

1.0 Introduction

1.1 What is Semiconductor

A semiconductor is a solid whose electrical conductivity can be controlled over a wide range, either permanently or dynamically. Semiconductors are tremendously important technologically and economically. Silicon is the most commercially important semiconductor, though dozens of others are important as well.

1.2 What is Semiconductor Industry

The semiconductor industry is the collection of business firms engaged in the design and fabrication of semiconductor devices

1.3 Semiconductor Industry In Malaysia

A market-oriented economy combined with a young, educated workforce, an excellent infrastructure, and a government committed to maintaining a business-friendly environment, has been Malaysia's formula for success in attracting investments into the country's electronics sector. Malaysia is now home to MNCs from the USA, Japan, Europe, Taiwan and Korea, manufacturing products ranging from semiconductor devices to consumer and industrial electronics. The list of projects reads like a Who's Who of the world's major electronics companies. Malaysia's electronics industry has certainly come a long way over the last 30 years. From a handful of companies with less than 600 workers in 1970, the industry has today attained world-class capabilities and is the largest contributor to the country's manufacturing output, employment and exports. There are currently more than 900 companies employing 360,048 workers. The value of exports in 2003 was RM183.2 billion (US\$48.2 billion).

Malaysia is now among the world's largest exporters of semiconductor devices and audio-visual equipment. Today, Malaysia aims to develop full-fledged electronics and information and communications technology (ICT) clusters built around the semiconductor sector with core activities in wafer fabrication, IC design and the manufacture of end-equipment such as digital audiovisual and ICT products. The ICT products are classified into two broad sub-sectors:

- Computers and computer peripherals and data storage devices; and
- Telecommunications equipment/devices.

Malaysia also offers the world her Multimedia Super Corridor (MSC) which brings together a legislative framework, a high capacity global telecommunications and logistics framework, and eco-friendly surroundings to create the ideal environment for the growth of multimedia industries. The types of companies encouraged in the MSC are computer hardware and software vendors, system integrators, R&D organisations and relevant high-tech service providers.

Malaysia's Electronics Industry In 2003

Number of companies	900
*Output	RM147.1 billion (US\$38.7 billion)
*Electronic Components	68.1%
*Consumer Electronics	19.5%
*Industrial Electronics	12.4%
Average Annual Growth 1997 - 2003	9.6%
*Employment	360,048
**Exports	RM183.2 billion (US\$48.2 billion)
**Electronic Components	RM88.5 billion (US\$23.3 billion)
**Consumer Electronics	RM19.8 billion (US\$5.2 billion)
**Industrial Electronics	RM74.9 billion (US\$19.7 billion)
**Imports	RM138.3 billion (US\$36.4 billion)

Malaysia's Electronics Industry, 1997 – 2003

Year	Output*		Employment*		Exports**		Imports**	
	RM billion (US\$ billion)	% growth	No.	% growth	RM billion (US\$ billion)	% growth	RM billion (US\$ billion)	%growth
1997	85.6 (22.5)	12.6	343 300	4.3	107.3 (28.2)	17.0	75.2 (19.8)	11.3
1998	106.7 (28.1)	24.6	341,700	(0.5)	146.7 (38.6)	36.7	92.5 (24.3)	28.8
1999	129.8 (34.2)	21.6	382,000	11.8	179.7 (47.3)	22.5	109.8 (28.9)	12.6
2000	167.1 (44.8)	31.0	423,600	10.9	212.7 (56.0)	18.4	143.4 (37.7)	30.6
2001	144.4 (38.0)	(15.1)	355,800	(16.0)	182.6 (48.0)	(14.2)	122.1 (32.1)	(14.9)
2002	136.6 (35.9)	(5.4)	345,500	(3.0)	188.4 (49.4)	3.2	138.6 (36.5)	13.5
2003	147.1 (38.7)	7.7	360,048	4.2	183.2 (48.2)	(2.8)	138.3 (36.4)	(0.2)

US\$1= RM 3.80

* Department of Statistics (Monthly Manufacturing Statistics)

** Department of Statistics (External Trade Statistics)

1.4 What is Semiconductor Devices

Semiconductor devices are electronic components that exploit the electronic properties of semiconductor materials, principally silicon, germanium, and gallium arsenide. Semiconductor devices have replaced thermionic devices (vacuum tubes) in most applications. They use electronic conduction in the solid state as opposed to the gaseous state or thermionic emission in a high vacuum.

Semiconductor devices are manufactured both as single discrete devices and as integrated circuits (ICs), which consist of a number—from a few to millions—of devices manufactured and interconnected on a single semiconductor substrate.

1.5 The Electrical and Electronics Industry

The electrical and electronics industry is Malaysia's leading industrial sector, contributing significantly to the country's manufacturing output, exports and employment. In 2004, gross output of the industry totaled RM183.1 billion (US\$48.2 billion), while the industry's exports of electrical and electronics products amounted to RM241.5 billion (US\$63.6 billion) or 64.1% of total manufactured exports. The industry created 369,488 jobs opportunities, accounting for 36.6% of total employment in the manufacturing sector.

Malaysia's electronics industry has developed significant capacities and skills in the manufacture of a wide range of semiconductor devices, high-end consumer electronic goods and information and communication technology (ICT) products.

1.6 Consumer Electronics

This sub-sector includes the manufacture of colour TV sets, audio visual products, VCD players, DVD players, home theaters and video and digital cameras. It also provides opportunities for the local small and medium companies to become vendors in supplying parts, components and services to the MNCs. The capital investment in this sub-sector for the period 2000 till 2004 amounted to RM2.8 billion (US\$0.75 billion).

1.7 Electronic Components

The products under this sub-sector include semiconductor devices, passive components (capacitors, inductors, resistors) and display devices. Capital investment for the year 2004 amounted to RM5.9 billion (US\$1.6 billion). Within this sub-sector, the semiconductor

industry is dominant in terms of production, employment creation and export contribution. Major semiconductor devices produced are linear and digital integrated circuits, memories and microprocessors, opto-electronics, discrete devices, hybrids and arrays. Malaysia was the second largest exporter of semiconductor devices among developing economies and it accounted for 7.1% of the global semiconductor exports. Exports of semiconductor devices in 2004 were valued at RM89.3 billion (US\$23.5 billion) or 37% of total electrical and electronics export.

1.8 Industrial Electronics

This sub-sector covers the production of copier machines, fax machines, typewriters, automatic data processing machines, i.e. computer and computer peripherals, telecommunications equipment and industrial controllers. Companies in this sub-sector have moved into the production of higher-end industrial electronic products such as computer networking equipment, new generation audio-visual digital equipment and data storage devices (MR magnetic heads, compact disc (CD) media and hard disc drives). The capital investment under this sub-sector amounted to RM1.5 billion (US\$0.4 billion) for the year 2004.

1.9 Electrical

Electrical products are categorized into three sub-sectors, namely industrial equipment, electrical components and household appliances. There are presently more than 250 companies producing a wide range of products such as household electrical appliances, wire and cables and electrical industrial equipment. Manufacturing activities in the electrical industry have evolved from mere assembly of simple components and products such as coils, rice cookers and refrigerators of foreign brands to higher-value added activities including R&D, design and marketing of 'local' brands for the regional and global markets. In 2004, Malaysia exported electrical products valued at RM17.2 billion (US\$4.5 billion).

1.10 Semiconductor Industry

Malaysia is currently among the world's leading sites for semiconductor assembly, testing and packaging, with industry names such as Intel, Motorola, Agilent, AMD, National Semiconductor, Fairchild, Hitachi, NEC, Fujitsu, Toshiba, Infineon and

STMicroelectronics among the MNCs based in the country. The main activities are the assembly and testing of semiconductor devices, which include microprocessors, memory chips, power ICs, linear ICs, opto devices and other logic and discrete devices. Many of these companies initially came to Malaysia in the early 1970s because of the country's inexpensive labour that was good at working on small electronic devices. Since then, the industry has grown by leaps and bounds, progressing from labour-intensive operations to state of the art robotics manufacturing sites that produce the latest generation of integrated circuits.

The semiconductor sector today has a major part in Malaysia's electronics industry, accounting for RM78.5 billion (US\$20.7billion) or 42.8% of the country's total electronics exports in 2003. The semiconductor industry in Malaysia is now moving towards backward integration into silicon ingot growing, cutting and polishing of silicon wafers, chip design and wafer fabrication. Currently, three companies are producing silicon wafers, one of which also has the intention to manufacture silicon ingots. Currently, four wafer fabrication plants are in operation. SCG Industries' wafer fab plant, the first in the country, was established as early as 1988, while MIMOS, a government-funded corporation, operates the second plant. Silterra, a joint venture between the Government of Malaysia and LSI USA, has invested RM4.5 billion (US\$1.2 billion) in a wafer fab facility in the Kulim Hi-Tech Park in the northern State of Kedah, while 1st Silicon will operate from Kuching, Sarawak with Sharp Corporation of Japan as its technology partner.

In chip design, Altera Corporation of the USA has set up base in Penang since 1996, its engineers working with cutting edge, sub-micron fabrication technology and CAD tools to design Altera's programmable logic chips. The Malaysian workforce has also grown in sophistication over the years thereby encouraging additional investments in R&D, particularly in materials and process technology upgrading, engineering, marketing and supply chain management. Agilent Technologies' Penang plant undertakes in-house R&D activities which include state of the art product development for optoelectronics, LED and display products, and RF integrated circuits, while Motorola has a R&D centre and a software development centre in Malaysia's Multimedia Super Corridor. Altera Corporation which operates as a VLSI layout design R&D centre has designed more than 50 products to-date. Malaysia's semiconductor industry has also spawned several supporting industries such as the production of leadframes and bonding wires. Three

major bonding wire manufacturers have set up base in Malaysia: Tanaka Electronics producing gold and aluminium bonding wires. Elektrisola copper bonding wires and Malaysian Electronics Materials gold bonding wires.

The Semiconductor Industry In Malaysia

Number of Companies	46
Exports in 2003	RM78.5 billion (US\$20.7 billion)

MAJOR COMPANIES

ASSEMBLY AND TESTING	<ul style="list-style-type: none"> • Intel • AMD • Motorola Agilent, • Texas Instruments National Semiconductor Fairchild • NEC • Toshiba • Infineon Technologies STMicroelectronics • FASL • Renesas ASE Electronics • ChipPAC
SILICON WAFER PROCESSING	<ul style="list-style-type: none"> • MEMC Electronics Material • S.E.H. • Hamadatec
WAFER FABRICATION	<ul style="list-style-type: none"> • SCG Industries • MIMOS • Silterra • 1st Silicon
CHIP DESIGN	<ul style="list-style-type: none"> • Altera Corporation • MIMOS

MAJOR SUPPORTING INDUSTRIES

LEADFRAMES	<ul style="list-style-type: none"> • Dynacraft • M-SMM Electronics • Shinko • Kyushu Matsushita Electric • Mitsui High-Tec • Possehl Besi Electronic • AKN Technology
BONDING WIRES	<ul style="list-style-type: none"> • Tanaka Electronics • Malaysian Electronics Materials
BURN-IN AND TESTING SERVICES	<ul style="list-style-type: none"> • TS Matrix • KESM Industries • KESP

1.11 Electronics

Passive Components and Display Devices

✓ Passive Components

More than 170 companies are involved in the manufacture of a wide range of passive components* which includes capacitors, inductors, resistors, inductors, coils, transformers, magnets, quartz crystals and oscillators. In the year 2003, the export value of capacitors alone was RM1.4 billion (US\$0.38 billion). Major companies in the industry include Matsushita, TDK, Alps, Chemi-con, Taiyo Yuden, Murata, PWB Ruhlatec, Shin-Etsu, Nichicon, Nidec Copal, Koa Denko, Coilcraft, Rohm-Wako, Epson and NDK. This sector plays a significant part in creating linkages with end-equipment manufacturers and offers tremendous growth potential in tandem with the fast expanding manufacture of end-equipment, in particular, digital wireless communication equipment. Taiyo Yuden recently announced a multi-million ringgit investment to upgrade and expand its facility, while several other companies are also planning substantial re-investments which incorporate R&D in materials and process technology.

***Passive components are components which do not require any input other than a signal to perform their function and contribute no power gain (amplification) to a circuit system.**

The Passive Components Industry in Malaysia

Number of Companies	170
----------------------------	------------

MAJOR COMPANIES

CAPACITORS	<ul style="list-style-type: none">• Matsushita Electronic Devices• TDK• Taiyo Yuden• Nichicon• Chemi-con• MMC Electronics• Murata Electronics
RESISTORS	<ul style="list-style-type: none">• Alps Electric• Koa Denko• Matsushita Electronic Devices• Kamaya Electric• Rohm-Wako
INDUCTORS/COILS	<ul style="list-style-type: none">• Koa Denko• Coilcraft• Fastron

QUARTZ & OSCILLATORS	<ul style="list-style-type: none"> • Epson Precision • HCJ Quartz • NDK Quartz
MAGNETS	<ul style="list-style-type: none"> • Shin-Etsu • Epson Precision • Vacuumschmelze

✓ **Display Devices**

The presence of Matsushita, Samsung and Chunghwa Picture Tubes in Malaysia in the production of cathode ray tubes has enabled the country to become an integrated manufacturing centre for televisions and computer monitors. Apart from catering to domestic demand, the cathode ray tube industry in Malaysia has also become a significant export earner. LCD and LED modules for various applications, including displays for calculators, organisers and watches, are currently being produced by eight companies in Malaysia. Besides international names like Flextronics, Varitronix and Vikay Technology, Malaysian companies such as Display Technology and Industronics have also developed their own products. Industronics, in particular, has established itself as the leading producer of large LED information display boards/scoreboards. The display devices industry in Malaysia is heading towards the production of larger colour LCD and plasma display units for testing instruments, mobile phones, notebook computers and large screen television. The presence of leading mobile computer companies like Dell and NEC as well as several television manufacturers has made Malaysia an ideal base for the production of thin film transistor LCD panels.

The Display Devices Industry in Malaysia

Number of Companies	15
----------------------------	-----------

MAJOR COMPANIES

CATHODE RAY TUBES	<ul style="list-style-type: none"> • Matsushita Electronics Corporation • Samsung Electron Devices • Chunghwa Picture Tubes
LCD	<ul style="list-style-type: none"> • Varitronix • Flextronics • Vikay Technology • Display Technology • Crystal Clear
LED DISPLAY BOARDS	<ul style="list-style-type: none"> • Industronics • Ledtronics

1.12 Information & Communications Technology (ICT) Products

✓ Computer And Computer Peripherals

The computers and computer peripherals industry has become one of the fastest growing sectors in Malaysia with the establishment of manufacturing facilities by global players like Dell, NEC, Samsung, BenQ Technologies, Fujitsu and Mitsumi. Besides these MNCs, six Malaysian companies - Nascom, FTEC System, Gerak Mobile, Perbadanan Komputer National Berhad, MIMOS and IBerhad are currently producing Malaysian brands for the domestic and export markets. Computer giants Dell and NEC are operating as integrated manufacturing centres incorporating R&D, logistic supply chain capabilities, treasury and fund management activities, technical services and support facility, and sales and marketing centre.

✓ Data Storage Devices

Malaysia is also emerging as a major disk drive manufacturer in the Asian region. Western Digital and Ventures manufacture hard disk drives while TEAC and Mitsumi are involved in floppy disk drive production. The disk drive industry has benefited from the presence of a strong supplier base in Malaysia. Several important components required for disk drive manufacturing are produced in the country. Among the components manufactured are disk media, disk substrates, magnetic heads, head gimbal assemblies, voice coil motors, actuators, bearings and flexible circuit assemblies. Certance produces state-of-the-art MR magnetic heads. Komag has two major factories in Penang and Kuching dedicated to disk media. Toyo Memory Technology and Showa Aluminium manufacture disk substrates, a major component for disk media. MMI and a Malaysian company, Eng Teknologi, are key suppliers of actuators. Other important parts manufacturers are Shin-Etsu (voice coil motors), Sankyo (spindle motors) and ISC Micron (bearings).

The Computers, Computer Peripherals and Data Storage Devices Industry in Malaysia

Number of Companies	75
Exports in 2003	RM32.03 billion (US\$8.4 billion)

Computers & Computer Peripherals

MAJOR COMPANIES

COMPUTERS	<ul style="list-style-type: none">• Dell• NEC
MONITORS	<ul style="list-style-type: none">• Mitsubishi• BenQ Technologies• Samsung• Jean• Motto• Great TV & Computer
KEYBOARDS	<ul style="list-style-type: none">• Fujitsu• Mitsumi
PRINTERS	<ul style="list-style-type: none">• Solectron• Tektronix• Instruments Technology• Hewlett Packard

MAJOR SUPPORTING INDUSTRIES

MOTHERBOARDS	<ul style="list-style-type: none">• Intel• Solectron• Sanmina-SCI• Jabil• Flextronics
CASINGS	<ul style="list-style-type: none">• CPI Technology• Likom

Data Storage Devices

MAJOR COMPANIES

DISK DRIVES	<ul style="list-style-type: none">• Western Digital• Ventures TEAC• Mitsumi
--------------------	---

MAJOR SUPPORTING INDUSTRIES

DISK MEDIA	<ul style="list-style-type: none">• Komag• Fuji Electric
DISK SUBSTRATES	<ul style="list-style-type: none">• Toyo Memory Technology• Showa Aluminium• Fuji Electric• Komag• Kobe Precision
MR HEADS	<ul style="list-style-type: none">• Seagate
ACTUATORS	<ul style="list-style-type: none">• MMI,• Eng Teknologi
HEAD GIMBAL ASSEMBLIES	<ul style="list-style-type: none">• Seagate
VOICE COIL MOTORS	<ul style="list-style-type: none">• Shin-Etsu• Min Aik
SPINDLE MOTORS	<ul style="list-style-type: none">• Sankyo
BEARINGS	<ul style="list-style-type: none">• ISC
TAPE DRIVES	<ul style="list-style-type: none">• Seagate
OPTICAL DISK DRIVES	<ul style="list-style-type: none">• Sanshin• Hitachi• Sony• BenQ Technologies

1.13 Telecommunication Equipment

The modernization of the telecommunications infrastructure in Malaysia and the Asian Region is providing further impetus for the fast expanding telecommunications equipment sector. This has encouraged companies like Ericsson, Alcatel, Marconi, Fujitsu and Motorola to adopt Malaysia as a staging post for new markets development in the region. The mainstay of the telecommunications equipment industry in Malaysia today is the manufacture of telephones, switching and transmission equipment and mobile communication equipment. There are 38 companies involved in the production of various types of telephones catering both to local and export markets. Among the major telephone manufacturers are Malaysian companies Pernec and Alif Telecommunications, besides MNCs such as Iwatsu of Japan and Inventec of Taiwan.

Telecommunications giants Alcatel, Pernec and Fujitsu are involved in joint venture projects with Malaysian partners for the production of switching equipment, catering mainly to the requirements of the country's largest telephone company, Telekom Malaysia, while Marconi, Fujitsu and Pernec are involved in the manufacture of transmission equipment including microwave radios, multiplexers, modems and transmission accessories. Flextronics which took over Ericsson's mobile phone plant was

the first mobile phone factory in Malaysia and in the Southeast Asian Region, earning itself 'pioneer status' in Malaysia. Other telecommunication products manufactured in Malaysia include PABX systems, answering machines, radio communication equipment (walkie talkies, 2-way radios, pagers, transceivers, etc.) and modulators. Several companies have also ventured into the broadcasting equipment industry producing satellite receivers, satellite dishes and descrambler units. Multimedia terminals are slated for production in the near future.

The Telecommunications Equipment Industry In Malaysia

Number of Companies	54
Exports in 2003	RM19.8 billion (US\$5.2 billion)

MAJOR COMPANIES

TELEPHONES (including key telephone systems)	<ul style="list-style-type: none"> • Pernec • Alif Telecommunications • Bestec • Iwatsu • Inventec • Kyushu Matsushita Electric • Bellcorp Technology
MOBILE PHONES	<ul style="list-style-type: none"> • Flextronics
SWITCHING EQUIPMENT	<ul style="list-style-type: none"> • Alcatel • Pernec • KUB-Fujitsu
TRANSMISSION EQUIPMENT	<ul style="list-style-type: none"> • Marconi • Pernec • KUB-Fujitsu
PABX SYSTEMS	<ul style="list-style-type: none"> • Teledata
RADIO COMMUNICATION EQUIPMENT	<ul style="list-style-type: none"> • Motorola • DMC Telecom • Ranger Communications
BROADCASTING EQUIPMENT	<ul style="list-style-type: none"> • Atlas Communication Electronics • Jalco Electronics • Shanshin • Cheng Hsi Electronics

1.14 Consumer Electronics

Consumer electronics is an important sub-sector of the electronics industry in Malaysia, contributing RM19.8 billion (US\$5.2 billion) or 10.8% of total electronics exports in 2003. Major products include audio products, colour televisions, video CD players and video cassette players/ recorders, digital versatile disc (DVD) players and video cameras.

The sector is represented by many well-known Japanese companies such as Sony, Sharp, Matsushita, Pioneer, JVC, Yamaha, Kenwood, Onkyo, Hitachi and Mitsubishi which together contributed significantly to the rapid growth of this sector over the years. The leading companies now undertake R&D activities in support of their operations in Malaysia as well as in other manufacturing sites. They include Matsushita, Sony, Sharp, JVC and Pioneer. Sharp set up an R&D company in 1995 to undertake design and development of audiovisual equipment for Sharp's manufacturing activities.

The Consumer Electronics Industry in Malaysia

Number of Companies	40
Exports in 2003	RM19.8 billion (US\$5.2 billion)

MAJOR COMPANIES

AUDIO PRODUCTS	<ul style="list-style-type: none">• Sony Electronics• Sharp-Roxy Corporation• Yamaha Electronics• Kenwood Electronics• JVC Electronics• Pioneer Technology• Matsushita Audio Video• Onkyo• Sanyo
COLOUR TELEVISIONS	<ul style="list-style-type: none">• Matsushita TV• Sony Technology• Sharp-Roxy Electronics• Hitachi Electronics• Funai Electric
VIDEOCASSETTE PLAYERS / RECORDERS	<ul style="list-style-type: none">• JVC Video• Sony Technology• Sharp Manufacturing Corporation• Hitachi Electronics• Matsushita Audio Video• Mitsubishi Electric
VIDEO CD PLAYERS	<ul style="list-style-type: none">• Sony Technology• Sharp Manufacturing Corporation• Matsushita Audio Video

	<ul style="list-style-type: none"> • Yamaha Electronics • Inventec
DVD PLAYERS	<ul style="list-style-type: none"> • Pioneer Technology • Sony Technology • Sharp Manufacturing Corporation • Onkyo
VIDEO CAMERAS	<ul style="list-style-type: none"> • Sharp-Roxy Electronics • JVC Video
R&D ACTIVITIES	<ul style="list-style-type: none"> • Matsushita • Sony • Sharp • JVC • Pioneer • Kenwood

1.15 Contract Manufacturing

Malaysia's contract manufacturing companies provide vital support to the semiconductor, consumer electronics, computers and peripherals, and data storage industries in volume turnkey \ manufacturing, printed circuit board design/layout and product testing.

The world's leading contract manufacturers like Celestica, Solectron, Sanmina-SCI, Jabil, Flextronics and Plexus have major operations in Malaysia. Others include Malaysian companies such as Carsem, Unisem, Globetronics and AIC in semiconductor assembly and testing and Capetronics, TKR and Pensanko in audiovisual products. The trend towards increasing outsourcing by the OEMs such as Intel, Dell, Motorola, Hitachi, Sony, Phillips, SMI and Infineon provides tremendous growth potential for contract manufacturing in Malaysia.

The Contract Manufacturing Industry in Malaysia

MAJOR COMPANIES

PRINTED CIRCUIT BOARD ASSEMBLIES (PCBA)	<ul style="list-style-type: none"> • Solectron • Sanmina-SCI • Jabil • Flextronics • Plexus • Celestica
SEMICONDUCTOR ✓ <i>ASSEMBLY AND TESTING</i>	<ul style="list-style-type: none"> • Carsem • Unisem • Globetronics • AIC • ChipPAC • ASE

<p>✓ <i>BURN-IN AND TESTING SERVICES</i></p>	<ul style="list-style-type: none">• TS Matrix• KESM• KESP
<p>✓ <i>CONSUMER ELECTRONICS</i></p>	<ul style="list-style-type: none">• Capetronics• TKR• Pensanko• Pensonic• Khind Industries

2.0 Electronics Manufacturing Services

2.1 The Key advantage of Malaysia's EMS

Electronics manufacturing services (EMS) providers are assuming an increasingly important role and making a significant impact on manufacturing industries worldwide today. EMS companies function as strategic partners to larger original equipment manufacturers (OEMs) by providing them with a full range of services from contract design and manufacturing to post-manufacturing services. By using the services of EMS providers, OEMs can concentrate on their core competencies such as research and development, sales and marketing. Outsourcing to EMS providers also enables OEMs to gain access to the latest equipment, process knowledge and manufacturing know-how without having to make substantial capital investments as capital risks are converted into variable costs. The trend in manufacturing partnership has been growing steadily as OEMs strive to cut costs to maintain their competitive advantage in the face of rapidly changing market conditions, technological advances and global competition.

2.2 Manufacturing Success

The EMS industry first appeared some 30 years ago and has flourished since. Consolidation within the industry has led to the emergence of a few well-known multi-billion dollar 'tier one' companies with worldwide operations such as Solectron, Flextronics, Celestica, Jabil, Plexus and Sanmina-SCI. In 1999, the EMS industry was estimated to be worth US\$75 billion with a compound annual growth rate of 25%. This represented only 15% of the total electronics manufacturing market of US\$500 billion. By 2001, the global EMS market had increased by about 33.3% to approximately US\$100 billion. According to industry sources, the global EMS market for 2003 is forecast at US\$149.4 billion. It is expected to increase by 35.9% in 2004 to US\$203 billion. By 2005, the market is expected to increase to US\$288 billion, representing 30% of the total global electronics market.

The Asian region (excluding Japan) is expected to be the fastest growing region for EMS as an increasing number of OEMs moves into the region to take advantage of the lower operating costs. Within the electronics industry, the growing global consumption of

optoelectronics components, which is expected to reach an estimated US\$1.12 billion in 2005 from US\$407 in 2000, promises extensive outsourcing opportunities.

The results of the Fifth Annual Electronics Manufacturing Outsourcing Survey conducted by Bear, Stearns & Co (New York) which was released in June 2002 confirmed the growing trend in outsourcing. The survey, which investigated the world's leading original equipment manufacturers from a wide variety of industries, found that 87% planned on increasing their outsourcing in the coming year.

2.3 Electronics Manufacturing Services

Leading EMS companies, many of whom rank among the top 50 companies worldwide, are located in Malaysia. Among them are the top five- Solectron, Flextronics, Celestica, Jabil and Sanmina-SCI. BCM is one of the home-grown companies that have since established a niche position within the EMS industry. Other Malaysian companies such as Globetronics, Carsem, Unisem and AIC specialize in integrated circuit and semiconductor packaging.

In 2003, exports of electronic products from Malaysia amounted to US\$48.2 billion. There is thus good potential for the further development of the EMS industry in Malaysia.

According to industry sources, the leading factor contributing to Malaysia's viability as a regional hub is the availability of quality manpower at a cost that is 40% lower than that of its neighbours Singapore and Hong Kong. The presence of a large number of established OEMs in Malaysia also offers a ready market for EMS companies. With an abundance of trained manpower, a well-developed infrastructure and an efficient telecommunication system coupled with its continued commitment to research and development and infrastructure and human resource development, Malaysia is a viable location for the establishment of EMS operations. The country's sound information technology infrastructure also allows EMS companies to tap opportunities in virtual manufacturing, a growing market trend arising from the influence of the cyber world and its borderless society. Malaysia also offers attractive tax incentives to encourage EMS companies to locate their operations in the country. These incentives range from Pioneer Status and Investment Tax Allowances to "pre-packaged" incentives which incorporate a special package of incentives to meet the specific needs of individual projects. The

incentives are given based on certain priorities such as the levels of value-added, technology used, industrial linkages, R & D expenditure, employment of scientific and technical staff, and capital investment incurred. Companies which qualify for these direct tax incentives are given partial or total relief from the payment of income tax for a specified period.

*** The current corporate tax rate in Malaysia is 28%. However, for small and medium scale companies, the rate is 20% for chargeable income of up to RM 500, 000**

2.4 Malaysia's EMS Industry

Malaysia, strategically located in the vibrant growth region of Asia, is the ideal location for companies looking to establish EMS operations or to source EMS solutions.

Malaysia's market-oriented economy and government policies that maintain a business environment with opportunities for growth and profits have made the country a highly competitive manufacturing and export base. Investors are attracted by Malaysia's:

- Political and economic stability
- Educated and productive multilingual work force
- Wide use of English, especially in business
- Liberal investment policies
- Attractive package of investment incentives
- Well-developed financial and banking sector
- Legal and accounting practice based on the British system
- Well-developed infrastructure and telecommunications support
- Intellectual property protection

Thus, multinational corporations from more than 40 countries have invested in over 3000 projects in Malaysia. The world's major electronics companies with manufacturing operations in Malaysia include:

USA	<ul style="list-style-type: none"> • Motorola • Intel • Texas Instruments • Dell, Solectron • AMD • Western Digital
Asia Pacific	<ul style="list-style-type: none"> • Sony

	<ul style="list-style-type: none"> • NEC • Matsushita • Hitachi • Samsung • TDK • BenQ • Sharp- Roxy • Mitsubishi
Europe	<ul style="list-style-type: none"> • Alcatel • Philips • STMicroelectronics • Siemens • Marconi • Osram • Infineon

Its vibrant business environment and excellent quality of life have made Malaysia the choice location for offshore manufacturing operations.

2.5 Malaysia An Attractive Investment Centre Electronics Manufacturing Services

A corporate tax rate of 28% applies to both local-owned and foreign-owned companies in Malaysia. However, a wide range of tax incentives is offered by the government to encourage investment in manufacturing activities. Companies which are given tax incentives qualify for partial or total relief from the payment of income tax for a specified period of time. These incentives are constantly reviewed to ensure that Malaysia maintains its competitive edge to attract investments.

1. Main Incentives for Manufacturing Companies

- ***Pioneer Status:***
Income tax exemption of 70% or 100% on the statutory income for a period of five or 10 years; or
- ***Investment Tax Allowance:***
Investment tax allowance of 60% or 100% on the qualifying capital expenditure incurred within five years. The allowance can be used to offset against 70% or 100% of the statutory income.
- ***Reinvestment Allowance:***
Reinvestment allowance of 60% on the qualifying capital expenditure. The allowance can be used to offset against 70% or 100% of the statutory income.

- ***Accelerated Capital Allowance:***

After the reinvestment allowance period, companies can apply for the accelerated capital allowance. Companies which qualify are given an initial allowance of 40% and an annual allowance of 20% for three years.

2. Incentives for High Technology Companies

- ***Pioneer Status:***

Income tax exemption of 100% on the statutory income for a period of five years.

- ***Investment Tax Allowance:***

Investment tax allowance of 60% on the qualifying capital expenditure incurred within five years. The allowance can be used to offset against 100% of the statutory income.

3. Incentives for Strategic Projects

- ***Pioneer Status:***

Income tax exemption of 100% on the statutory income for a period of 10 years.

- ***Investment Tax Allowance:***

Investment tax allowance of 100% on the qualifying capital expenditure incurred within five years. The allowance can be used to offset against 100% of the statutory income.

4. Pre-packaged Incentives

- A customized incentive package that includes both tax and non-tax incentives.

5. Incentives for R&D

- ***Pioneer Status:***

Income tax exemption of 100% on the statutory income of five years.

- ***Investment Tax Allowance:***

Investment tax allowance of 100% on the qualifying capital expenditure incurred within 10 years. The allowance can be used to offset against 70% of the statutory income.

6. Other Incentives

- Industrial Building Allowance
- Infrastructure Allowance
- Incentives to Strengthen Industrial Linkages
- Tariff-Related Incentives