Chapter1

Introduction to the Semiconductor Industry

Chapter1 will be presented in to five sections such as the Development of the Semiconductor Industry, Technology and Major Products, Rational & Problems, Objective & Scope of the Study, and Conceptual Framework, orderly.

1.1 The Development of the Semiconductor Industry

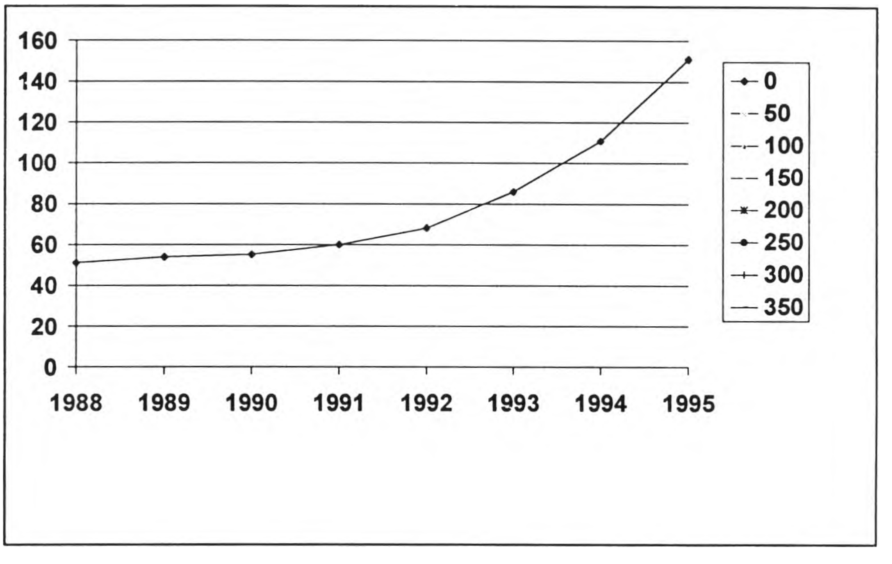
The growth of electronic component has outperformed the overall manufacturing sector since 1960. The existing electronic industry paved the way for the semiconductor industry, as the semiconductor industry is a basic division and the foundation on which the entire electronics industry is built. Referring to the evolution of the semiconductor industry, since 1950 the first country which has made a significant contribution to the innovation and development of the industry was the United States. The world's two largest companies in semiconductor technology were Fairchild and Texas Instruments in the USA. In 1958 the first integrated circuit was created by Texas Instruments (TI). (Stroch Corporation, 1987, p. 5)

The semiconductor component is simply called an integrated circuit (IC). IC is the key component to most electronic equipment used in our daily lives. Familiar applications can be found in computers, thermostat controls, air conditioners, television sets, calculators, mobile phones, satellites, and electronic devices in automobiles, aerospace, and in the military.

The definition of a semiconductor component, mostly referred to as an integrated circuit or microelectronics, each capable of processing and storing information more efficiently than the last, has resulted in a progressive broadening of the range of applications of semiconductor devices and in a rapid increase in of integrated circuit (IC) consumption throughout the world. (Figure 1.1)

The progressive phases of circuit integration started from small-scale integration to medium-scale integration, then large-scale integration and finally very large-scale integration. Integrated circuits[1] have become less like components and more like complete electronic systems or subsystems.

Figure1.1
Worldwide IC Consumption



Source: Data Quest May, 1996

1.2 Technology and Major Products

There are two figures for explaining the Semiconductor Industry's Products as follows:

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[1]Very large-scale integration. VLSI devices are ICs that contain 1,000 or more gate equivalents

Large-scale integration. LSI devices contain 100 or more gate equivalents or other circuitry of similar complexity.

Medium-scale integration. ICs containing 10 or more gate equivalents but less than 100.

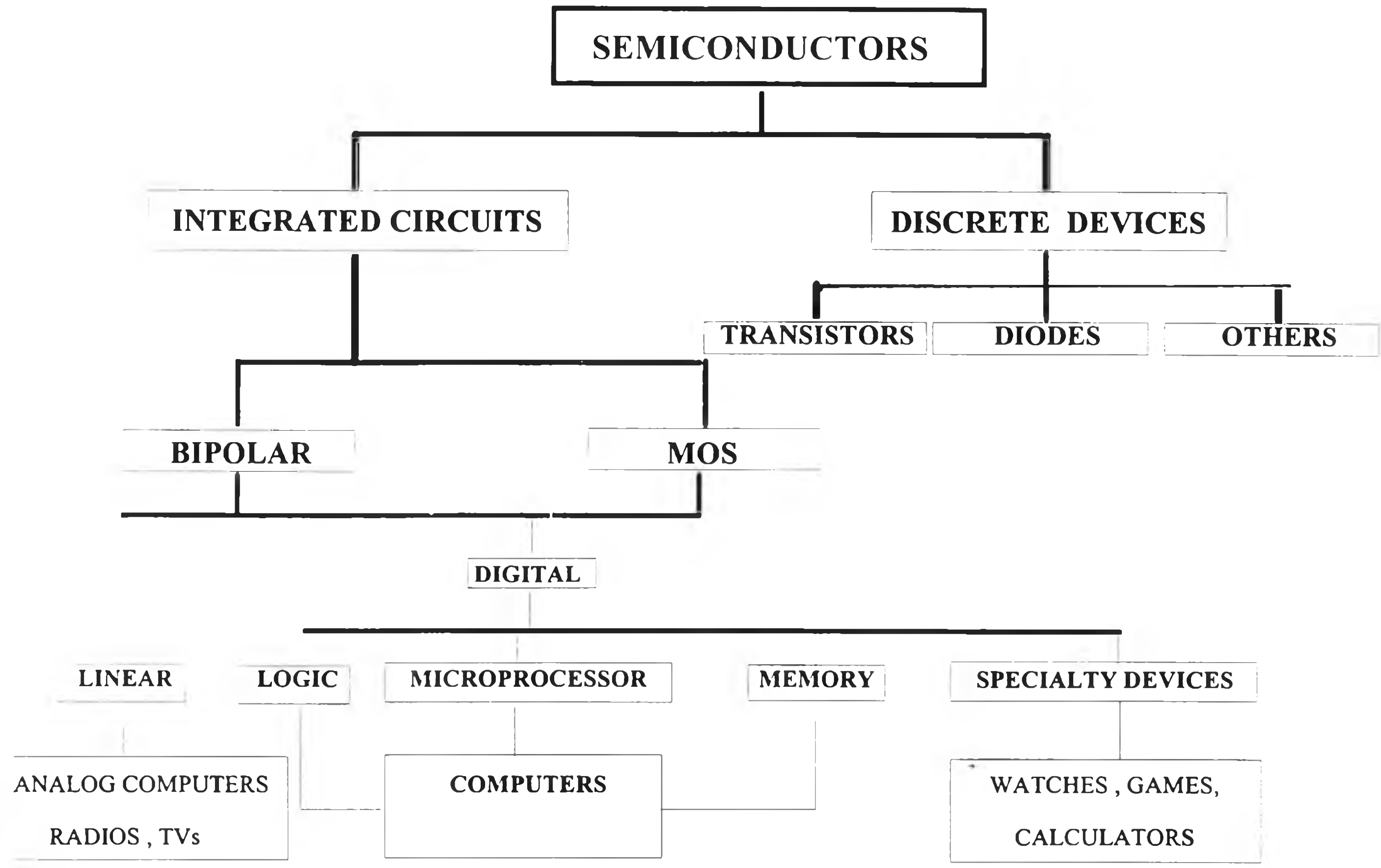
Small-scale integration. ICs containing fewer than 10 logic gates.

A. First Figure (figure 1.2) prepared by the United Nations, "Definition of industry and its major products" in Transnational Corporation in the International Semiconductor Industry, showed the "family the tree", an illustration of the semiconductor industry including some examples of principal end uses of different semiconductor device types. The ICs in figure 1.2, "Integrated Circuit differ from discrete devices and, when first developed, represented a significant technological advance over the latter in that they contain more than one circuit element within a single silicon substrate. Monolithic (as opposed to Hybrid) ICs are the principle focus of the present because of their far more pervasive use. In general, the abbreviation IC is used to refer only to monolithic type. When hybrid ICs are being discussed they are referred to as such." (United Nation, 1986: p4)

Transnational Corporation in international Semiconductor Industry have defined ICs in several ways: (a) by the technology process employed in their fabrication; (b) by the specific functions they are designed to perform; and (c) by the end-user markets they most frequently serve. Figure 1.2 illustrates all of the mention classifications. The broadest distinction is between bipolar and MOS (metal oxide semiconductor) ICs. These are alternative methods of fabricating transistors which make up the elements of the integrated circuit. Bipolar represents the more mature of the two processes and has come to be replaced by MOS for many device types and applications. Bipolar is still the prevalent technology in linear ICs and is also fairly common in digital logic circuits. MOS has come to dominate digital memory and microprocessor chip fabrication as well as special chips used in digital watches. Bipolar is generally more costly than MOS per circuit function and cannot be used for very densely packed circuits because of its greater power consumption and heat generation. The principal advantage of bipolar over MOS is the operating speed, which has made it the technology of choice in certain applications - such as

Figure 1.2

"Family tree" of Semiconductor Technology and End Uses



Sources : Charles River Associates Inc.,Innovation , Competition and Government Policy in the Scmiconductor Industry (1980) Boston

Trannational Corparation in International Semiconductor Industry, United Nation (1986) : New York high speed computers for military use - where speed is crucial and cost not a major deterrent. MOS has advantages over bipolar in lower cost, lower power consumption and greater attainable circuit density. Its main drawback, traditionally, has been its relatively slow speed. Within the broad category of MOS, there are a number of variations on the basic process, the most common of which are n-channel NOS and p-channel MOS (NMOS and PMOS for short); high reliability MOS (HMOS); complementary MOS (CMOS) which pairs NMOS and PMOS transistors to achieve substantial power savings. Thus, the latter is used widely in digital watches and desk calculators. Until recently, however, its slow speed has prevented its widespread adoption for industrial and commercial electronics applications. With these technological advances, CMOS devices are now able to perform at speeds approaching bipolar ICs, while possessing the distinct advantage over the latter of permitting high levels of circuit integration. Since CMOS circuits are relatively less complex than their NMOS equivalents they are easier to design. Thus, CMOS is becoming increasingly more widely used for very large-scale integration (VLSI), which refers to the incorporation upwards of 100,000 (100K) circuit elements on a single silicon chip. For VLSI, low power dissipation appears to be the principal advantage of CMOS. Hence, there has occurred a rapid increase in the utilization of CMOS process technology in recent years.

A further distinction between ICs (see figure 1.2) relates to the method in which they alter electrical signals, "Linear circuits process electrical signals over a continuous voltage range and are therefore suited for such consumer electronic applications as television and radio tuners. Digital ICs, on the other hand, process information only in binary digits corresponding to high and low voltage electrical impulses." (United Nations, 1986) In other words, the digit "one" is stored or transmitted as a high voltage impulse while the digit "zero" is stored or transmitted as a low voltage impulse. All information processed by such circuits must therefore be encoded in binary digits ("bits" for short). Digital ICs are by far the most commonly used in computers and various other types of electronic equipment. Digital ICs can be further subdivided, the most frequent distinction being that between logic and memory chips. Logic circuits perform various arithmetic or other operations on data stored in the memory circuits. In those cases where the operations to be performed are not simple, standard arithmetic functions (add, subtract, multiply, divide), the operating instructions (programme) for the processor unit are generally stored in a type of memory known as ROM (read-only memory). The data which is to be processed in accordance with the instructions contained in the ROM, is stored in a RAM (random access memory). The information stored in a ROM can only be retrieved sequentially while that stored in a RAM can be retrieved at random. The most widely used variety of RAM is a dynamic RAM (or DRAM), in which the stored data can be erased from memory simply by interrupting the flow of electrical current to the circuit's memory cells. Certain digital ICs, known as microprocessors, contain the entire central processing unit (or CPU) of a computer system on a single chip. Depending on the programmed instructions contained in its ROM, a single microprocessor can be adapted to a variety of applications. Certain microprocessors contain an on-chip ROM while others must be linked to a ROM via external connections on a printed circuit board (PCB). Microprocessors are also linked to RAMs and a variety of peripheral chips which together with the CPU constitute a single microprocessor family. In certain cases, the RAM/ROM memory and the input/output interface functions may all be contained on the same chip as the CPU, in which case the device is known as a single-chip microcomputer. The controller circuit is an essential part of the microprocessor family since it regulates the interchanges between other members of the family, establishing priorities and keeping signals flowing smoothly through the maze of interconnections.

Another type of digital IC related functionally to the microprocessor is the gate array (or uncommitted logic array). The device is a semi-custom logic circuit which is fabricated using certain standardized configurations of logic gates (groups of circuit elements which constitute a single logical function). In a final metallization process, after the gate array patterns have been fabricated on the chips, the device can be customized to perform different functions as required by different end users. The gate array has the advantage of cost savings over fully customized circuits but the disadvantage of less efficient use of the area on a given chip. For any given application a number of logic gates may be unutilized. Gate arrays are made in some cases with bipolar logic technologies; more frequently they are fabricated in CMOS. In general, they consist solely of logic gates and have a restricted number of pins for input and output. Thus, wiring efficiency and performance can both suffer or the gate array must be connected with, for example an external memory chip.

Standard cells - sometimes called "cell libraries" - are a recent innovation designed to surmount the problems posed by gate arrays. A customer ordering a standard-cell-based chip selects complete functional cells - logic gates, memories, and even complete processing units - from a library, indicating how they are to be interconnected by the IC manufacturer. Such a device may still not make the most efficient possible use of a chip "real estate", but it serves to enhance performance and economize on external connections.

Microprocessors, gate arrays and standard cells are in effect three different approaches to solving the same set of problems faced by semiconductor manufacturers as a result of the continually rising levels of circuit integration. In short, cost efficient production of a given semiconductor device requires volume production to permit the exploitation of scale and learning economies. The unit cost reductions associated with cumulative production experience have been primarily responsible for the dramatic price reductions in ICs which have broadened immensely their potential markets. At the same time, in the case of logic circuits, each potential customer is developing a somewhat different system which requires a unique configuration of circuit elements (logic gates). When logic elements consisted of discrete transistors or even small or medium-scale integrated circuits, such a configuration could be achieved through the design of a printed circuit board permitting the necessary connections to be made externaliy. With large-scale integration (LSI), then very large-scale integration (VLSI), the system requirements must be designed into the individual IC, which comprises a complete or virtually complete system in itself. To customize the hardware would in effect commit a chip to a single end-user's needs; but, frequently, a single end-user's demand for a particular logic circuit is insufficient to enable the manufacturer to exploit fully learning and scale economies. Thus, only a customer willing to pay a premium for a fully customized chip is apt to find a supplier. Normally, IC manufacturers would want to be able to adapt the logic circuit to a variety of end-users' applications, in order to be able to produce a large enough volume to realize scale and learning economies. To achieve this, IC manufactures must maintain a more or less standard circuit design, while allowing for customization of chips to different end-users' requirements in one or two ways: (a) by altering the software which instructs the circuit how to perform its designated functions (microprocessors) and (b) by altering the configuration of interconnections among standardized cells through a final of metallization in the actual fabrication of the hardware (gate arrays and standard cells).

Thus far, microprocessors are the most widely employed solution to the trade-off between customized and standard logic designs in terms of cost and efficiency. While end users would generally choose fully customized designs over standard designs on efficiency criteria, they would generally prefer standard designs to fully customized designs strictly on cost criteria. Microprocessors as a solution to this dilemma also generate a new set of problems. They rely on software as the link between standard design and customized applications. Generating the necessary software, however, is becoming an increasingly costly undertaking owing to the paucity of software engineers with the requisite skills. Other factors have contributed to the emergence of a software bottle-neck. Software development shares many of the problems of other research and development activity. It is difficult to protect from imitators; output and productivity are difficult to measure, hence to regulate; and it is a relatively high risk investment. For all these reasons software development has tended to lag behind hardware development, with the result that software costs are coming increasingly to predominate in total microprocessor/microcomputer systems costs. The escalating costs of software development for microprocessor-based systems have been at least a partial impetus to the development of product technologies like gate arrays and standard cells, which permit semi-customization without the same substantial investments in software.

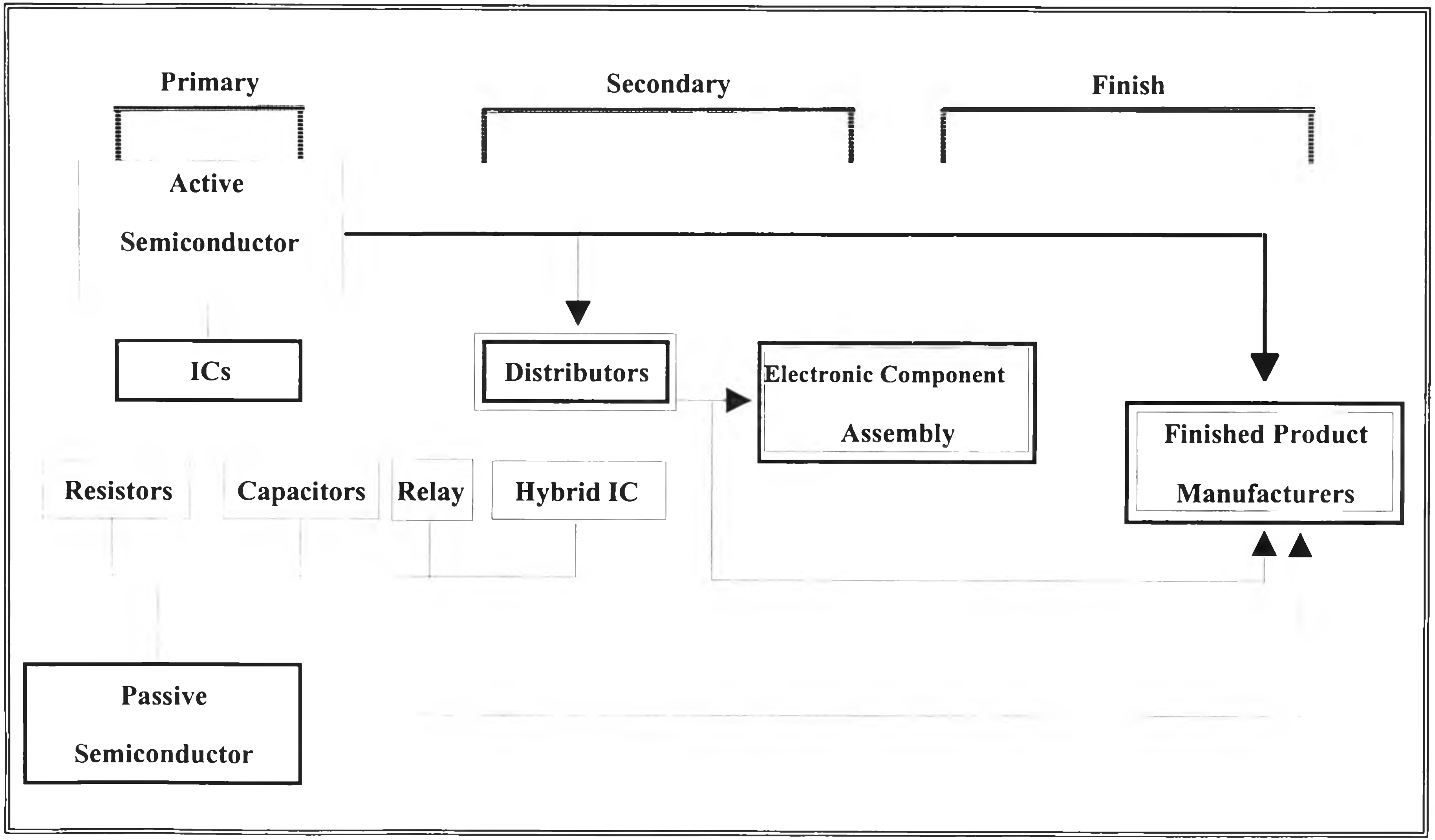
B. Second figure (figure 1.3) prepared by Dhsaha Siam's Research Office, Electronic Component Industry, has defined this industry into active and passive components as follows:

Active Semiconductors

The major technological trend in electronic components continues to be miniaturization, whereby many parts and components are replaced by ICs. The

Figure 1.3

The process of major product in Semiconductor Industry



Source : *Electronic Component Industry, Dhaha Siam's Reserch Office, 1995* component industry produces active devices such as vacuum tubes, discrete semiconductors, and monolithic integrated circuits (ICs). The active component is the most important part of the IC and is directly mounted to ICs. This industry is capital intensive, also requiring high investment and continuous product and production technology development (R&D). The active semiconductor determines the function and application of the component and finished products.

1. Integrated Circuits

Integrated circuits (ICs) are the most important component today. An IC consists of a complete electronic circuit in a single silicon chip. It can contain thousands of transistors, diodes, resistor, and capacitors. ICs can also be described as semiconductor networks in a single package. Semiconductor wafers or chips are placed and wired on lead frames and covered for protection. The IC industry is entirely export-oriented, consisting of a few large US., Japanese, and local firms. Because of the need for high production technology , most manufacture users in Thailand are subcontractors. Only a few have their own technology.

Passive Semiconductors

Passive semiconductors help and support the active semiconductors, providing the IC its full range of functions. Passive components are included in resistors, capacitors, relays and hybrid integrated circuits. These products are commodity type products.

1. Resistors

Resistors are used in circuits to adjust and set current and voltage levels. Their resistance is rated in ohms, accuracy in percentage, and power in watts. The production process for resistors in Thailand is highly automated and subject to large economies of scale. Most of the materials used are imported. Resistor production in Thailand consists only of assembly, except for wire-wound types. Japan used to be a major producer of resistors but many of its wire-wound resistor factories there have closed down and production bases shifted to Taiwan and Korea.

2.Capacitors

Capacitance is the ability of an electric circuit or component to store electric energy for a considerable time by means of an electrostatic field. Capacitors are used for filtering, tuning, coupling, decoupling, isolation, and storage of electrical energy. Their most important use is in consumer electronic equipment in the automotive, telecommunication and computer industries. Basically, a capacitor consists of two metal plates (conductors) placed near each other and separated by an insulating material (dielectric). The dielectric can be air or any non-conducting material such as paper, mica, or ceramic.

3. Relays

Relays work quite similarly to switches: they open and close electronic (and electrical) circuits and are mainly electromechanical.

4. Hybrid Integrated Circuits

The Hybrid IC integrates a system of circuits made of discrete devices and/or ICs on a thin plastic film. The Board of Investment (BOI) has reported that Hybrids are exported mainly to Japan, Singapore, and the United States.

1.3 Rationale and Problems

Between 1981-1985, many major manufactures of electronics products relocated to Thailand to make parts and components for computers and electronic and electrical appliances. It was the first time that a number of electronics components were locally produced. After 1985, Thailand moved toward higher production of value-added and more advanced products such as telecommunication equipment, which basically includes integrated circuits. Firms that traditionally manufactured standard components for exporting purposes gradually started supplying parts and components to be assembled into export products. However, critical parts and components still had to be imported. (BOI, 1995) Similar to other developing countries in Asia, Thailand's domestic factors, export growth, and market demand enhance the growth of this industry. These factors systematically aim to create economic incentives for Thailand and preferences for our desired national goals. Thailand has continually developed a strong interest in the semiconductor industry due to many domestic factors such as the tax incentive, low cost of labor supply, and favorable GSP arrangements.

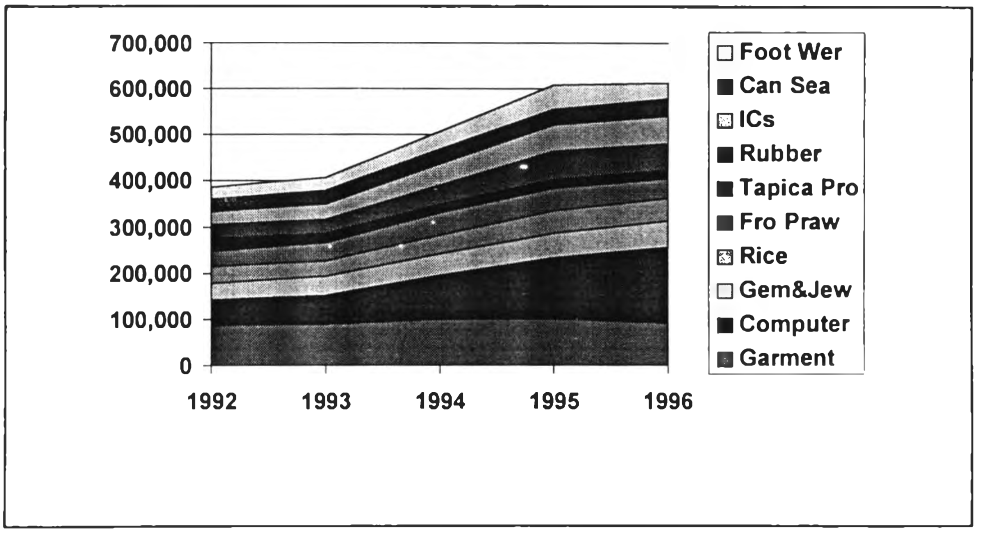
One of the main factors which plays an important role in supporting the growth of this industry is the availability of cheap semi-skilled labor. Thailand has approximately 61.2 million semi-skilled laborers compared to 3.1 million in Singapore, and 20.6 million in Malaysia. Many firms and companies utilize this relatively inexpensive labor to their advantage. It is normal practice in a developing country to hire cheap unskilled labor and train them into well-trained semi-skilled labor within a short period of time, thus reducing the production costs for semiconductor devices. Another factor is the availability of vast land resources which may be developed into science parks or high-tech industrial estates. This land development is crucial in supporting research and development (R&D) which is the heart and core of semiconductor industry development. A third factor is that Thailand's BOI issued many policies such as tax holidays which promptly promoted the semiconductor industry as the target industry. Finally, Thailand has more political stability compared with the Philippines, Indonesia, or other neighboring countries.

The growth of semiconductor component exports has risen since 1992. Figure 1.4 a and 1.4b show the increasing trend confirming that the semiconductor industry has become a major export in Thailand. Therefore, it is worth investigating the comparative advantage in Thailand's semiconductor industry and the factors which would lead this industry to become a major exporter of goods. An investigation of not only the comparative advantages of the industry, but also the competitiveness of the industry is required.

Figure 1.4a

The First Top Ten Export Items of Thailand

(Value in Million Baht)

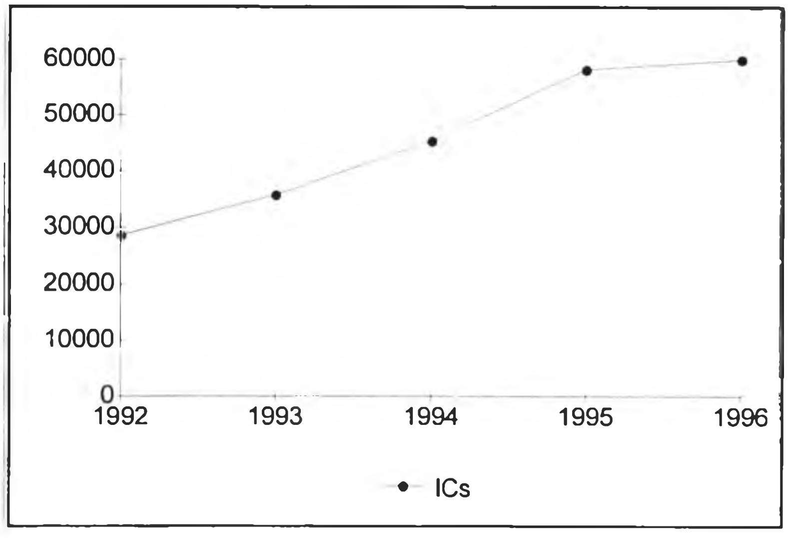


Source Bank of Thailand

Figure 1.4b

Thai ICs Export Years 1992 to 1996

(Value in Million Bath)



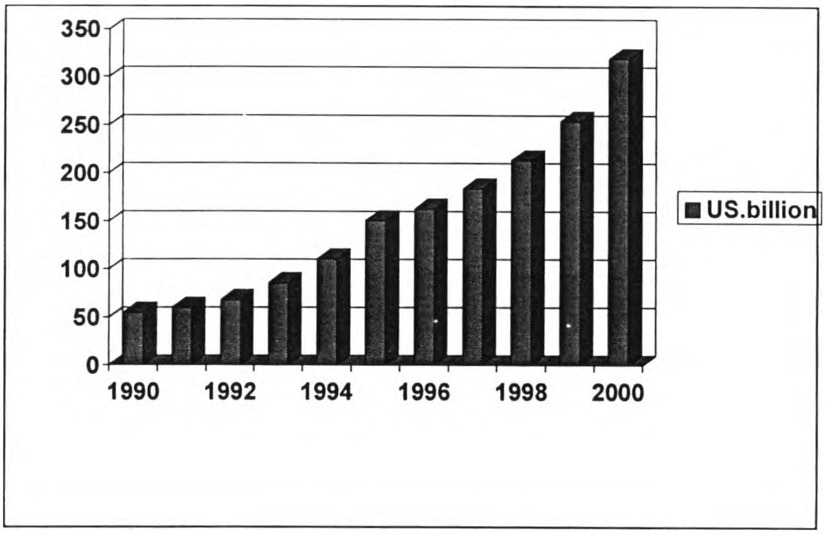
Source Bank of Thailand

Finally, worldwide market demands for integrated circuits or semiconductor components has increased since 1988 and is expected to continue doing so in the near future. (see Figure 1.5)

Also, the market demand for electronic expansion has a direct effect on the growth of the semiconductor industry. Figure 1.6 shows the direct proportion between the electronic industry and the semiconductor industry.

Figure 1.5

Forecast of World Semiconductor Market, Years2000
(in US.billion Dollars)

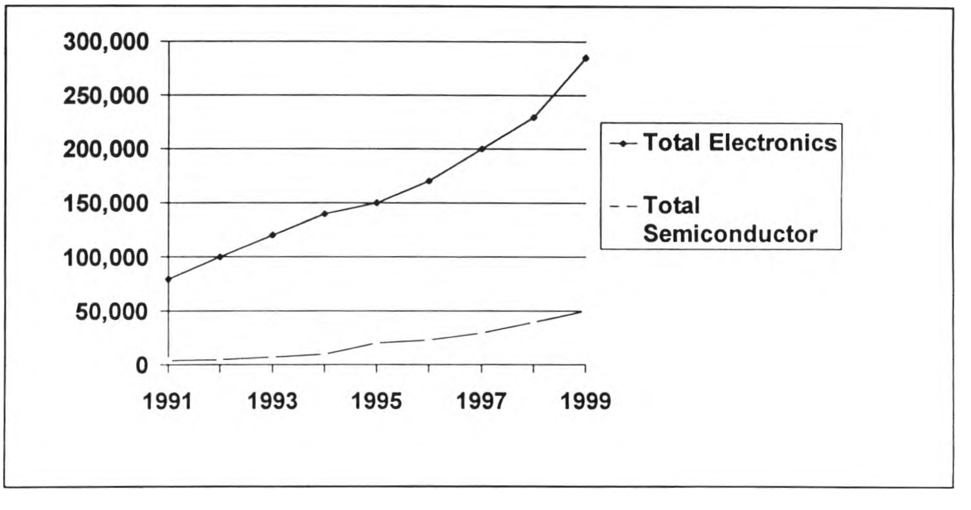


Sources: Data Quest May, 1996

Alfatec Electronics Public Company Limited.

Figure 1.6

Market of Electronics Component in Asia Pacific and its Forcast
(in US$million dollars)



Source: Data Quest, May, 1996

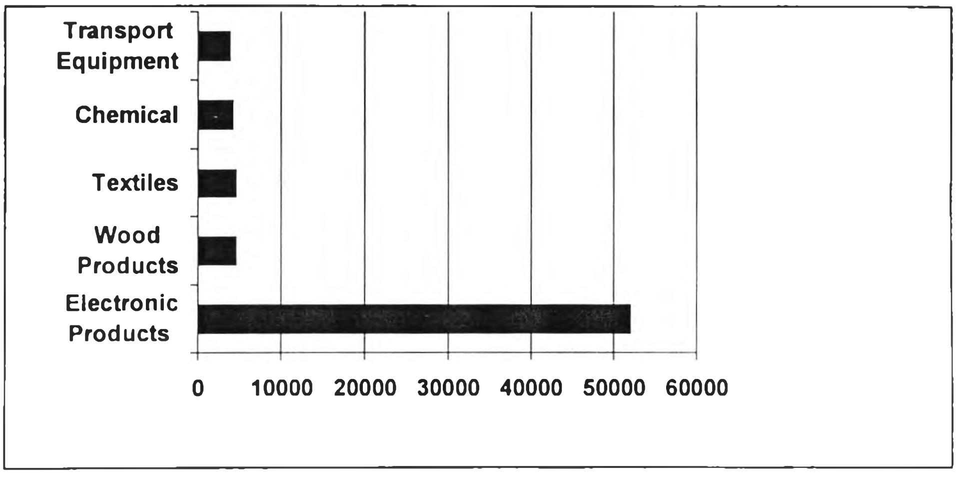
As the rate of market demand for electronics increased the rate of market demand for semiconductor industry also increased. The demand for integrated circuits has expanded on an average of 22.6 percent within the last 5 years. The semiconductor manufacturing base has been extended from leading manufacturing countries such as the US, the EU, and Japan to other areas in the world, especially to Asia, such as to Malaysia, to Indonesia, and to Thailand.

Malaysia is Thailand's exporting competitor for electronic/semiconductor components and other commodities. This broad-based transformation of Malaysia's export profile is the result of the nation's shift towards increasingly capital-intensive, value-added manufacturing like Thailand. Malaysia's electrical and electronic products form the largest portion of manufacturing goods, and accounts for more than half of the exports from this sector, followed by wood products, textiles and clothing, and chemical and chemical products. (figure 1.7)

Figure 1.7

Export of Malaysian Manufactured Goods 1995

(Value in RM Million)

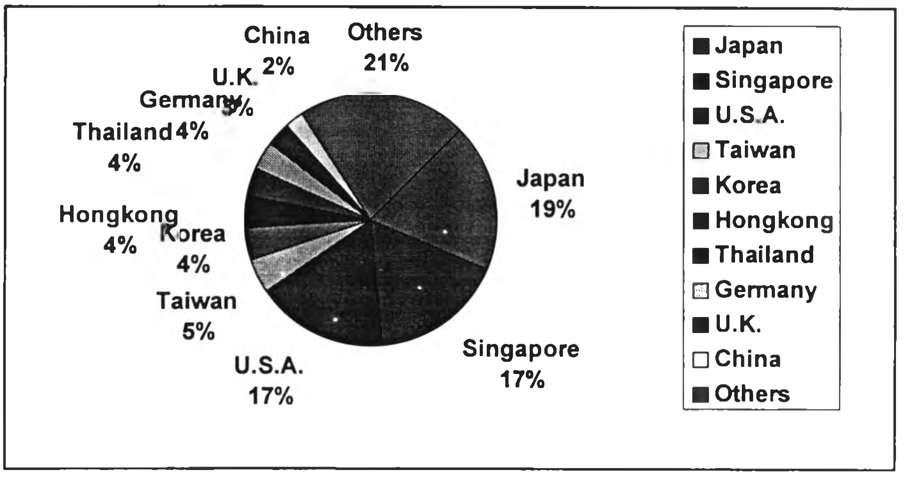


Sources: Malaysia External Trade Development Corporation (MATRADE, 1998)

In general, Malaysia and Thailand compete in the same markets, for instance, Singapore, Japan, and USA in exporting their products. (Figure 1.8a and 1.8 b)

Figure 1.8 a

Top Ten Malaysia's Trading Partners(1996)

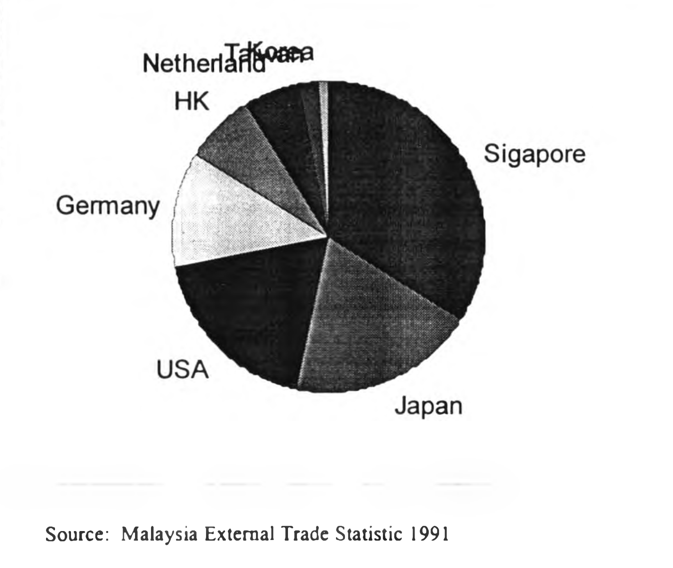


Sources: Malaysia External Trade Development Corporation

Trade Statistics for 1996

Figure 1.8 b

Malaysia ICs's Trading Partners (1991)

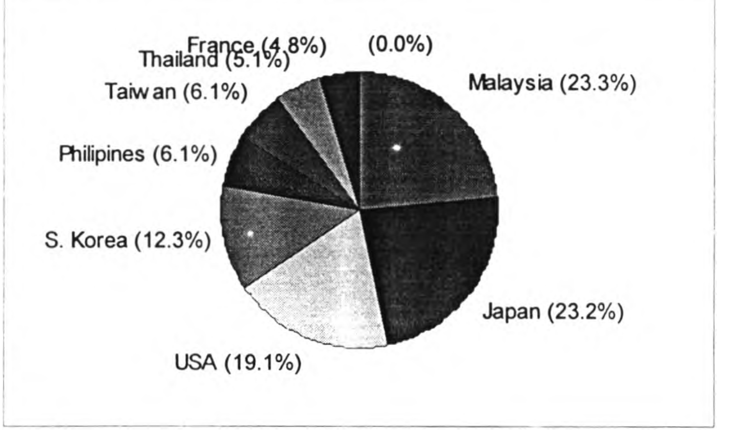


Source: Malaysia External Trade Statistic 1991

Figure 1.8 c shows that Malaysia is the largest exporter of IC's to Singapore. This could be interpreted as Malaysia and Thailand having shared the same IC export markets like Singapore, USA, and Japan. Thus, Malaysia is perceived as a threatening rival to Thailand, followed by Indonesia.

Figure 1.8 c

Singapore Import IC Classifies by Countries Year 1996



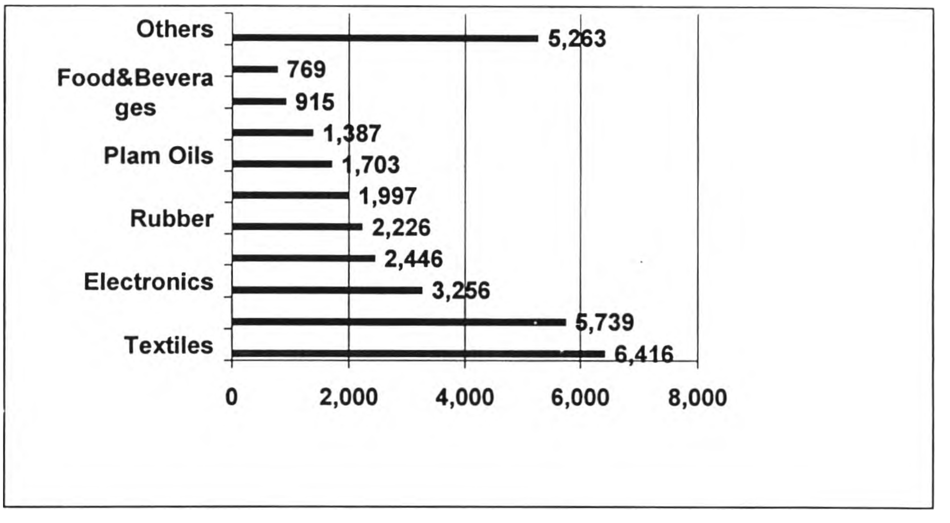
Source: Singapore Trade Statistic, December 1996

Indonesia is one of the Asian countries aiming to become a newly industrialized country. The Factors Condition or endowment of Indonesia is quite similar to Thailand. Indonesia has a large population of 192 million people with its boundaries extending 3,200 miles East-West and extending more than 1,200 miles North-South. Indonesia is targeting international manufacturers. According to the recent deregulation efforts, the government has dramatically reduced barriers resulting 100 percent foreign-owned investments. Figure1.9 shows that electronics is the leading export product which plays an important role in earning revenue for the country.

Figure1.9

Indonesia Leading Industrial Export Products

US$Million-F.O.B. 1996, (Total32,117)



[Electronic products and leather/footwear recorded higher export growth compared to previous years]

Sources: The Ministry of Industry and Trade of the Republic of Indonesia

Indonesia Central Bureau of Statistics (BPSv)

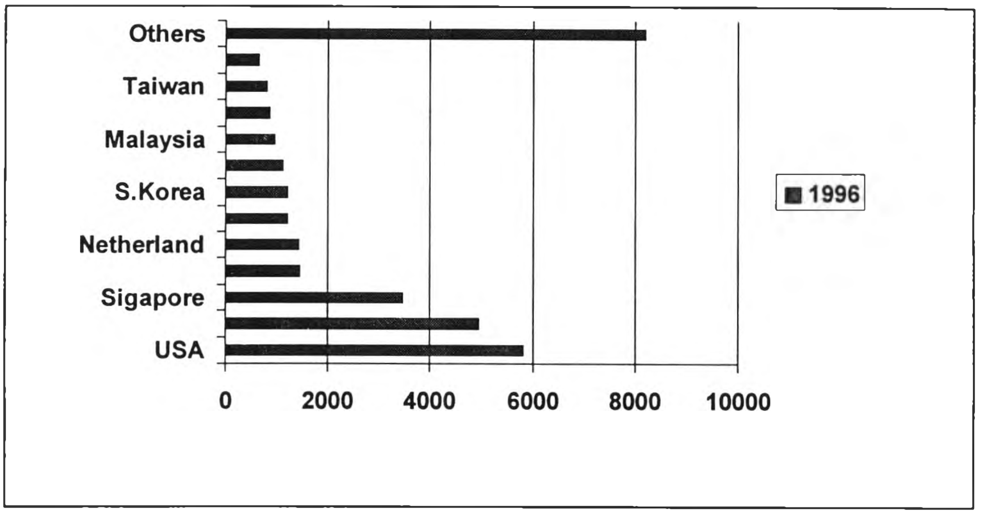
Indonesia tends to move towards value added products that include electronic and semiconductor components. Moreover, Indonesia, Malaysia and Thailand are sharing a market share in the USA, the biggest market, followed by Japan and Singapore. (See table 1.10a, and 1.10 b)

The semiconductor industry should also continue to grow. The rapid expansion of information technology around the world should create the demand for a low cost offshore IC assembly service around Asia. Thailand should be able to capture a significant share of the market. As the IC industry in terms of multinational companies starts moving toward Asia, Thailand should also be able to attract some of that investment, whether by existing firms and companies, or by new entrants.

Figure 1.10 a

Leading Country Destinations of Indonesia's Industrial Exports

US$ Million-FOB 1996. (total 32,117)

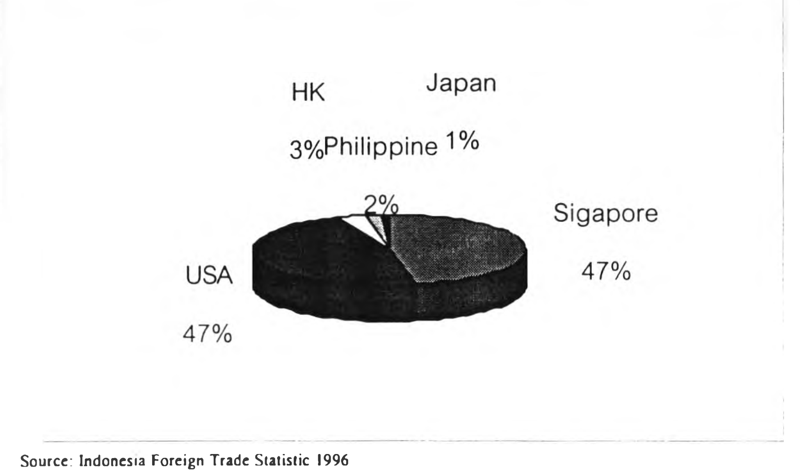


Sources: The Ministry of Industry and Trade of the Republic of Indonesia

Indonesia Central Bureau of Statistic(BPS)

Figure 1.10 b

Indonesia IC Export Destination Year 1996



Source: Indonesia Foreign Trade Statistic 1996

1.4 Objectives and Scope of the Study

In this study, the semiconductor industry, one of the major export industries, is selected as a case-study. An evaluation of its international competitiveness using available data of the latest year, and historical development from 1986 to 1995 has been undertaken. The objectives of this study are:

1). To study the structure of the semiconductor industry in Thailand.

2). To compare the comparative advantages of the Malaysian export, the Indonesian export and the Thai export of integrated circuits by the semiconductor industry by using the Revealed Comparative Advantage Method (R.C.A.).

3). To analyze the competitive advantages of the semiconductor industries by using the SWOT analysis apply with "Diamond Model" of Michael E. Porter .

4). To examine the incentives of government policies and to assess whether they are consistent with the comparative advantage theory.

1.5 Conceptual Framework

This section will be presented according to the theories of comparative advantage, competitive advantage, and method of the analysis (SWOT analysis) respectively.

The Concept of the Comparative Advantage

Economists have defined the concept of comparative advantage as a guide to optimal resource allocation in an open economy. The concept of comparative advantage is intellectually important and has significant associations for trade policy. The theory of comparative advantage was first developed by Adam Smith, then further explored by David Ricado,Eli Heckscher and Bertil Ohil, respectively.

The Classical School of Thought credits Adam Smith with the notion of Absolute Advantage in which a nation should export products over which it has absolute advantage and import products over which it has complete disadvantage.

The theory of comparative advantage was developed by David Ricado to clarify the notion of an efficient allocation of resources among a country's production sectors. The Ricadian Model assumed that if there is full employment and the demand in trading countries are identical, the differences in labor productivities between two countries determine the trade direction. Ricardo believed in pure competition in both factors and products.

In 1930, a well known extension of Ricado's analysis of the trade theory was introduced by two Swedish Economists, Eli Heckscher and Bertil Ohlin. This theory explained the differentiation in terms of cooperative price. The Heckscher-Ohlin Model described the importance of factor endowments in different countries. A country have comparative advantage in a good whose product is relatively intensive in the factor that the country is relatively well endowed. Consequently, the country will export goods.

From Asian-Pacific Economic literature, "Comparative and Competitive Advantage" by Warr (1994) stated that differences between countries in the structure of comparative advantage (comparative costs) across industries, could arise from differences in the factor endowments of these countries. While in Ricardo's treatment, the sources of comparative advantage laid in differences in productivity of labor across industries and between countries, in Heckscher-Ohlin's framework there were no differences in the production function in different countries.

The Competitive Advantage

" Competitive advantage is created and sustained through a highly localized process. Differences in national economic structure, values, cultures, institutions, and histories contribute profoundly to competitive success." (Porter, 1990, p.19). Michael E. Porter tries to extend the trade theory of comparative advantage into competitive advantage toward an individual firm of a nation; "comparative advantage based on factors of production is not sufficient to explain patterns of trade" (Porter, 1990, p.12)

Porter has delineated the key country factors determining the competitiveness of a firm in the world market. Porter in his 1990 book, The Competitive Advantage of Nation, stresses the framework for understanding the relationship between nations and the competitiveness of their firms and how these relationships shape the dynamics of international trade and business competition. He called this the " Diamond Model". The Diamond Model is an extension of Porter's earlier work, Competitive Strategy (1980), a strategic management "environment fit" model, which served as the basis for United States corporate strategy research and education. It is also an extension of Competitive Advantage (1985), a "five force" model, the purpose of positioning of industrial analysis.

Porter explains the gains of competitive advantage in an industry convincingly under the determinants of national advantage. A nation does achieve international success in a particular industry within four broad attributes as follows:

"1) Factor Condition. The nation's position in factors of production such as skilled labor, infrastructure, necessary to compete in a given industry.

2) Demand Condition. The nature of home demand for the industry's product.

3) Related and Supporting Industries. The presence or absence in the nation of supplier industries and related industries that are internationally competitive.

4) Firm Strategy, Structures, and Rivalry. The conditions in the nation governing how companies are created, organized, and managed, and the nature of domestic rivalry. In addition the role of government and chance are involved in this model." (Porter, 1990, p. 12)

The theme of his competitive advantage of nation is that success of a particular firm or of a particular industry will be based on the following elements: first, "cost based advantage" in its production of relatively standardized products: and second, the development of "product based advantage", centered on the development of differentiated products.

Comparative and Competitive Advantages.

Warr concluded that the differences between comparative and competitive advantages were "The theory of comparative advantage is the most relevant for the exploitation of cost-based advantage, while the literature of competitive advantage is the most salient for the development of successful differentiated products." (Warr, 1994, p.7) Competitive Advantage involves the determinants of the commercial performance of individual firms. Comparative Advantage is about the allocation of resources at national level, specifically among the traded goods and services producing sectors of the economy.

The analysis of this study "A Comparative and Competitive Advantages of the Semiconductor Industry: A Case Study of Thailand, Malaysia, and Indonesia" will combine both theories of comparative and competitive advantages and examine whether both theories exist within three countries, Thailand, Malaysia, and Indonesia. First of all, the comparative advantages will be investigated in particular industries of the three mentioned countries, due to the optimum of resource allocation in those countries. When comparative advantage is found to exist in the particular countries, the theory of competitive advantage will be applied to the particular industry to ascertain whether these three countries are competitive in their particular industry.

Strength, Weaknesses, Opportunities, and Threats (SWOT) Analysis

SWOT is an acronym for the internal Strengths and Weaknesses of an industry and the environmental Opportunities and Threats facing that industry. SWOT analysis is a systematic identification of these factors and of the strategy that represents the match between strengths, weaknesses, opportunities and threats. It is based on the assumption that an effective strategy maximizes an industry's strength to capture opportunities, minimize its weaknesses and avoid threats.