry	750	35.7%	—	—
Manufacturing Industry capacity	—	14.7%	3	Japan, US

Data source：IEK, ITRI, 2002

A. The Current Status of the Semiconductor Industry in Taiwan

ERSO of ITRI, Taiwan, has played an important role in the Taiwan semiconductor industry throughout its development. In the beginning, its electronics project chose technological transfer from RCA of the US. With the backing of funds from Taiwanese governmental science and technology projects, ERSO laid a crucial part of the foundation of the Taiwan semiconductor industry. Because the project at the time set its objective of establishing the mass production ability, the entire spectrum of experience from RCA, including product planning, design, photo-masking, manufacturing, packaging and testing, was transplanted to Taiwan and became part of ITRI's development project. With the maturing of these projects, one company after another was spun off from ITRI, which in turn generated more spin-off companies of their own. Professional talents were also trained continuously by ITRI. These accounted for the comprehensive system of the Taiwan semiconductor industry, which includes the up-, mid- and down-stream (the coverage of the industry is as shown in Figure 3), and laid down the resource-base and factors of the industry's success. The division of labor in the Taiwan semiconductor industry mainly covers IC design, photo-masking, specialized manufacturing, packaging and testing, with famous international companies in each respective field.

Figure 3
The structural coverage of the semiconductor industry



Data Source: IEK, ITRI, 2002

Structurally speaking, the most striking difference of the Taiwan IC industry from other countries in the world is its operation style of "horizontal division labor." It can also be seen as an outstanding example of quasi-vertical division labor (integration of various production stages with cluster effect). Unlike major international manufacturers, which mostly operate in vertical integration to complete the design, manufacturing, packaging, testing stages of an individual product and even system integration products on their own, the highly specialized and flexible division of labor in Taiwan has created a lively and quick-responding culture that eventually put Taiwan into the prominent position it enjoys today in the global semiconductor industry.

After more than two decades of development, the Taiwan semiconductor industry has cultivated its distinctive advantages under the support of a complete semiconductor industry supply chain, pronounced cluster effect, and solid manufacturing capability of the wafer foundry industry. Currently, the wafer foundry industry in this country accounts for 73% of global production value, and is the world leader in this field, as it is in the IC packaging industry. The IC photo-masking and testing industries also have very strong, solid foundations. The IC design house, with the support of our existing manufacturing niche market and government development policy, has grown rapidly to take a 26% share of the global production value, coming in at number two in the entire world. The comprehensive semiconductor silicon industry structure has created in Taiwan the only specialization division system of the semiconductor industry around the world.

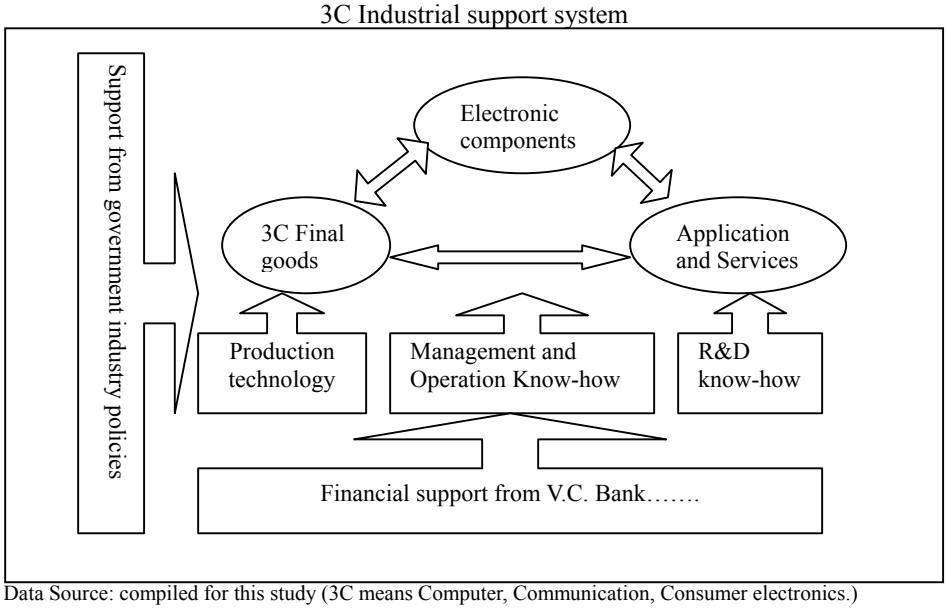
This country possesses the highest silicon wafer production efficiency worldwide. With the four 12-inch wafer factories, twenty-two 8-inch wafer factories, eight 6-inch wafer factories, five 5-inch wafer factories, and one 4-inch wafer factory it currently has, the industry has sufficient opportunity to take Taiwan into the next generation of

the semiconductor industry.

B. The Development Strategies and Key Success Factors of Taiwanese Semiconductor Industry

This study plans to use the literature review and historical event method to find out the development strategies and key success factors of the Taiwan semiconductor industry. From the copious body of literature about the Taiwan semiconductor industry, we discover that the following factors are largely accountable for the success of the semiconductor industry: the effective guidance of government policy measures, the vision and support of high-leveling leaders in the government, human resources, the localization of foreign technology, industry cluster effect, and the support of up-, mid- and down-stream industries.

Figure 4
3C Industrial support system



Data Source: compiled for this study (3C means Computer, Communication, Consumer electronics.)

In addition to government support, the other critical factor of the success of the semiconductor industry is the fact that a complete testing ground is available in the domestic market. The development of the 3C industries provides an excellent testing ground for semiconductor components, where the design and production technology have the opportunity to be continuously adjusted before they are ready for international marketing. The IT industry also needs a place to serve as a testing ground for application and services, (but the place is not limited to the domestic market.) As a

result, this testing ground has linked heterogeneous up-, mid- and down-stream industries to create another fundamental resource and success factor for the industry. Other than this, many supporting factors need to be established, as illustrated in Figure 6. From these, many important key success factors (KSF) for Taiwan Semiconductor Industries can be derived. This study will make an analysis of each KSF based on the balanced scorecard system.

Because IT industries in Taiwan were developed in synch with the semiconductor industry, there are local down-stream industries to stimulate demand for the components produced by the up-stream semiconductor industry. This advantage was accompanied by other factors to create the present powerhouse of the Taiwan semiconductor industry. R&D capital, manufacturing and management know-how, were simultaneously established in Taiwan. The government provided a set of well-designed tax policies and a healthy financial environment for raising capital. And the government took the leading role in industry policies.

C. Vision and Goals of Development

Based on the proposal by the Industry Development Bureau (IDB) of the Ministry of Economic Affairs (MOEA), (the governing authority of Taiwanese semiconductor industry,) the government's visions and goals for the future of the semiconductor is constructed as follows:

1. Vision: to become the third largest supplier of IC products in the world in 2006.
2. Goals: they are set according to the four perspectives of the balanced scorecard.
   (1) Financial: to reach a production value of US$45,500,000 with three companies ranking among the global top ten manufacturers.
   (2) Customer: to construct an environment of industry development, in which the up-, mid- and down-stream industries support each other.
   (3) Internal processes: to become the area with the highest concentration of 12-inch wafer factories and the highest efficiency in the world.
   (4) Learning and growth aspect: to develop Taiwan's own proprietary SoC technology and increase the proportion of locally manufactured products.

D. Industry Development Strategies

In Taiwan's case, the government used to play the leading role in developing the IC industries by transferring all the related technology from abroad, and assigning ITRI the responsibility to function as the receiver of technology and the center for training related professionals. From a value chain perspective, the Taiwan government hoped to develop all the up-, mid- and down-stream relationships in the IC industry. There were other considerations, such as the fact that Taiwan has good experience in developing small and medium enterprises, and that no company can possibly own sufficient capital for developing a comprehensive set of technology. Based on those conditions, the Taiwan government adopted a unique competitive strategy by mixing the low cost strategy and the focus strategy. The resource-base that Taiwan now enjoys is the result

of that strategy. At present, however, the industry has developed into a rather mature state. Therefore, the government has yielded the power to lead the development of the industry to the enterprises themselves. Now the government plays a role in guiding the industry, and the competitive strategy remains to be the mix of scale strategy and specialization strategy.

Now, we will explain the problems facing the Taiwan semiconductor industry from the four perspectives in the balanced scorecard system.

1. Financial: this can be further divided into the finance side and the taxation side:
   (1) On the finance side, the healthy and active domestic finance market in which IC manufacturers could easily obtain a large amount of capital is a thing of the past. In recent years, the sagging global economy and the declining overall willingness to invest, have conspired to create a hostile environment for raising capital. This in turn leads to insufficient capability of manufacturers to conduct further R&D on their products, which is a potentially dangerous obstacle for Taiwan in developing advanced semiconductor industries. On the other hand, when one observes the future trends of IC products, it becomes evident that the 12-inch silicon wafer is the inevitable mainstream. Although the initial investment cost is prohibitively high, the profit on the wafers is also higher, which means faster recovery of costs. If Taiwan steps back from building 12-inch wafer plants, it may not hold the status of world's largest wafer foundry base much longer. But the estimated initial cost required for building a 12-inch wafer plant is around US$3 billion, which no manufacturer of modest scale can afford by any means. So how to help domestic manufacturers raise the capital needed will be a major challenge.
   (2) Taxation: The various favorable taxation measures provided by the government are not working the way they are supposed to. Due to insufficient promotion effort on the government's part, manufacturers are not well aware of the tax credit for expenditure on equipment, technology, professional talents, R&D and training. Even when they are aware of the taxation measures, they have no access to guidance on how to apply for the deduction. Also, it seriously requires reexamination whether the government is offering the tax credit and exemption categories that the enterprises actually need. In the past, Taiwan used to have a rather wholesome taxation environment that attracted the investment of high-tech companies abroad in Taiwan, thus accelerating the technological development of the semiconductor industry. But in recent years, foreign companies are closing down their operation units in Taiwan or moving their investment targets out of the country. Therefore, the problems of how to provide custom-made tax break measures for major foreign high-tech companies to attract them back to Taiwan and enhance the advanced semiconductor technology, is very much worth exploring.
2. Customers: The industry cluster effect has produced tremendously impressive results in the past. Taiwan needs to realize that the major issue facing it today is how to master marketing strategies. At present, a relatively low proportion of domestic IC products are free of reliance on imports, especially in terms of critical

components and equipment. Therefore it is important to improve technology, encourage local R&D and production to lower costs, achieve lower production costs in existing conditions, pursue the transfer of advanced technology from abroad, and increase the share in international consumer markets. As for the government, it should cooperate with domestic enterprises to pursue opportunities to work with major international manufacturers in sharing the production process (strategic alliance of division labor with major European or Japanese manufacturers, for example.) This can in turn help to enhance the international competitiveness of domestic IC industries. Another issue is that the expansive domestic demand market of China, and the corresponding tax break its government offers, has improved the international competitiveness of Chinese manufacturers by a large extent. Since China's development potential is impossible to ignore, and it will become a major challenge to achieve market segmentation and differentiation between the IC industries of Taiwan and those of China.

3. Internal processes: in the past, Taiwan rivaled any country in the world in its production efficiency and its control of product acceptance rate. Not to mention its world-leading use of IT and network products. Looking into the future, Taiwan should be more proactive in adopting the latest technology and deploy it in enterprises and factories. In the current stage, enterprises may enhance their efficacy and production efficiency though the application of wireless technology. On the other hand, this was all beneficial to the development of the semiconductor industry due to the establishment of a system, which allowed fast accumulation of relevant knowledge. This and competition worked together to create a sound environment for industry innovation, thanks to cooperation between industry and R&D groups. This environment quickly developed the channels of communication, and promoted knowledge sharing within the industry, thereby accelerating the formation of new knowledge and the rate of industry and product innovation.
4. Learning and growth: In the pursuit of a knowledge economy for a resource-base, the most crucial factor is innovation. It involves no more and no less, than issues regarding professional human resources and technology.
   (1) On the professional talent side: Domestic enterprises in IC-related industries have huge demand for R&D staff, but the desperately short supply of qualified people has become a common problem for the industries. The compensation systems of local semiconductor manufacturers are mostly in the forms of employee bonus or profit sharing, which provide little incentive for employees to stay with the same enterprise for a long time. Although on a positive note, the high turnover rate of employees helps to improve the overall quality of employees in IC industries, the difficulty lies in tracking the status of human resources supply. This has become an annoying problem for enterprises. Furthermore, newly graduated employees, even if they majored in related fields, are still not professionals and require a certain period of pre-occupational training before they can be individually assigned tasks. Therefore, how to narrow the gap between the professional training provided by the education system and that required by the industry remains a great challenge.

(2) On the technology side: IC design houses in Taiwan focus on developing and designing digital IC products, but they are quite weak in the fields of analogue, high-frequency and system products. This poses a potential threat for the future development of IC products. As for the manufacturing sector, the fact that only a small number of domestic companies are able to develop advanced, sub-13 μ production process, coupled with the insufficient of product acceptance rate threaten to slow down the overall advance of technology in IC industries. The packaging and testing industries face their own challenge in the trend of moving low-level packaging and testing technology to mainland China. In response, Taiwan manufacturers really need to think about how to move in their own direction toward developing advanced packaging technology such as CSP or Flip-chip, and gain control of critical technology in order to meet the demand of portable, lightweight, compact terminal products. The cluster effect of the semiconductor industry as provided a platform for the quick transfer of knowledge, and has brought about rapid technological advancements. At the same time, a new driving force for industry innovation has been created, whether for an industrial technology research institute or independent departments separated from different companies. We can look at UMC's creation of MediaTek as an example. The government has also begun focusing on Intellectual Property Rights protection, thereby creating a good system for the industry to operate in.

In order to overcome the problems described above, it is an urgent task for Taiwan to seek out the resource-based and key success factors for its industries, according to its past experience and based on the demand from the four perspectives of the balanced scorecard system. It is even more important to execute policy measures through the most efficient use of resources.

To address those issues, this study asks experts of the industry to conduct interviews of researchers of the Taiwan semiconductor industry, and interview the staff of IT Industries Division of IDB, MOEA, the governing authority of the Taiwan semiconductor industry. A questionnaire was issued for a survey on the Taiwan development experience. Among the 70 questionnaires issued, 63 valid copies were returned. After examining the results from the survey, we were able to draw conclusions regarding the following issues: the resource-base the industry seeks to establish, key success factors and industrial policy measures, the correlation analysis of various key success factors and industrial policy measures, the correlation analysis among the industrial policy measures, and a comparative analysis of the Taiwan semiconductor industry with its main competitor, the South Korean semiconductor industry.

E. The Resource-based and Key Success Factors of the Industry in Taiwan

Based on the information obtained through the interviews with employees of semiconductor enterprises and from the questionnaires, we compile a chart depicting some issues regarding the Taiwan semiconductor industry, including the resource-base

it seeks to establish, the key success factors, and the industrial policy measures adopted. A discussion on those issues is made based on the four aspects of the balanced scorecard system. See Table 2 below:

Table 2
The resource-based, the key success factors, and the industrial policy measures for IC industry

Balanced scorecard	Resource–based sought to establish	Key success factors	Major government industrial policy measures
Financial	(1) Funding sources	(1) assistance from gov. project funding	(1) provision of a IPO and fund raising environment by the government
		(2) support of tax policies	(2) encouragement of venture capital firms and tax exemption for focus industries
		(3) support of financial market	(3) government funding or investment matching for indicatory manufacturers
	(2) Profitability	(4) profitability of the industry	(4) tax incentive systems to encourage export
			(5) investment tax credit of five-year tax exemption period for shareholder in focus industries
Customer	(1) price competitiveness	(1) ability to market products internationally	(1) assistance in international business operations
	(2) market share		
	(3) vertical integration materials and component supply in the up-stream	(2) industry cluster effect	(2) organization of industry alliance
		(3) specialized division labor and interaction among the up-, mid- and down-stream industries	(3) development of Industrial Park and establishment of industrial district and processing & export zone
		(4) degree of economy of scale	(4) creating a fully competitive environment for industries
	(4) cost and quality that meet market demand	(5) manufacturing management capability	(5) support in public construction and facilities(such as roads and airports)
		(6) support of domestic industries	
		(7) good customer service	
	(5) customer satisfaction	ability(acceptance rate and fast delivery)	(6) subsidy and guidance for industrial safety, quality assurance and computerization
			(7) allowance to introduce foreign labor in important investment projects
		(8) application environment	
	(6) application environment for down-stream industries	for the industry	(8) development of domestic market and provision of environment for product application and testing

Table 2 (continued)

Balanced scorecard	Resource−based sought to establish	Key success factors	Major government industrial policy measures
Internal processes	(1) benchmarking system (2) project management (3) administration and production efficiency	(1) vision of high-leveling government officials and project leaders (2) organizational culture of the research institute (3) continuous support of national policies (4) flexibility of SME (5) ability to use IT	(1) support of high-leveling government officials and support in policy (2) establishing national prices for various benchmarks (3) encouraging the development of SME (4) tariff exemption for imported machinery and equipment (5) tax credit on investment in automation and computerization equipment
Learning and growth	(1) Development of talent and ability to improve technology (2) ability of new product R&D and innovation (3) patent and IP (4) ability to control new product specifications	(1) policies on talent development and introduction of the government and the enterprises themselves (2) smooth introduction of foreign technology (3) degree of control on patents (4) production technology ability (5) ability to guide specs or speed to follow new specs (6) ability to adapt to changes in the external environment (7) ability of product innovation (8) ability to use technology	(1) support of technology projects (2) policies for developing technology talent pool (3) introduction of talents from abroad (4) foundations established with government donation to assist in the development of industry technology and products(ex：ITRI and III) (5) introduction of foreign technology and patents (6) protection of intellectual property rights (7) tax exemption for royalty from foreign profit-taking business (8) provision of information on industry development and market trends (9) subsidy for R&D on technology and products (10) encouraging enterprises to set up R&D centers (11) loans for R&D on technology and products (12) tax credit on company investment on R&D and staff training expenditures

Data source: compiled from the results of the questionnaire survey of this study

F. The Relationship between Key Success Factors and Industrial Policy Measures

This study is mainly based on the opinions of elite members of the industry, academia and research circles that were present at the Taiwanese Semiconductor Industry Summit

organized by IDB, MOEA in 2002. In the Taiwanese Semiconductor Industry Summit organized by IDB of MOEA, the attendees included the leaders and important high-leveling managers of all the internationally famous enterprises mentioned above, such as TSMC, UMC, IDM, WinBond, MediaTek, Via, etc. The opinions of the experts at the summit are as follows:

Taiwan has laid a solid foundation for its industries thanks to the efforts of the government and enterprises in the past. The industry must continuously improve its technology in the future. In addition, the development of Intellectual Properties (IP) and SoC should be synchronized with international competitors. The government should also invest funds as a catalyst for encouraging the exchange of IP.

Regarding technology, the government should first encourage pilot studies and provide different incentives in each stage of technology development. Next, substantial support should be given to international cooperation, and the down-stream application, testing environment and infrastructure in Taiwan should be improved. Finally, the IC design house should strengthen their ability in leading the determination on specifications and standards. From these important conclusions, as well as the study on the key success factors of the semiconductor industry in the abovementioned literature, this study selects ten (10) important KSFs that Taiwan may develop and eleven (11) important policy measures, and conducts a correlation analysis on them. The analysis is illustrated in Table 3 on next page.

According to the degree of importance and correlation, each item is given a score of correlation. 5 points are given for very high correlation, 3 points for average correlation, 1 for weak correlation, 0 for no correlation, and -1 for negative correlation. Depending on the characteristics of the industry, different aspects are given different weighting proportions. For example: in picking ten key success factors for the semiconductor industry, the financial aspect is given a 30% weight (3 items to be picked); the customer aspect gets 20% (2 items picked); the internal processes aspect gets 20% (2 items picked); the learning and growth aspect get 30% (3 item picked). Based on the results, we are able to decide the priority position for the placing of resources. Of course, different policies do not always demand the same resources, but incase there is overlapping demand for the same resources, this can help decide where the resources can be best allocated.

From the analysis of Table 3, it is easy to tell that those important policy measures selected, show that the following items are regarded as the most beneficial: ability of product innovation, the speed of catching on and following specifications （quick response）, the professional training policies of the government and the enterprises themselves, and the vision of project leaders. The support of the financial market and the ability to use IT receive the lowest attention. When we ask: which policy measures taken by the Taiwan government are the most beneficial for the important key success factors? The results of this empirical study show that the following policy measures are the most influential: technological professional training policies, subsidies for R&D on technology and products, development of a domestic market, provision of environment for product application and testing, and the development of an Industry Park, industrial districts and processing and export zones.

Table 3

Table of correlation between key success factors and industrial policy measures

Industrial policy measure / Key success factors		High-leveling support	IPO	Talent development	R&D centers	Foreign technology	Industry Park and industrial zone	Tax credit	R&D Subsidy	Environment for product application & testing	Foreign recruitment	Market information	Total
Financial	Gov. technology project	□	▲	□	□	□	○	○	□	□	○	□	**38**
	Taxation policies	□	▲	□	○	●	□	□	□	○	○	○	**32**
	Financial market	○	□	○	●	○	●	□	□	●	▲	▲	**27**
	Sub-total	**11**	**5**	**11**	**9**	**9**	**9**	**11**	**15**	**9**	**2**	**6**	**97**
Customer	Application environment	●	▲	□	□	●	□	○	□	□	○	○	**34**
	Cluster effect	□	▲	●	●	●	□	□	▲	●	●	○	**31**
	Sub-total	**8**	**0**	**8**	**8**	**6**	**10**	**6**	**5**	**8**	**4**	**2**	**65**
Internal processes	Vision of leaders	□	□	□	●	○	□	○	○	□	□	□	**41**
	Ability to use IT	○	●	□	○	○	○	●	□	●	○	●	**27**
	Sub-total	**6**	**8**	**10**	**4**	**2**	**6**	**4**	**6**	**8**	**6**	**8**	**68**
Learning and growth and innovation	Talent development policy	□	□	□	●	●	●	□	●	●	□	○	**41**
	Innovation and quick response	○	□	□	□	□	□	○	□	□	●	●	**43**
	Technology and management	●	○	□	▲	○	○	○	□	□	○	●	**26**
	Sub-total	**9**	**11**	**15**	**8**	**9**	**9**	**7**	**13**	**13**	**9**	**7**	**110**
Total		**34**	**24**	**44**	**29**	**26**	**34**	**28**	**39**	**38**	**21**	**25**	

Data source: compiled based on the results of questionnaire survey of this study

□ : very high correlation (5) ● : average correlation (3) ○ : weak correlation (1) ▲ : no correlation (0)

□ : negative correlation (-1)

G. SWOT and Competitive Analyses against Major Competing Countries

The main objective in this section is to make a SWOT analysis of the home country and a competition analysis of major competing countries. From an analysis of the up-stream a down-stream IC industries, we can see that the IC design house has the advantage of good cost management, proximity to the down-stream IT application market, and control of numeric technology. Its disadvantages include relatively weak product innovativeness, lack of experience in designing analogue and wireless communication IC product, lack of SoC technology know-how, and relatively weak marketing capability. The advantages of the IC manufacturing industry are sufficient production capacity, good service quality and the progression of OEM technology in synch with the rest of the world. The disadvantages include lack of control on DRAM technology and relatively weak marketing capability. The advantages of the IC packaging and testing industries are proximity to the foundry factories and advanced technology. The disadvantages are insufficient cost competitiveness in low-level products and lack of strategic deployment in the mainland Chinese market. The entire SWOT analysis is shown in figure 5 below:

Figure 5
The SWOT analysis of Taiwanese IC industry

➢ Specialized division labor and strong cluster effect. ➢ The power of Taiwanese foundry industry stimulating the development of up- and down-stream industries. ➢ Support of down-stream PC and IT industries. ➢ Good operation flexibility Relative cost advantage. ➢ Good capability in digital design and CMOS production process.	➢ Excessive homogeneity of fields and products, lack of innovation. ➢ Insufficient specialty in high-frequency, wireless communication and analogue design and systems. ➢ SoC-related design, production, packaging and testing technology need improving. ➢ Insufficient marketing channels and market sensibility.
Strength	**Weakness**
Opportunity	**Threat**
➢ Huge appetite of Chinese PC/digital consumer product market. ➢ Component business opportunities derived from IA products. ➢ Strengthened capability due to alliance, tech transfer and acquisition. ➢ Continuous orders from major IDM companies a boon for manufacturing, packaging and testing industries. ➢ The down-stream wireless communication industry in Taiwan has taken off.	➢ New entry of the game of wafer ➢ foundry competition from Korea and China. ➢ Designing up-comers from Israel and Europe are catching up fast. ➢ High entry barrier of wireless communication products, companies without critical technology or early movers have difficulty to survive.

Data source: compiled for this study

The Taiwan semiconductor industry should regard South Korea, number three in the world in this field, as its main competitor. The following is a simple analysis of the Korean industry:

The Korean semiconductor industry was born in 1965, when Commy Corp. from the United States established a transistor assembly factory in South Korea. Other American semiconductor companies such as Motorola followed suit. The beginning of South Korea's own semiconductor industry should be in 1974, with the establishment of Korea Semiconductor Corp., which was later acquired by Samsung Group. The South Korean government began its intervention in full force in 1981, with the conception of its semiconductor development project, and the introduction of large conglomerates such as Samsung, Goldstar and Hyundai into the semiconductor business. The Korean semiconductor industry soon won a position in the global market. Goldstar merged with Hyundai in 1994.

As it is, the Korean semiconductor industry is mainly lead by large enterprises, especially Samsung, Hyundai and LG. All of the companies are large, vertically integrated companies, and integrated component manufacturers as well. That means the entire production process, from up-stream to down-stream, can be completed within their own factories. The largest packaging plant is also in South Korea, although it almost does not do any business with the three largest Korean semiconductor manufacturers, but takes commission from abroad exclusively.

Table 4

Analysis of the major competitor in semiconductor industry

Balanced scorecard	**Key success factors**	**Taiwan vs. Korea**
Financial	Funding of Gov. technology projects	○ Equal
	Supporting taxation policies	○ Equal
	Support of financial market	● Korea is superior
Customer	Industry technology and application environment	● Korea is superior
	Industry cluster effect	▲Taiwan is superior
Internal processes	Vision of gov. and project leaders	○ Equal
	Ability to use IT technology	○ Equal
Learning and growth	Talent development policies of government and companies	● Korea is superior
	Product innovation, control of specs and speed to follow new specs	● Korea is superior
	Capability of manufacturing technology and management	▲Taiwan is superior

Data source: compiled according to the results of questionnaire survey in this study

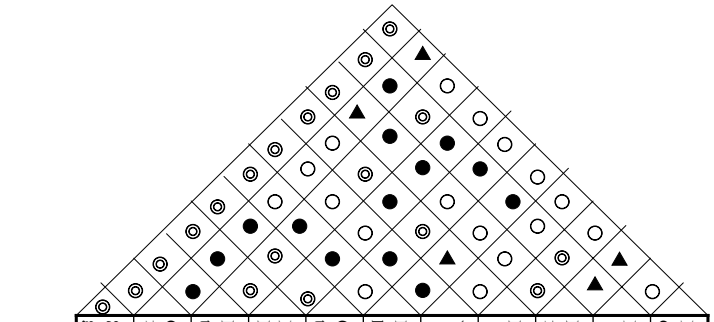
□ : competitor is very strong ● : competitor is relatively strong ○ : two countries are equal

▲ : home country is relatively strong □ : home country is very strong

In the historical development process of the Korean semiconductor industry, facing its different domestic and international environment, the Korean government needed to develop the national economy in a very short period of time. Therefore, it sought to work hand in hand with major conglomerates in pursuit of rapid development, with the government supporting the conglomerates with subsidies and joint R&D projects. With sufficient funds invested in R&D, they managed to quickly catch up with the leading countries in the IC industries.

From Table 4, we can see that the weaker key success factors for Taiwan include the following: financial market support, the environment for industry technology and application, professional talent development policies of the government and the companies themselves, the ability of product innovation, and the speed to control and follow specifications. Since those are the points requiring improvement, the Taiwanese government needs to put more consideration into related issues and propose policy measures for improvement.

Figure 6
A chart of the correlation analysis among industry policy measures



	Support of high-leveling government officials	Government assistance in creating a fund raising enviroment through IPO	Policies on developing technological talents	Encouraging enterprises to set up R&D centers	Complete introduction of foreign technology and patents	Industrial park,industrial districts,and processing/export zones	Various types of tax Credit	R&D Subsidies	Developing the domestic marketing for the environment	Introduction of foreign talents	Information on industry development and market trends
weight	50	20	36	32	32	21	18	31	19	29	12

Data Source ：compiled for this study

H. Analysis of the Correlation between Various Industry Policies

Based on the results of the questionnaire survey, Figure 6 is produced to analyze the relationship among various policies and reveal the importance of the policies and the interrelationship among them. In the same modus operandi as the previous correlation, the analyses of various degrees of correlation are given different scores. Very high correlation receives 5 points, average correlation gets 3, weak correlation gets 1, no correlation gets 0, and negative correlation receives -1 point. The analysis shows that the support of high-level officials in the government is the most influential factor for the policies, and the policy for developing technological talent also has a heavy influence on other policies. Therefore, they should come in highest priority in policy execution. Also, measures such as encouraging enterprises to establish R&D centers and the introduction of a complete series of foreign technology and patents, also play an important role.

I. Performance Measurement

Finally, in order to have a clear understanding of the status of industry development and effectively solve the problems facing Taiwan as described above, it is necessary to establish related indicators for measurement to evaluate the degree of accomplishment in various stages. This study uses Table 3 to select the ten important key success factors that Taiwan can develop, and then uses the achievable resource-based shown in Figure 8 to properly select measurement indicators. These measurement indicators can be used to assess whether the respective resource-bases have been successfully accumulated, and to make decisions for establishing key success factors. See Table 5.

Taiwan government authorities have adopted policy measures to pursue the upgrade of its semiconductor industry in the future. So far, it has drawn up a “Silicon Island Project” and developed related measures. From the four perspectives in the balanced scorecard system, the measures include the following:

(1) Financial: There should be stepped-up efforts to assist the provision of factors on the capital side, as well as tax incentives to facilitate the development of the semiconductor industry.
   (i) On the finance side, the government should provide mid-term and long-term low-interest loans and help companies raise funds by listing their shares as technology stocks on the securities exchange.
   (ii) On the taxation side, tax exemption should be provided for venture capital companies investing in focus industries.
(2) Customers: The government should assist enterprises in establishing the channels of international marketing and cooperation for the semiconductor industry. It should also take advantage of the cluster effect existing in Taiwan, and promote efforts to turn Taiwan into the testing environment for global semiconductor products, services and technology.

Table 5
Performance measurement chart on balanced scorecards

Balanced scorecard	Resource-based sought to establish	Measurement indicators
Financial	(1) Funding sources	(1) amount of investment from the industry, number of manufacturers, amount of investment from government technology projects
	(2) profitability	(2) average gross profit and net profit of the industry, industry production value (per employee average), capital turnover rate, return on capital, operation profit
Customer	(1) price competitiveness	(1) price flexibility, rate of price decrease over per unit of time
	(2) market share	(2) market share, global ranking for Taiwanese industry
	(3) customer satisfaction	(3) number of orders received, delivery period, and supportive service
	(4) cooperation with up-stream material and component suppliers	(4) rate of domestic supply of equipment and materials
	(5) application environment for down-stream industries	(5) rate of locally produced components used by the industry, ratio of import and export
	(6) costs and quality that meet market demand	(6) acceptance rate and ratio of reduced cost over per unit of time
Internal processes	(1) the establishment of benchmarking system	(1) ratio of recognition in the industry
	(2) ability to manage projects	(2) ratio of shortened development schedule
	(3) industrial safety	(3) rate of industrial disaster occurrence, rate of investment in public safety equipment
	(4) administration and production efficiency	(4) penetration rate of IT and communication products in enterprises, amount of investment in IT equipment
Learning and growth	(1) development of talents and ability to elevate technology standards	(1) number of workers in the industry and number of foreign-educated talents
	(2) ability of new product R&D and innovation	(2) ratio of production value of new products to the total production value, ratio of R&D investment of the industry, level of production process standard
	(3) patents and intellectual property right	(3) number of patents and revenue from royalty
	(4) ability to control specifications for new products	(4) the lag between the success of first copy of new product in the industry between that of major international manufacturers

Data source: compiled for the study

(3) Internal processes: Services to provide industry information and intelligence should be strengthened to keep enterprises in touch with the latest trends of international trade and market changes. Enterprises should stay abreast of and apply the latest technology to enhance their enterprise efficacy and production efficiency.
(4) Learning and growth:
    (i) For human resources, a semiconductor academy should be established to train the professionals enterprises need, and professional talent from abroad should be recruited with earnest effort.
    (ii) For technology, the government should make use of the IC Design Industrial and R&D Center, as well as the IC Design Industry Park Network, to assist and strengthen the R&D system that needs improvement. It should also accelerate the establishment of critical technology for the industry, help enterprises to participate in the determination of international specifications, and assist in promoting the standardization of IC design product specifications. The major goals of its development in the future will be (1) to continue the advantages of specialized division labor to achieve the maximum value of the OEM model; (2) to continue expanding production capacity; (3) elevate the production process technology and (4) increase the coverage of product lines to cover new areas such as network communication and SoC.

IV. CONCLUSION

This study tries to explore the influence of related government policies and measures on guiding the development of selected industries. This study uses the concepts of the balanced scorecard and value chain to help the government examine whether the efficiency of the use of resources has reached its optimum state. It also provides a new model for thinking and analysis, which links the strategy aspect and the execution aspect to clearly reveal what resource-base the industry needs. Also, it uses competition analysis to help it determine what policy measures need to be strengthened. From the discussion above, we know there are still a number of weak spots in the Taiwan semiconductor industry calling for improvement, and a lot remains to be done.

From the results of the analysis, we discover that if Taiwan wants to be a player in the international market in the future, the most important key success factors would be the vision and support of high-leveling government officials, the provision of professionals that meet the demand of industries, and assistance for enterprises in establishing their technology base. The core resources to be established include: sources of funding, profitability, price competitiveness and market share, customer satisfaction, close matching with materials and components in the up-stream and the application environment for the down-stream industries, manufacturing and management ability to produce at the cost and of the quality that meet the market demand, and the ability to control new product specifications.

In terms of government policies, the most important policy measures are those most beneficial for the ability of product innovation, the ability to control the speed to follow new product specifications, the professional training policies of the government and enterprises themselves, and the vision of high-leveling government officials and

project leaders. The analysis of the key success factors in Taiwan government policy measures, shows that the most influential policy measures for industry development include the policy for developing technological talents, subsidies for R&D on technology and products, the development of an Industrial Park, and the establishment of industrial districts and process and export zones.

From the analysis of the case study in this paper, the following relationships have been found:

(1) The training of professional talents shows the strongest correlation with the key success factors.
(2) All policy measures concerning the Taiwan semiconductor industry possess the most crucial significance for the industry's innovative ability, its control of specifications, as well as keeping pace with competition elsewhere.
(3) A high-level government support should be the key determinant for policy measures to succeed.

These results reflect the situation in countries in the Asia-Pacific region, and their governments differ from American and European countries by directing industry development policy. No matter the case, the Taiwan government has developed policies for the semiconductor industry over the past forty years. The industry development policy measures play a significant role in the development of the supply chain connecting the up, mid, and downstream of the industry.

This study has discussed the vital role the Taiwan government has played its successful semiconductor industry. Since the introduction of chip manufacturing, and then the supply network of packaging, testing, photo-masking, and design, the Taiwan semiconductor industry has become an essential part of the global manufacturing network. It has a complete supply chain management system, in which taxation, technology and R&D, the internet, and policy control, all play a critical role. The combination of policies is a key success factor for the industry. Therefore, this paper studies the relationship between industry development policy and key success factors with respect to other policies. It also provides different considerations on how to establish for the industry, strategies, policies, and key success factors for the successful development of a global manufacturing network and supply chain management.

REFERENCES

Chen, Wu. Tung, 2002, "The Entrepreneurial Management of Management Strategies – Using IC Enterprises as Examples, Master's thesis," *Department of Technology Management , Chiao-tung University.*

Doz, Y.L., P.M. Olk and P.S. Ring, 2000, "Formation processes of R&D consortia: which path to take? Where does it lead?" *Strategic Management Journal*, 21(3),239-266.

Helfat, C. E. and R. S. Raubitschek, 2000, "Product sequencing: co-evolution of knowledge, capabilities and products," *Strategic Management Journal*, 21(10-11), 961-979.

Holbrook, D., W. M. Cohen, D. A. Hounshell and S. Klepper, 2000, "The nature, sources, and consequences of firm differences in the early history of the semiconductor industry," *Strategic Management Journal*, 21(10-11), 1017-1041.

Hoskisson, R. E., M. A. Hitt, W. P. Wan and D. Yiu, 1999, "Theory and research in strategic management: Swings of a pendulum," *Journal of Management*, 25(3),417-456.

Husain, Z. and Sushil, 1997, "Management of Technology：A Glimpse of Literature," *International Journal of Technology Management*, 14(5),539-578.

Kaplan, R. S. and D.P. Norton, 1993, "Putting the balance scorecard to work, *Harvard Business Review*, Sep/Oct,134-147.

Kaplan, R. S. and D.P. Norton, 1992, The balance scorecard-Measures that drive performance," *Harvard Business Review*, Jan/Feb, 71-79.

Kaplan, R. S. and D.P. Norton, 1996, "Using the balance scorecard as a strategic management system," *Harvard Business Review*, Jan/Feb, 75-85.

Kaplan, R. S. and D.P. Norton, 2000, "Having trouble with your strategy," *Harvard Business Review*, Sep/Oct, 167-176.

Keegan, D. J. and R. G. Eiler, and C. R. Jones,1989, "Are Your Performance Measures Obsolete," *Management Accounting*, 45-50.

Kogut, B., 2000, "The network as knowledge generative rules and the emergence of structure," *Strategic Management Journal*, 21(3), 405-425.

Lampel, J., and J. Shamsie, J., 2000, "Probing the unobtrusive link: dominant logic and the design of joint ventures at General Electric," *Strategic Management Journal*, 21(5), 593-602.

Lin, Chin. Huang, 2002, "A Study on the Characteristics Presented IC Manufacturing Industry in Technologic," Market and Capital Factors in the Development Process of Taiwan's IC Industry, Chiao-tung University.

McEvily, B., & Zaheer, A., 1999, "Bridging ties: A source of firm heterogeneity in competitive capabilities," *Strategic Management Journal*, 20(12), 1133-1156.

Porter, M. E., *Competitive Strategy*, New York, The Free Press, 1980.

Porter, M. E., *Competitive Advantage*, New York, The Free Press, 1985.

Porter, M. E., *The Competitive Advantage of Nations*, New York, The Free Press, 1990.

Shaffer, B., and A.J. Hillman, 2000, "The development of business-government strategies by diversified firms", *Strategic Management Jo*urnal, 21(2),175-190.

Winter, S. G., 2000, "The satisfying principle in capability learning," *Strategic Management Journal*, 21(10-11), 981-996.

Tsai, Ming. Jie, 2000, *The Pursuit of Competitiveness – Practical Strategies for the IC Industry*, Wealth Publishing Co., Taipei.

Xyu, Zuo. Sheng, & Yi. Jia, Qiou, 2000, *Knowledge-Base Innovation and Competition: an Empirical Study on the Analytic Model for Competitive Advantage Strategies*, first edition, Yuan-liou Publishing Co., Taipei.

Yang, Tze jiang, 1998, "Semiconductor Industry Chronicle: an Observation of a Financial Investor," *ITRI*, 6.13-16, Hsin-chu.

Zou, Yu jing, 2000, "Applying Porter's Strategy Theories in the Planning and Design of Balanced Scorecards," Master's thesis, Department of Transportation Engineering and Management, Chiao-tung University.

APPENDIX

Questionnaire 1

This questionnaire seeks to research the Taiwanese IC and Semiconductor Industry and 1.key success factors; and 2.the relevance of industry policies to its success. Please fill out the following questions based on your knowledge of the industry, in order to provide a reference for future policies.

1. Based on previous experience in the Taiwan Semiconductor Industry, please list the key success factors. _____
2. Do you think the factors below are key to the success of the semiconductor industry? (Multiple Choice)

(1) assistance from government project funding	Yes□	No□
(2) support of tax policies	Yes□	No□
(3) support of financial market	Yes□	No□
(4) profitability of the industry	Yes□	No□
(5) ability to market products internationally	Yes□	No□
(6) industry cluster effect	Yes□	No□
(7) specialized division of labor and interaction among the up-, mid- and down-stream industries	Yes□	No□
(8) degree of economy of scale	Yes□	No□
(9) manufacturing management capability	Yes□	No□
(10) support of domestic industries	Yes□	No□
(11) good customer service ability (acceptance rate and fast delivery)	Yes□	No□
(12) application environment for the industry	Yes□	No□
(13) vision of high-leveling government officials and project leaders	Yes□	No□
(14) organizational culture of the research institute	Yes□	No□
(15) continuous support of national policies	Yes□	No□
(16) flexibility of SME	Yes□	No□
(17) ability to use IT technology	Yes□	No□
(18) policies on talent development and introduction of the government and the enterprises themselves	Yes□	No□
(19) smooth introduction of foreign technology	Yes□	No□
(20) degree of control on patents	Yes□	No□
(21) production technology ability	Yes□	No□
(22) ability to guide specs or speed to follow new specs	Yes□	No□
(23) ability to adapt to changes in the external environment	Yes□	No□
(24) ability of product innovation	Yes□	No□
(25) ability to use technology	Yes□	No□

Based on previous experience in the Taiwan Semiconductor Industry, please list any other key success factors _____

Questionnaire 2

This questionnaire seeks to research the Taiwanese Semiconductor Industry along three topics, which are: 1.analysis of correlation between key success factors and industrial policy measures; 2.correlation analysis among industry policy measures; and 3.analysis of the major competitor in the semiconductor industry (Korea). Based on different degrees of correlation, the study gives them the rate (Please write down the a ; b ; c ; d ; e in the following questionnaire.) such as a. very high correlation (5), b. average correlation (3), c. weak correlation (1), d. no correlation (0), and e. negative correlation (-1). Please fill out the following questions based on your knowledge of the industry, in order to provide a reference for future policies.

1. Based on your expertise, please rate the correlation between industry policy measures listed below and key success factors of the industry.

(1) Assistance from government project funding	(2) Support of taxation policies
High-leveling support ___	High-leveling support ___
IPO ___	IPO ___
Talent development ___	Talent development ___
R&D centers ___	R & D centers ___
Foreign technology ___	Foreign technology ___
Industry Park and industrial zone ___	Industry Park and industrial zone ___
Tax credit ___	Tax credit ___
R&D subsidy ___	R & D subsidy ___
Environment for product application and testing ___	Environment for product application and testing ___
Foreign recruitment ___	Foreign recruitment ___
Market information ___	Market information ___

(3) Support of financial market High-leveling support ___ IPO ___ Talent development ___ R & D centers ___ Foreign technology ___ Industry Park and industrial zone ___ Tax credit ___ R & D subsidy ___ Environment for product application and testing ___ Foreign recruitment ___ Market information ___	(4) Application environment for the industry High-leveling support ___ IPO ___ Talent development ___ R & D centers ___ Foreign technology ___ Industry Park and industrial zone ___ Tax credit ___ R & D subsidy ___ Environment for product application and testing ___ Foreign recruitment ___ Market information ___
(5) Industry cluster effect High-leveling support ___ IPO ___ Talent development ___ R & D centers ___ Foreign technology ___ Industry Park and industrial zone ___ Tax credit ___ R & D subsidy ___ Environment for product application and testing ___ Foreign recruitment ___ Market information ___	(6) Vision of high-leveling government officials and project leaders High-leveling support ___ IPO ___ Talent development ___ R & D centers ___ Foreign technology ___ Industry Park and industrial zone ___ Tax credit ___ R & D subsidy ___ Environment for product application and testing ___ Foreign recruitment ___ Market information ___

(7) Ability to use IT technology High-leveling support ___ IPO Talent development ___ R&D centers ___ Foreign technology ___ Industry Park and industrial zone ___ Tax credit ___ R&D subsidy ___ Environment for product application and testing ___ Foreign recruitment ___ Market information ___	(8) Policies on talent development and introduction of the government and the enterprises themselves High-leveling support ___ IPO ___ Talent development ___ R&D centers ___ Foreign technology ___ Industry Park and industrial zone ___ Tax credit ___ R&D subsidy ___ Environment for product application and testing ___ Foreign recruitment ___ Market information ___
(9) Ability to guide specs or speed to follow new specs High-leveling support ___ IPO ___ Talent development ___ R&D centers ___ Foreign technology ___ Industry Park and industrial zone ___ Tax credit ___ R&D subsidy ___ Environment for product application and testing ___ Foreign recruitment ___ Market information ___	(10) Manufacture technology and management High-leveling support ___ IPO ___ Talent development ___ R&D centers ___ Foreign technology ___ Industry Park and industrial zone ___ Tax credit ___ R&D subsidy ___ Environment for product application and testing ___ Foreign recruitment ___ Market information ___

2. Analysis of correlation between key success factors and industrial policy measures

(1) What is the correlation between high-leveling support and industrial policy measures? IPO ___ Talent development ___ R & D centers ___ Foreign technology ___ Industry Park and industrial zone ___ Tax credit ___ R & D subsidy ___ Environment for product application and testing ___ Foreign recruitment ___ Market information ___	(2) What is the correlation between IPO and industrial policy measures? Talent development ___ R & D centers ___ Foreign technology ___ Industry Park and industrial zone ___ Tax credit ___ R & D subsidy ___ Environment for product application and testing ___ Foreign recruitment ___ Market information ___
(3) What is the correlation between talent development and industrial policy measures? R & D centers ___ Foreign technology ___ Industry Park and industrial zone ___ Tax credit ___ R & D subsidy ___ Environment for product application and testing ___ Foreign recruitment ___ Market information ___	(4) What is the correlation between encouraging enterprises to set up R&D centers and industrial policy measures? Foreign technology ___ Industry Park and industrial zone ___ Tax credit ___ R & D subsidy ___ Environment for product application and testing ___ Foreign recruitment ___ Market information ___

(5) What is the correlation between introducing foreign technology/patents and industrial policy measures? Industry Park and industrial zone ___ Tax credit ___ R & D subsidy ___ Environment for product application and testing ___ Foreign recruitment ___ Market information ___	(6) What is the correlation between developing Industrial Parks and industrial zones and industry policy measures? Tax credit ___ R & D subsidy ___ Environment for product application and testing ___ Foreign recruitment ___ Market information ___
(7) What is the correlation between providing tax credit and industrial policy measures? R & D subsidy ___ Environment for product application and testing ___ Foreign recruitment ___ Market information ___	(8) What is the correlation between providing R&D subsidies and industrial policy measures? Environment for product application and testing ___ Foreign recruitment ___ Market information ___
(9) What is the correlation between providing an environment for product application & testing and industrial policy measures? Foreign recruitment ___ Market information ___	(10) What is the correlation between foreign recruitment and industrial policy measures? Market information ___

3. Please compare key success factors between the Taiwanese and Korean Semiconductor Industry.

Key Success Factors	Compare whether Taiwan or Korea is superior, or if the two countries are equal.
Funding of government technology projects	□Taiwan □Korea □Equal
Supporting taxation policies	□Taiwan □Korea □Equal
Support of financial market	□Taiwan □Korea □Equal
Industry technology and application environment	□Taiwan □Korea □Equal
Industry cluster effect	□Taiwan □Korea □Equal
Vision of government and project leaders	□Taiwan □Korea □Equal
Ability to use IT technology	□Taiwan □Korea □Equal
Talent development policies of government and companies	□Taiwan □Korea □Equal