Regional Production Networks, Regional Cooperation, and Their Implications on Malaysian Trade and Investment Policy

Shankaran Nambiar

I. INTRODUCTION

The rise of regional production networks in Asia, interestingly, occurred at the intersection of national industrial policies and the strategies of multinational corporations (MNCs), as countries like South Korea, Taiwan, and Singapore aggressively pursued export-oriented industrialization (EOI) and MNCs from Japan and the United States established low-cost production bases in Southeast Asia during the 1970s.

Today, in comparison to both Europe and North America, Asia appears to have the most elaborate production networks in the world, which have been central to the region's industrial development (Linden, 1998). Quite a number of South Korea's *chaebols* are now playing leading roles in the global electronics industry; Taiwanese firms have become fairly successful in advanced electronics and computer hardware; Singapore is now a regional production base, acting as an integrated assembly platform for electronic products.[1]

The national innovation system (NIS) models of countries in the region, nonetheless, seem to be varied—and to some, the concept even looks elusive. In the case of Malaysia, the country's NIS approach can be described as one similar to the Direct-Foreign Investment Leveraging (DFI) Model adopted by Singapore. DFI, according to Lall and Teubal (1998) and Wong (1999), strongly favors specialized high technology industry for export markets, as well as the promotion of subcontracting for local small and medium industries (SMIs). Likewise, this approach aggressively targets and screens MNCs to direct them into high value-added and research and development (R&D) intensive activities. Some large local enterprises are also created by the public sector to venture into targeted strategic industries.

Malaysia has attempted to emulate Taiwan's Small and Medium Enterprise-Public Research Institute Innovation Network Model and South Korea's Large Firm Internalization Model over the years, though the results thus far have been less fruitful. The fact that the progress of industrial upgrading in Malaysia still trails Singapore's implies that the former's industrial-upgrading strategy lacks specific policy instruments to engineer positive spillovers from MNCs that operate mostly in the manufacturing sector. Malaysia lagging behind Singapore in industrial development can also be attributed to its weak technology-based SMI sector, which is of paramount importance to technology diffusion (Ariff, 2003).

On a related note, the meteoric rise of China and India will have far-reaching implications for Malaysia. With an agreement on the ASEAN-China Free Trade Area (FTA) scheduled to be concluded this year, China alone is expected to achieve its target

[1] South Korea, however, has pulled ahead of Taiwan. According to Mody (1990), this can be traced principally to differences in the two countries' industrial and firm structures. Apparently, the conglomerate organizational mode of South Korea accelerated its entry into many markets, while the smaller Taiwanese companies have been unable to sustain themselves in similar markets.

of US$100 billion in annual trade with the 10 member countries of ASEAN by 2005[2]. Considering that these two juggernauts are being integrated into the world at an unprecedented pace, the institutional frameworks, technological learning landscapes, and innovation network requirements in the region are likely to evolve into a different plane in the future. Consequently, only firms that are able to penetrate market niches, precipitate a process of creative destruction, and outperform prior technologies will emerge as regional forerunners. Overall, it is expected that changing regional production networks will have significant impacts on Malaysia's industrial development policies and its regional cooperation with other countries.

The aim of this paper is to analyze changing regional production linkages and provide insight as to how Malaysia will respond to the challenges posed by these changes. Section 2 describes government policy and two key industries in the manufacturing sector, namely electrical and electronics (E&E) and automobiles. Sections 3 and 4 explain the impacts that the Multimedia Super Corridor (MSC), China, and India will have on the regional production networks. This is followed by Section 5, which is a resource-based examination of the necessary strategic response to the changing demands of competing within future regional production networks. Section 6 provides the overall conclusions.

II. MALAYSIAN INDUSTRIAL GROUPS

Malaysia's industries are broadly classified into the following groups: electrical and electronics (E&E), transportation, chemicals, textiles and apparel, resource-based, and advanced materials, agro-based and food products, and machinery and equipment. Of all these, the government has singled out E&E and textiles and apparel as potential production clusters.

A. Electrical and Electronics Industry

Despite low local participation, Malaysia is a major exporter of semiconductors, consumer electronics, telecommunications equipment, computers, and peripherals—accounting for about 9 percent, 15 percent, and 3 percent of the world's total exports of these products, respectively. It is also worth noting that the country's semiconductor exports alone already constitute almost half of the total exports in the region.

The Malaysian electrical industry produces wires, cables, electrical appliances, and includes industrial apparatus sub-industries. Meanwhile, the electronics industry consists of firms that turn out semiconductors and components, computers and peripherals, and telecommunications equipment. Consumer electronics are also part of the country's electronics industry's output. (See Tables 1 and 2.)

[2] On October 2003, China said it would allow duty-free imports of some Southeast Asian goods this year. The China-ASEAN free trade area will be the biggest in the world by population, encompassing 1.7 billion people. The combined gross domestic product of China and ASEAN countries is US$2 trillion.

Table 1: Production of the Electrical and Electronics Industries, 1985-2003

Production	1985	1990	1995	2000	2003
Integrated circuits, (million units)	2,561	6,084	10,277	21,424	23,269
Semiconductors, (million units)	1,468	2,565	4,757	16,373	15,932
Electronic transistors, (million units)	3,450	5,956	9,058	17,519	24,206
Telephone cables, (tons)	22,370	10,757	23,149	22,524	22,650
Insulated wires & cables, (tons)	13,765	33,623	91,384	73,673	62,580
Television sets, (units)	568,387	2,168,817	9,460,804	10,550,521	9,915,171
Room air-conditioners, (units)	148,253	981,245	3,071,251	1,879,651	2,015,778
Household refrigerators, (units)	148,424	212,018	294,599	215,310	184,485
Radio, (units)	8,829	37,019	38,767	36,348	27,640

Source: Quarterly Economic Bulletin, Malaysian Central Bank (various issues)

Table 2: Exports of the Electrical and Electronics Industries, 1985-2003

(USD Million)

Production	1985	1990	1995	2000	2003
Semiconductors	4,439	11,685	33,197	71,111	78,540
Electronic equipment and parts	454	3,670	23,583	95,680	72,828
Consumer electrical products	581	5,531	21,353	26,490	19,774
Industrial electrical products	356	3,342	10,059	23,661	20,253
Electrical industrial machinery products	608	2,144	7978	12,585	13,838
Household electrical appliances	54	130	578	903	1,882
Total E&E exports	**6,493**	**26,502**	**96,748**	**230,429**	**207,116**

Source: Quarterly Economic Bulletin, Malaysian Central Bank (various issues)

The electrical industry began in the 1960s through import substitution, producing household appliances and electrical fittings through joint ventures with foreign firms. The industry now serves both domestic and export markets. The electronics industry, meanwhile, started during the adoption of an export-oriented industrialization strategy and the relocation of MNC operations to countries like Malaysia in the early 1970s. The first semiconductor plant was opened in Penang in 1972.

Semiconductor devices have consistently made up the largest share of the electronics sector's output, though since the early 1990s, the industry's output structure has changed significantly: The contribution of electronic components to the total output dropped from 84 percent in 1986 to 43 percent in 1995; consumer electronics and industrial electronics jumped from 16 percent to 57 percent during the same period—proof that the industry is diversifying into higher value-added electronic products.

The cluster-based development approach currently adopted requires the E&E industries to move into higher value-adding activities such as R&D, product design, and marketing, the industries will see the emergence of new product lines in the local E&E cluster in the next couple of years. The major difference between the new and existing clusters is the consolidation of the computer, telecommunications, and consumer electronics sub-industries into a common group, namely digital electronics.

Rasiah (2000) cautions, however, that electronics firms in Malaysia face a host of critical issues. First, the electronics industry is still dominated by foreign MNCs because most local electronics firms lack the technological absorption capacity and the linkages

to move up the value chain. Second, imports used for about two-thirds of exports still dominate most of the production stages. Third, the number of technology-driven SMIs is too small to create a critical mass for strong, integrated production. Fourth, the local electronics industry continues to face a growing innovation deficit. Fifth, there is a serious shortfall in the supply of skilled human capital. Sixth, electronics firms in locations outside Penang suffer from serious gaps in their inter-firm links and business networks. Seventh, majority of the local electronics companies have yet to develop their own market prospecting and development capabilities.

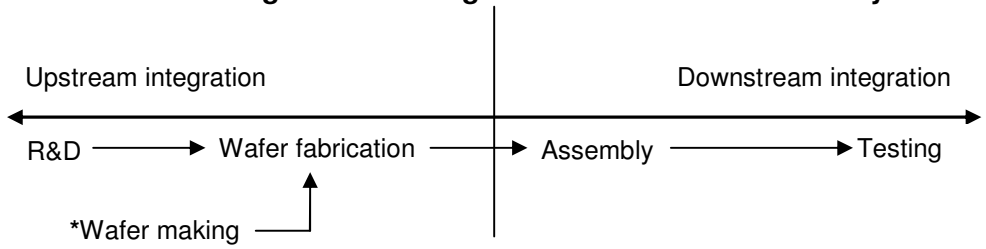
1. The Semiconductor Industry

Malaysia has long been recognized as a leading semiconductor producer, but the chips have invariably been the property of foreign MNCs. The country, therefore, needs the capability to design and fabricate its own wafers. Ironically, the semiconductor industry, which has contributed about 30 percent of Malaysia's total manufactured exports, has only been taken seriously by the government since the mid-1990s. In view of its rapid growth as an export product (from RM2.3 billion in 1980, RM11.7 billion in 1990, to RM78.5 billion in 2003), the government should have realized much earlier the product's potential to develop as a key Malaysian industry—especially because of its importance to a wide range of electronic devices. It must also be noted that fabricated silicon wafers are used in the two industries in which Malaysia has successfully carved out a name for itself: semiconductors assembly and E&E product manufacturing.

To develop an integrated semiconductor industry, local production cannot concentrate on just assembly and testing (downstream integration). It also needs to do R&D and wafer fabrication (upstream integration) (See Figure 1). That is, while the semiconductor integrated value chain begins at the stage of polysilicon manufacturing, there is no Malaysian manufacturer that has successfully ventured into it to date.[3] (See Figure 2 for the semiconductor integrated value chain.)

Presently, the two largest Malaysian semiconductor assembly and test (full turnkey) manufacturers are Malaysian Pacific Industries Berhad and Unisem (M) Berhad. Both of them are increasingly adopting new micro lead-frame packaging (MLP) technology for small form-factor integrated circuit (IC) products.

Figure 1: An Integrated Semiconductor Industry

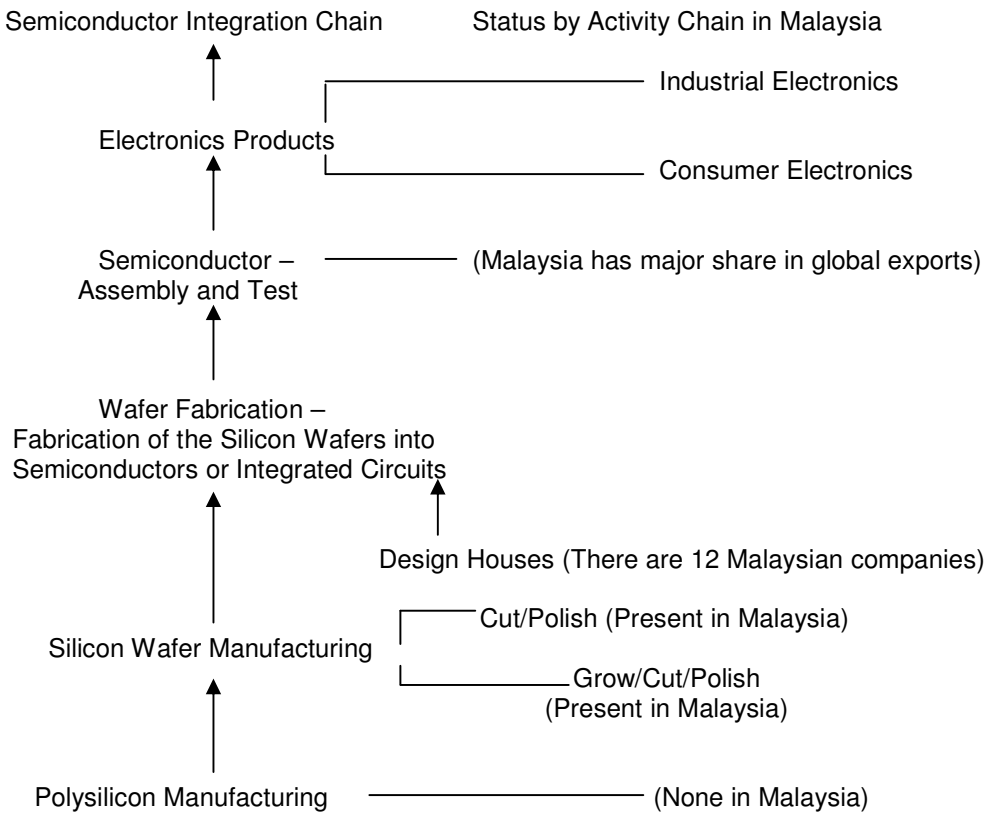


* Wafer making involves the making of silicon wafers by chemical manufacturers and is distinct from semiconductor production. It is not a technology-intensive stage.

Source: Goh (2001)

[3] Wafer fabrication, a process of converting the base material (polished silicon wafer) into semiconductor wafers, has been undertaken by Malaysian companies only since 1998.

Figure 2: The Semiconductor Integrated Value Chain



Source: Adapted from Industrial Master Plan 2 (1996-2005)

As has been proven in other leading semiconductor producing countries such as South Korea, Taiwan, and Singapore, government intervention is important during the industry's early stages. In Malaysia's case, 1stSilicon Sdn Bhd (1Si), with government support, established the country's first state-of-the-art 200 mm wafer foundry on January 1998 in Kuching, Sawarak. 1Si's facility has 126,000 ft^2 of manufacturing room—including 92,000 ft of Standard Mechanical Interface production areas—and is designed to produce more than 40,000 wafers per month at full capacity. Most of 1Si's clients are from Japan, the US, Taiwan, South Korea, and Europe.

Meanwhile, the Malaysian Institute of Microelectronic Systems Berhad (MIMOS), one of the country's leading industry-based government research institutes, recently transformed its semiconductor division (MIMOS Semiconductor Sdn Bhd or MySem) into an integrated design and manufacturing (IDM) plant capable of manufacturing semiconductors and, eventually, world-class ICs[4]. While the IDM plant is confined to offering services to other companies, it plans to design and market its own products in the near future. MySem's fabrication technology, worth a total of US$166 million, was acquired from Germany's Integrated Measurement Systems and Japan's Nippon Telegraph and Telephone Corporation (Japan). Its Pesona microprocessor chips, however, have yet to realize commercial success.

[4] The global IC design market is worth between US$150 billion and US$180 billion a year.

1Si and MySem are expected to improve the domestic semiconductor industry, though they would definitely face stiff competition not just from semiconductor makers, but also from chip producers (such as Samsung Electronics), especially in the market for dynamic random access memory (DRAM). More importantly, wafer fabrication facilities like those found in both companies should attract MNCs engaged in developing electronics—particularly semiconductor chip companies and IC design houses. It is also likely that industries that use polysilicon, silicon ingot, and high purity gases and chemicals find Malaysia a more attractive investment site because of these facilities.

Today, in response to the relocation of most low value-added semiconductor work to China, the Malaysian government is considering the adoption of micro-electromechanical systems (MEMS) as a means to upgrade the local industry. On this matter, MIMOS is working with the Malaysian Industrial Development Authority, the Collaborative Research and Resource Centre, the Penang Skills Development Centre and the Penang Development Corporation to plan the development of a 20-company MEMS R&D cluster in Penang or Kuala Lumpur. So far though, AKN Technology Berhad is the only Malaysian chipmaker that has invested in MEMS technology. On the whole, the challenge is for local E&E companies with developed capabilities as contract manufacturers and original equipment manufacturers (OEM) to upgrade themselves to original brand manufacturers (OBM) and world-class exporters.

2. Automobile Industry

Malaysia has one of the largest automobile markets in the region, gaining strength over the years despite being badly hit by the 1997 Asian financial crisis. Both sales and production numbers have already surpassed pre-crisis levels, though there are some signs of weakening in recent years (see Tables 3-6).

Table 3: Sales of Motor Vehicles in Malaysia 1996-2003

(in units)

Item	1996	1997	1998	1999	2000	2001	2002	2003
Passenger car	275,615	314,399	142,194	239,647	282,103	328,172	359,934	319,847
Commercial vehicle	89,173	90,438	21,657	26,172	61,071	68,209	75,020	85,163
Total	**364,788**	**404,837**	**163,851**	**265,819**	**343,174**	**396,381**	**434,954**	**405,010**

Source: Malaysian Automobile Association

Table 4: Production of Motor Vehicles in Malaysia 1996-2002

(in units)

Item	1996	1997	1998	1999	2000	2001	2002
Passenger car	254,881	362,088	148,960	272,304	295,318	355,868	379,212
Commercial vehicle	84,899	150,306	12,751	31,415	63,877	72,833	77,610
Total	**339,780**	**512,394**	**161,711**	**303,719**	**359,195**	**428,701**	**456,822**

Source: Department of Statistics, Malaysia (extracted from Malaysia International Trade and Industry Report, various issues)

Table 5: Exports of the Automobile Industry in Malaysia 1996-2002

(in RM millions)

Item	1996	1997	1998	1999	2000	2001	2002
Passenger car	479	567	734	539	322	187	334
Commercial vehicle	19	283	512	88	57	41	26
Component part	193	226	298	397	466	502	577

Total	**691**	**1,076**	**1,544**	**1,024**	**845**	**730**	**937**

Source: Department of Statistics, Malaysia (extracted from Malaysia International Trade and Industry Report, various issues)

Table 6: Imports of the Automobile Industry in Malaysia 1996-2002

(in RM millions)

Item	1996	1997	1998	1999	2000	2001	2002
Passenger car	4,280	3,084	1,315	3,372	3,756	3,410	3,590
Commercial vehicle	1,681	2,821	767	425	770	894	1,020
Component part	956	1,417	816	773	1,034	1,065	1,332
Total	**6,917**	**7,322**	**2,898**	**4,570**	**5,560**	**5,369**	**5,942**

Source: Department of Statistics, Malaysia (extracted from Malaysia International Trade and Industry Report, various issues)

The first national automobile project was Perusahaan Otomobil Nasional Berhad (Proton), developed within the context of a heavy industrialization program initiated in the early 1980s. Proton was incorporated in 1983 to manufacture, assemble, and sell motor vehicles and related products. Mitsubishi and Mitsubishi Motors, besides being 15.8 percent shareholders, have also been Proton's technical assistance partners and component suppliers for the past 20 years.[5]

In 1996, it was noted that Proton successfully made a major step in upgrading its engineering capabilities with the acquisition of Lotus Group International Limited (Lotus), a British automobile engineering company and manufacturer of luxury sports cars. After six years of R&D, the acquisition has resulted in the invention of the CamPro, with 1.3 and 1.6 liter engines that are now mass produced. (The latter is presently used in Proton's new GEN.2 model.) This unprecedented technological transformation is expected to trim the production cost by 20 percent and save the company RM1 billion (USD0.26 billion) over the next five years. Hence, Proton should be in a more competitive position by 2005, when Malaysia opens its automobile market in line with ASEAN Free Trade Area (AFTA) rules. At present, Proton controls more than 50 percent of the Malaysian passenger car market and has customers in 50 countries across five continents.

The establishment of Perusahaan Otomobil Kedua Sdn Bhd (Perodua) in 1994 to undertake the second national automobile project was an extension of the country's vision to be a global major automobile manufacturer. Controlling about 30 percent of the local passenger car market, Perodua was once a holding company by Daihatsu Motor Company Limited and five other companies for consolidating their production and sales of Malaysian national cars. In 2001, Daihatsu, Mitsui Ltd, and Perodua concluded a joint venture agreement resulting in the establishment of a new holding company, Perodua Auto Corporation Sdn Bhd. This is to give Daihatsu a greater role in the liberalization of the automobile industry in the post-AFTA regime.

Aside from Perodua, Industri Otomotif Komersil Sdn Bhd (Inokom) is looming as a competitor to Proton. Incorporated in 1992, Inokom is a joint venture between Berjaya Group Berhad, Pesumals Sdn Bhd, Renault, Hyundai Motor Company, and Hyumal Motor Sdn Bhd, with Renault and Hyundai as technical assistance partners and

[5] However, both Mitsubishi Corporation and Mitsubishi Motors Corporation have reportedly offered to sell their entire combined shares in Proton to local institutional investors.

suppliers. Accorded national automobile maker status in early 2002, Inokom is currently involved in manufacturing light commercial vehicles, namely Permas and Lorimas. Its manufacturing plant in Kulim, Kedah is now producing a multi-purpose vehicle that is based on the Hyundai Atoz, a five-passenger, one-liter micro hatchback.

3. Government Policy and Industry Competitiveness

Yet amid the involvement of foreign companies in local automobile production, it has to be noted that Malaysia's automobile industry is the most protected in the ASEAN, with high import tariffs, local content requirements, a mandatory deleted item policy (prohibiting car assemblers and franchise holders from importing components listed as mandatory for use in local car assembly), and import licenses. Companies that produce locally are qualified for certain tax and tariff incentives as long as local content requirements set at between 45% and 60% percent are followed. (See Table 7 for the list of motor vehicle assemblers in Malaysia.)

Prior to January 2004, specific tariffs were based on engine capacity, but generally, rates for completely built-up and completely knocked-down motor vehicles were 140 to 300% and 80% respectively; for vans, 40%; and 60 to 200% for completely built-up four-wheel drive or multipurpose vehicles.

Excise duties on completely knocked down units were levied progressively: 25% for the first RM7,000 of a vehicle's ex-factory value plus 30% percent tax for the next RM3,000 in value, another 35% tax for the next RM3,000, and remaining values exceeding RM 25,000 subject to a lump-sum 65 percent tax (Siow, 2003). In this regard, Proton, which paid only 13% in excise duties during the time, effectively got a 50% rebate. On December 2003, the government announced reduced import tariff rates and excise duties to take effect from January 1, 2004 onwards. (See Tables 8 and 9.)

Table 7: Motor Vehicle Assemblers in Malaysia

Assembler	Make of vehicles
*PROTON	Proton
*PERODUA	Perodua
*INOKOM	Atos, Permas, Lorimas
*^Malaysian Truck and Bus (MTB)	Isuzu, Mitsubishi, Hicom MTB, Ssang Yong
Asia Automobile Industries	Mercedes-Benz, Mazda, Kia
Assembly Services	Toyota, Hino
Associated Motor Industries	BMW, Ford, Mazda, TATA, Scania, Suzuki, Land Rover
Automobile Manufacturers Malaysia	Citroen, Proton
Honda Malaysia	Honda
Kinabalu Motor Assembly	Isuzu
Oriental Assemblers	Honda, Peugeot, Mercedes, Hyundai
Swedish Motor Assemblies	Volvo, Suzuki
Tan Chong Motor & Sons	Audi, Nissan, Peugeot, Renault

Note: * national motor vehicle manufacturers

^ MTB is entrusted to spearhead only the manufacturing and assembly of commercial vehicles.

Source: Ministry of International Trade and Industry, extracted from Teh (2003)

Table 8: New Motor Tariffs (completely knocked-down vehicles), (in percent)

Engine capacity (in cc)	ASEAN				Non-ASEAN			
	Import duty		Excise duty		Import duty		Excise duty	
	Old	New	Old	New	Old	New	Old	New
Passenger cars								
< 1,800	42	25	55*	60	42	35	55*	60
1,800 to < 2,000	42	25	55*	70	42	35	55*	70
2,000 to < 2,500	60	25	55*	80	60	35	55*	80
2,500 to < 3,000	70	25	55*	90	70	35	55*	90
3,000 or higher	80	25	55*	100	80	35	55*	100
MPV/Van								
< 1,500	5	0	30	30	5	5	30	30
1,500 to <1,800	10	10	30	30	10	20	30	30
1,800 to < 2,000	20	10	30	40	20	20	30	40
2,000 to < 2,500	30	10	30	70	30	20	30	70
2,500 to < 3,000	40	10	30	80	40	20	30	80
3,000 or higher	40	10	30	90	40	20	30	90
4WD								
< 1,800	10	10	45	50	10	20	45	50
1,800 to < 2,000	20	10	45	60	20	20	45	60
2,000 to < 2,500	30	10	45	70	30	20	45	70
2,500 to < 3,000	40	10	45	80	40	20	45	80
3,000 or higher	40	10	45	90	40	20	45	90

Note: * change from progressive rate to flat tax
MPV – multipurpose vehicle,
4WD – four-wheel drive,
old – prior to January 2004,
new – on or after 1 January 2004

Source: Ministry of International Trade and Industry, extracted from The Edge, 9 February 2004, pg. 59

Table 9: New Motor Tariffs (completely built-up vehicles), (in percent)

Engine capacity (in cc)	ASEAN				Non-ASEAN			
	Import duty		Excise duty		Import duty		Excise duty	
	Old	New	Old	New	Old	New	Old	New
Passenger cars								
< 1,800	140	70	0	60	140	80	0	60
1,800 to < 2,000	170	90	0	70	170	100	0	70
2,000 to < 2,500	200	110	0	80	200	120	0	80
2,500 to < 3,000	250	150	0	90	250	160	0	90
3,000 or higher	300	190	0	100	300	200	0	100
MPV/Van								
< 1,500	60	40	0	30	60	60	0	30
1,500 to <1,800	60	40	0	30	60	60	0	30
1,800 to < 2,000	80	50	0	40	80	70	0	40
2,000 to < 2,500	150	90	0	70	150	100	0	70
2,500 to < 3,000	180	110	0	80	180	120	0	80
3,000 or higher	200	120	0	90	200	130	0	90

4WD								
< 1,800	60	40	0	50	60	60	0	50
1,800 to < 2,000	80	50	0	60	80	70	0	60
2,000 to < 2,500	150	80	0	70	150	100	0	70
2,500 to < 3,000	180	100	0	80	180	120	0	80
3,000 or higher	200	110	0	90	200	130	0	90

Note: MPV – multipurpose vehicle
4WD – four-wheel drive
Old – prior to 1 January 2004
New – on or after 1 January 2004

Source: Ministry of International Trade and Industry, extracted from The Edge, 9 February 2004, pg. 59

Policies on local material content and mandatory deleted items were initiated in the early 1980s to promote automobile products manufactured in Malaysia. The former was abolished in 2002; the latter has been phased out beginning January 1, 2004 (see Table 10). But these changes are unlikely to cause a jump in the imports of car components and parts, considering the presence of a number of well-established Malaysian automobile component manufacturers, such as APM Industries Holdings Berhad, BSA International Berhad, and MINTYE Industries Berhad.

Table 10: Tariff Reduction Exercises, 2002-2003

Products removed by 1 January 2002	Products removed by 1 January 2004
Coil spring	Air filter
Exhaust system	Alternator & voltage regulator
External body protective molding	Battery
Flasher relay	Carpet & underlay
Fuel tank	Horn
Glasses	Leaf spring
Melt damping sheets	Mud flaps
Seat & slide assemblies	Radiator
Seat pads	Radiator hoses
Shock absorbers	Seatbelts
Windscreen washers	Sparkplugs
	Starter motor
	Tubeless tire valve
	Tubing for brake clutch & fuel
	Tires
	Wheel nuts
	Wiper motor
	Wire harness
	U bolt assemblies comprising spring pins & shackle pins/bolts & shackle assembly for commercial vehicles

Source: Automotive Unit of Industries Division, Ministry of International Trade and Industry

While the import license/approved permit system has successfully limited the number of foreign completely built-up vehicles in the Malaysian market, it will have to be dismantled soon in accordance with World Trade Organization (WTO) rulings. However, the government is expected to retain some form of licensing in order to monitor the

number of imported vehicles.

As a whole, the government's traditionally protectionist stance has not resulted in rapid progress for the industry—even if it's understood as a sector with long gestation and payback periods (Jomo, 1997; Bowie, 1988). In fact, the long period of protection the industry was awarded has actually impeded its effectiveness. The use of Proton's monopoly rents to develop its export orientation, so far, has been unsuccessful.

Lack of competition as a result of government intervention has caused inefficiency in the product value chain and distortion in the market. For instance, because of excess demand, consumers would often have to wait months before deliveries take place. This is hardly surprising, as vendors of the national automobile makers are appointed through a single sourcing system—allowing them direct and protected relationships with manufacturers. Due to self-complacency and the moral hazard problem, this kind of system cannot encourage vendors to be innovative and cost competitive.

As the realization of AFTA draws near, there has been insufficient time for the national automobile projects to mature and reach sizeable economies of scale, although all of them have been important growth engines for over 250 local small and medium component and accessory manufacturers. A worrying issue is that the increase in the annual production volume has surprisingly failed to translate into lower unit prices. On the contrary, prices of all the local makes have been edging up over the years. Benchmarked against other world automobile producers, the current 300,000 units of annual production is far below the minimum economically efficient production size of at least 1 million a year.

Equally worrisome is the fact that many local automobile makers are still somewhat dependent on their foreign partners in technical know-how. Given the fact that some critical components still have to be imported from Japan, local automobile makers have been expressed to the volatility of the exchange rate between Ringgit Malaysia and the Japanese Yen. While Proton's acquisition of Lotus in 1996 may have been commendable, it is incorrect to assume the purchase of foreign technology is a sure way of obtaining and assimilating new technology.

Most Malaysian automobile part suppliers—required to manufacture exact replicas of completely knocked down unit parts, components and related accessories—clearly lack the needed design capabilities; after all, there could hardly be any room for design alteration or improvement by just conforming to the original specifications. As a result, one could not discount the possibility that many of them would not be able to operate competitively in the new post-AFTA business environment; they may either be sidelined or relegated to tier-two sub-component suppliers in the region.

It is also worth noting that quite a large number of Japanese motor vehicle corporations have traditionally preferred their *Keiretsu* counterparts in Thailand and Indonesia over the years. Therefore, local automobile part manufacturers that have yet to establish such strong Japanese linkages may possibly face the risk of losing their market share to the *Keiretsu*, with most ASEAN manufacturers controlled wholly or in part by Japanese conmpanies.

Local automobile manufacturers, for their part, stand to lose to bigger, foreign manufacturers in vendor selection ratings. With an average annual turnover of RM50 million and just 300 workers per manufacturing company, local automobile part suppliers can hardly afford to set up basic R&D facilities and laboratories, let alone operate production bases in multiple ASEAN countries. From all these, it is quite clear that local automobile part manufacturers have been generally put at a great disadvantage in the region. Thailand, which is already a regional hub for motor vehicle production, is very likely to be the largest ASEAN-wide sourcing center in the coming years.

In the post-AFTA regime, both Proton and Perodua would have to compete directly with imported, completely built-up automobiles from other ASEAN countries. Ironically, Proton's plan to re-enter the one-liter compact car segment this year suggests that the company would have to also compete with Perodua in the future. The market share and profitability of the two national carmakers, especially in the passenger car segment, are therefore likely to be eroded to a certain extent.

It is not yet clear what strategies the government would adopt in dealing with these issues. Neither is it certain if local automobile makers would be able to compete in a highly competitive trading environment—especially after the departure of Prime Minister Mahathir Mohamad, the man who originally conceived the idea of Malaysian automobiles.[6] While the entry of cheaper foreign brands should not entirely wipe out local makers' share in the market given their extensive sales and repair network, it is now clear that the debate on national car projects should not have been whether to develop such projects, but rather on how to make these globally successful.

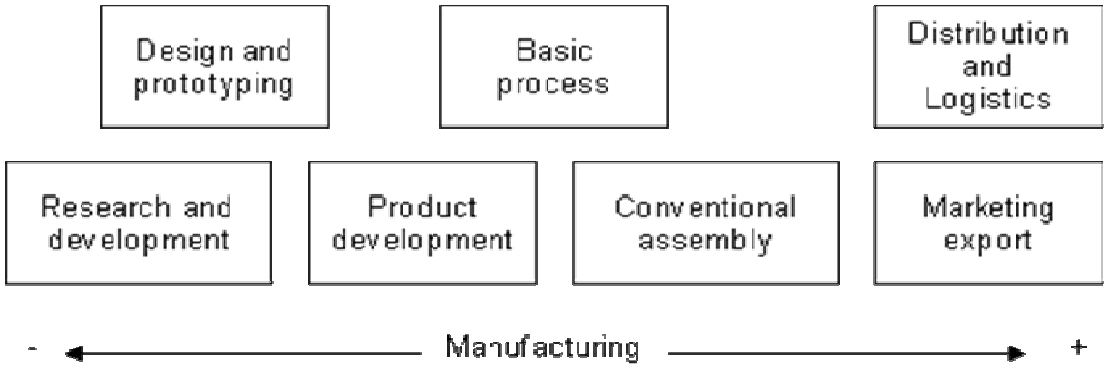
In this regard, the government can look at policy options, such as imposing higher charges for certificates of eligibility or taxes to replace the collection of revenue from the duties. Obviously, these are not long-term solutions for Malaysia to develop into a world-class automobile producer. Merging with foreign automobile makers is a possibility, but perhaps a better way is for local producers to cooperate and pool resources first. Most importantly, a comprehensive strategic development plan to ensure the survival of the industry on both the domestic and international markets is warranted. (The government has envisioned Malaysia as a regional motor vehicle hub. See Figure 3.[7])

---

[6] After launching Proton's new GEN.2 model on February 2004, Prime Minister Abdullah Ahmad Badawi said that there would be no further trade protection, as Proton could stand on its own now.

[7] Only with such a hub can Malaysia start selling manufacturing know-how and using a licensing export business. But Mahaleel (2004), Proton's chief executive officer, reasons that such a plan can only be realized if current incentives are restructured—including a 20-year, RM2.8 billion research grant. Australia, in comparison, offers foreign carmakers cash grants amounting to RM2.8 billion for 20 years, aside from export credits.

Figure 3: Manufacturing in Automobile Industry



Source: Adapted from Second Industrial Master Plan (1996-2005)

III. THE IMPLICATIONS OF THE MULTIMEDIA SUPERCORRIDOR

Science and technology (S&T) parks, by facilitating the incubation and growth of innovation-based firms, will be playing a key role in future regional production networks, whether catering to technology-based R&D, high-technology manufacturing, or software and ICT services. Among the prominent S&T parks in the region are Daeduck Science Park (South Korea), Hsinchu Science-based Industrial Park (Taiwan), Singapore Science Park (Singapore), and Zhongguancun Science Park (China).

The Multimedia Super Corridor (MSC), a 15 x 50 km area S&T park established in 1996, is the largest of its kind in Malaysia, and is expected to take 20 years before the park is fully operational.[8] To make itself competitive in the region, the MSC is committed to a set of "promises" given to all MSC-status companies: a bill of guarantees, infrastructure, cyberlaws, and incentives.[9] The seven areas of flagship applications currently being developed are electronic government, multipurpose card, smart school, tele-health, R&D clusters, e-business (world wide manufacturing web and borderless marketing), and technopreneur development. According to Wang (2000), the MSC is strong in physical and institutional infrastructure, FDI, and administration, but relatively weak in venture capital, domestic and overseas markets, universities, institutes, and available talent.

It can be noticed from Tables 11-15 and Figures 4-5 that the MSC has been growing despite the economic troubles of the past three years. The number of world-class ICT companies in the MSC jumped 360% percent—from 13 in 1997 to 60 in 2003—because of its decision to concentrate on ICT and multimedia technologies.

The considerable economic impacts and technological effects arising from the MSC have prompted some of the state governments in the country to follow suit. For instance, Penang is reportedly in the midst of creating a MSC zone to promote the development of high-value ICT industry in the state.

---

[8] Over the first 10 years, expenditure on the MSC is expected to exceed RM28 billion (US$7.4 billion).

[9] See http://www.msc.com.my/msc/promise.asp for more details.

Table 11: Number of MSC Status Companies, 1997-2004

Item	1997	1998	1999	2000	2001	2002	2004*
Malaysian Owned	47	107	181	276	410	543	680
Foreign	44	84	112	144	198	248	283^
50-50 J.V.	3	6	7	9	13	21	26
Total MSCMSC	**94**	**197**	**300**	**429**	**621**	**812**	**989**

Note: * Only up to 1 March 2004 ^ 60 of them are world-class MSC-Status companies
Source: Multimedia Development Corporation

Table 12: Majority shareholding by Country and Region for MSC Status Companies as of March 1, 2004

Country/Region	Number	%
Malaysia	680	68
European – Belgium (1), Netherlands (15), Germany (13), Sweden (11), United Kingdom (28) Finland (9), France (4), Italy (3), Norway (2), Russia (1), Switzerland (2) and Ireland (2)	91	8
North America	37	4
Singapore	35	4
India	36	4
Japan	23	2
Asian – Hong Kong (5), Taiwan (3), Sri Lanka (2), Brunei (1), the Philippines (1), Thailand (1) and South Korea (2)	15	2
Australia	17	2
Others	55	6

Note: Figures in the parentheses are the number of MSC status companies from the country.
Source: Multimedia Development Corporation

Table 13: MSC-status Companies by Sector as of March 1, 2003

Sector	Number	%
Software Development – Business Applications	197	20
Software Development – Engineering and Specific Applications	159	16
Internet based Business – E-Commerce Service / Solution Providers	106	11
Content Development	98	10
Internet based Business – Application Service Provider	62	6
Education and Training	62	6
Systems Integration	57	6
Hardware / Electronics Design	48	5
Telecommunications / Networking	33	4
Production / Postproduction / Animation	32	4
Wireless / Mobile Technology	27	4
Consultancy	24	2
Computer / System Security	22	2
Data Centre / Support Centre / Heavy User	26	3
Computer / Engineering Design	15	1
Internet based Business – Web-hosting, Web, Online Publishing	9	0
Incubator	8	0
Biotechnology / Life Sciences	4	0
Total	**989**	**100**

Source: Multimedia Development Corporation

Table 14: Growth of Sales in the MSC, (in RM billion)

Year	Number of companies	Local sales	Export sales	Total sales
2001	292	2.30	0.70	3.00
2002	403	3.26	0.67	3.93
2003	528	4.81	1.04	5.85
2004	500	6.16	1.82	7.98

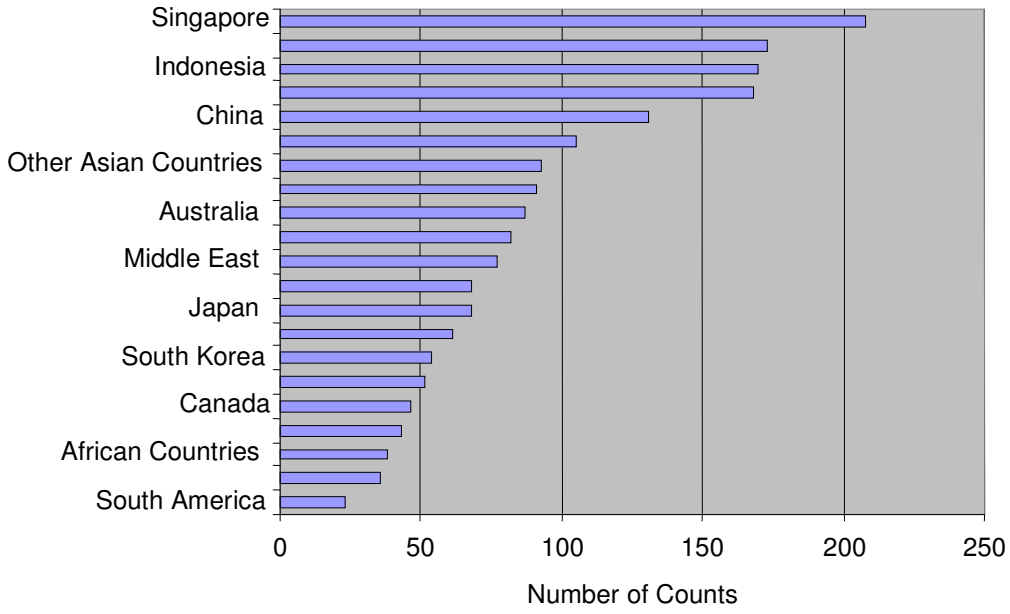
Source: Multimedia Super Corridor Impact Survey 2003

Table 15: Number of Patents, Industrial Designs and Trademarks Filed by MSC Status Companies

Category	2002	2003	2004
Patents	197	151	288
Industrial Designs	14	41	93
Trade Marks	167	188	192

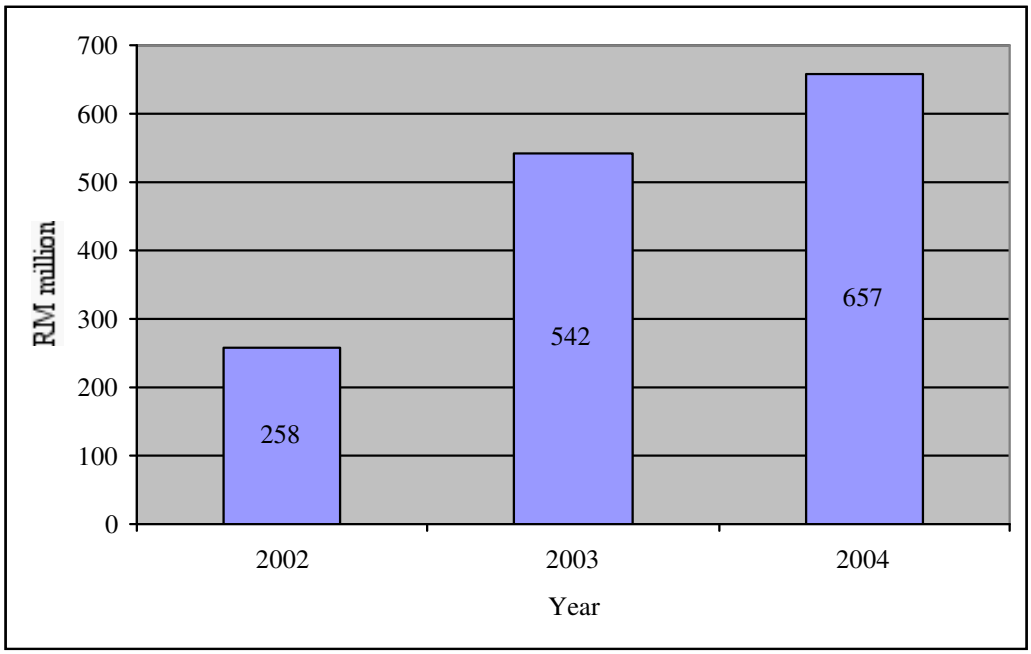
Source: Multimedia Super Corridor Impact Survey 2003

Figure 4: MSC Market Reach, by export destinations



Source: Multimedia Super Corridor Impact Survey 2003

Figure 5: MSC expenditure on R&D
(in RM million)



Note: 2002 (based on 309 companies); 2003 (based on 409 companies); 2004 (based on 391 companies)
Source: Multimedia Super Corridor Impact Survey 2003

Nevertheless, the MSC needs to be careful so as not to confine itself to software development and thereby competing with India, which is a recognized global leader in enterprise software, outsourcing, and customer relationship management through call centers. Since venturing into business process outsourcing (BPO) might already be too late for Malaysia, it is imperative that Malaysian MSC status companies form strategic partnerships with world-class Indian ICT and software companies such as Wipro Technologies Limited, Satyam Computer Services Limited, and Infosys Technologies Limited. These are companies reportedly on an Asian ICT firm buying spree. Malaysian biotechnology companies may tie up with Dr Reddy's Laboratories Limited, an emerging Indian global pharmaceutical company with proven research capabilities.

Reciprocal technological upgrading is an effective process of catching up, so there is a need to enhance collaboration between the MSC and newly industrializing economies, principally China and India. The government could probably initiate a private-sector managed coordinating body to promote global strategic alliances among the leading S&T parks in the region. Because both the quality and competitiveness of the tenants are the key factors in determining how beneficial such agreements are going to be, this means the imposition of more stringent rules and conditions in selecting MSC-status companies in the future.

IV. THE IMPLICATIONS OF CHINA AND INDIA

A. China

It is very likely that the rapidly growing Chinese economy would impact the industrial development of other Asian countries, which, in turn, should affect regional production networks. The DFI Leveraging Model currently used by Singapore and, to a large extent, Malaysia, may not be applicable in the future should most foreign MNCs in these two countries decide to gradually shift their operations to China. Alternatively, these MNCs can opt for the "China plus one" strategy, with a firm in China producing components and sub-assemblies using many labor inputs, and another firm in Malaysia focusing on quality and higher-skilled work. In such a case, changes in the technological learning landscapes and innovation network requirements are probably going to take place. Eventually, it would not come be surprising if Asia develops into an industrial community one day.

Indeed, China appears to be the catalyst Malaysia requires to pursue knowledge-based, export-led industrialization. Not only does China provide a huge export market (1.3 billion population) for Malaysian manufacturing firms, this economic juggernaut offers Malaysia an opportunity to learn how to operate in a highly competitive environment. Fortunately, a considerable number of Malaysian home-grown manufacturing firms have been able to successfully run their operations in China. On average, over the last five years, Malaysian manufacturers have been reportedly investing around 100 FDI projects in China annually. Exports from Malaysia to China increased by 150 percent during the same period.

China was initially expected to not have any major effect on AFTA when the idea was first proposed, since its products were of low quality and most Chinese companies were not really profitable. But China, to the contrary, has emerged as an important global manufacturer, fueled by surging domestic demand for electronics from an expanding middle class. Many Chinese manufacturers are now beginning to aggressively market their products overseas. A notable example is Lenovo Group Ltd[10], official sponsor and provider of computers and services in the 2004, 2006, and 2008 Olympics. While only 5% of Lenovo's total sales in 2003 came from overseas markets, the company expects to increase it to 25% by 2008 (Asian Wall Street Journal, 2004). Meanwhile, China's largest electrical appliance manufacturer, Haier Group Corporation, is now exporting its refrigerators and washing machines through Wal-Mart, the U.S.'s giant retailer. Haier has also started promoting its products in Tokyo's upscale Ginza shopping district.

This expansion by Chinese firms is expected to continue for several years. Prices of China-manufactured products should remain low due to economies of scale and their determined marketing position. As most Chinese companies are new industry players, they are probably prepared to "invest in market share," so to speak, and live with no returns or losses in their initial years. This can be clearly seen in the case of Semiconductor Manufacturing International Corporation (SMIC), the largest Chinese chip maker[11]. Based in Shanghai, the four-year old company produces custom-made electronics chips for customers such as Texas Instruments, Samsung Electronics and Infi neon Technologies. Although SMIC is still incurring losses, it plans to triple its production capacity between the beginning of this year and the end of 2005 by spending US$1.95 billion in 2004 and US$1.37 billion in 2005 to build new facilities in Beijing and

[10] Formerly known as Legend Group Ltd, Lenovo now captures close to 30 per cent market share of China's personal computer market.

[11] There are now about 60 semiconductor foundries in China.

Tianjin (Dean and Song, 2004).

A related fact worth pointing out is the threatened leadership position of Japanese manufacturers in the E&E market segment due to the emergence of China. Chinese manufacturers can now probably match their Japanese counterparts in terms of sheer model numbers alone, and the substantial difference between their products' prices is enough for consumers to at least wonder if Japanese products are worth the premium they currently demand.

B. India

India has not only emerged as a major software exporter, it has also become the main destination for BPO and has the potential to evolve into a competitive exporter of manufactured goods in the foreseeable future. India has been reforming its economy since 1991, and those who have survived the changes have been slowly penetrating overseas markets since the second half of the 1990s.

There is growing evidence that Indian manufactured goods are capturing significant shares in the global market (Bhaskaran, 2004). A recent survey by the Associations Council of the Confederation of Indian Industry (ASCON) shows that the number of sectors exhibiting export growth of 20 percent more than doubled, from 14 in 2002 to 29 in 2003. And India appears to have developed competitive advantage in several niches of the automobile industry, considering that Hyundai, Ford and Suzuki are now using their Indian operations to produce compact cars for sale in Eastern Europe and Latin America. A similar thing is happening in India's computer hardware industry, as the top five companies in the global contract manufacturing market—Flextronics, Solectron, SCI, Celestica and Jabil Circuit—are now expanding rapidly in the country[12]. In terms of PC monitor manufacturing, Philips, Samsung and LG already have made their presence felt domestically.

Much of this growth in electronic hardware production activities is attributed to India's tax regime: Excise duties being halved to 4% and the abolishment of 4% in special additional duties have led to price declines in personal computers, laptops, and other hardware. This is expected to trigger sales growth and stimulate local manufacturing (Shama, 2004). India annually exports around US$ 1.2 billion in electronics hardware every year, about 43% percent of which are electronic components. Among the world-class Indian ICT hardware manufacturers are Encore's Simputer (mobile computing device maker), Moser-Baer (optical media manufacturer), and D-Link India (networking products). The Manufacturers' Association of Information Technology in India expects that tax incentives will grow the industry to US$69 billion by 2010 (US$44 billion domestic market, US$25 billion exports); PC volumes are expected to increase to 22 million from the current 3 million. Overall, instead of just a place to source software skills, India will be a regional ICT hub for manufacturing and selling.

This, of course, endangers Malaysia's export market share in the coming years, if it fails to move up the manufacturing value chain. And as more and more low-cost Indian exporters venture into the manufacturing sector, the Malaysian manufacturers would be forced to cut costs and lower prices. Many Malaysian manufacturers would be caught off guard by such a price movement.

[12] These five companies account for about 60 per cent of the US$ 200 billion global market.

In view of these developments, forging strategic alliances with Indian firms is probably the best way to minimize any negative impacts on Malaysian companies, such as the one between Karnataka and Penang.[13] Karnataka Hardware Consortium (India) and Penang Electronic Consortium (Malaysia) in 2003 agreed to jointly develop hardware products for the global market. Such collaboration, furthermore, stands to synergize the strengths of Indian software and Malaysian hardware manufacturing expertise, not to mention result in more partnerships with China.

V. TECHNOLOGICAL ADVANTAGE AND ITS STRATEGIC RESOURCES

Regional production networks would exert pressure on local suppliers to upgrade their industrial capabilities, for they would be dropped from network flagships upon failure to comply with price and quality standards. On most occasions, flagships would transfer the necessary technical know-how to local suppliers so that they can meet the required specifications. Flagships would then be encouraged to transfer more advanced technical knowledge to suppliers which have upgraded their capabilities (Ernst, 2001; Borrus et al, 2000).

Technical knowledge can be effectively transferred only if it is internalized and translated into the capability of the local suppliers (Ernst and Kim, 2001). The resource-based view suggests that the superior performance of a firm is derived from its pursuit of strategies that best exploit its unique resource positions. This is based on the link between a firm's resources and its sustained competitive advantage, and one needs to delineate the unique resource positions of these firms to understand why certain "latecomer" countries are able to achieve rapid industrial upgrading (Barney, 1991).

Countries that are equipped with a set of strong and vibrant strategic resources for industrial upgrading are likely to stand out as the leaders. Resources, in this context, pertain to human capital, research and development, government research institutes, foreign technology transfer, and venture capital. They are all present in Malaysia today, but their limited effectiveness means these have to rethought and revitalized.

A. Human Capital

Technically skilled human capital in Malaysia today at present is insufficient for industrial upgrading compared to other newly industrializing economies (NIEs). Both public and private institutions of higher learning need to reverse the current ratio of science to arts students from 40:60 to at least 60:40 (See Tables 16 and 17), though if one goes by standard indicators of the government's commitment towards human capital formation such as the proportion of total expenditure on education, Malaysia compares very favorably with NIEs even with developed countries such as Japan and the US (Mani, 2002). The introduction of the Human Resource Development Funds is an effort by the government to enhance the country's competitiveness through the development of technically skilled and innovative human resource, particularly scientists and research engineers (See Table 18).

[13] Malaysia exports US$100 billion worth of goods every year, of which 61 per cent are electrical and electronic products. They are mostly manufactured in Penang, a state with a population of over 1.3 million.

Table 16: Research Scientists and Engineers (RSEs) 1980-2000

(per 10,000 Labor Force)

Year	RSEs per 10,000 Labour Force	Number of RSEs
1980*	1	NA
1990	2	NA
1992	2	NA
1994	2	11,472
1996	5	9,233
1998	7	12,127
2000	16	13,500

Source: *Human Development Report (2000); Malaysian Science and Technology Information Centre (various years)

Table 17: Output of S&T Degree Holders from Local Institutions, 1970-2004

Item	1976-80	1981-85	1986-90	1991-95	1996-2000	2001-04[a]
Science	7,565	9,317	17,510	17,370	34,805	91,607
(%)	38.0	34.7	33.1	26.5	25.6	31.3
Technical	1,793	2,719	7,550	9,830	22,765	66,007
(%)	9.0	10.1	14.3	15.0	16.7	22.6
Arts	10,575	14,802	27,780	38,270	78,433	134,764
(%)	53.0	55.2	52.6	58.5	57.7	46.1
Total	**19,933**	**26,838**	**52,840**	**65,470**	**136,003**	**292,378**

Note: [a] estimated

Source: Five-Year Malaysia Plan (various issues)

Table 18: Human Resource Development Funds

Type	Details
Post Graduate Grant Scheme for In-Service Personnel	It provides support in the form of scholarship to research officers at public research institutions or academic staff at public institutions of higher learning to pursue further training at MSc and PhD levels in national prioritised areas of research. The grant is awarded for full-time studies by research either at local universities or any selected universities of high or competitive ranking abroad. Successful candidates receive all scholarship facilities and fully paid study leave for the whole duration of their studies.
Post-Doctoral Research Grant Scheme	It provides opportunities for further training to researchers from local research institutions and universities in identified fields of research. Also, it offers grant assistance to research institutions or universities that wish to acquire the services of overseas post-doctoral researchers. Under the grant, universities or research institutions provide monthly allowances, ranging from RM2,500 (US$650) to RM5,000 (US$1,300), to appointed post-doctoral fellows.
National Science Fellowship	This is a special pre-service scholarship scheme designed to provide financial support to graduates who are Malaysian citizens to pursue higher degrees (at M.Sc. and PhD level) in S&T areas at identified local universities. The scholarship grant covers

	tuition fees, examination fees and personal allowances (stipend – i.e. RM1,560/ US$400 monthly for M.Sc candidates and RM2,300/US$600 monthly for PhD candidate).
Training Specialist/Consultant Grant Scheme	Local research institutions or universities are given a grant or financial support to acquire the services of training specialists/consultants for the purpose of providing specific, hands-on training in S&T areas to the researchers and officers. The costs incurred in acquiring the services of a specialist can be supported include travelling expenses, accommodation, food, and honorarium or professional service fees.
Attachment for Researchers Grant Scheme	It offers a special training opportunity to scientists/researchers or technical officers from local research institutions and universities to obtain hands-on training in an identified scientific research area and at a place of research which is relevant to their on-going research work. The support for this attachment scheme is limited for a period not exceeding three months. Selected candidates are supported in the form of grant to cover the cost of air transportation, living allowance and other fixed allowances.
Wafer Fabrication Training Grant	It is to establish the right capabilities within the wafer fabrication industry in the country. It provides assistance through grant to help defray the cost of training. The grant is based on a certain fixed quantum per trainee-day depending on the type of training undertaken. It finances up to 70 per cent of the total cost of training, excluding the costs related to the employment of the trainee such as salaries, bonuses and overseas allowance.

Source: Malaysian Science and Technology Information Centre (2002)

It has been argued that the composition of coordinating bodies for training and skills development has to be more private sector-oriented so that programs can be run in collaboration with MNCs or industrial training institutes; the government is better off strengthening recruitment programs and introducing more liberal immigration policies.

B. Research and Development

With gross expenditure on R&D (GERD) always less than 0.5% of GDP, R&D investment in the country is relatively insignificant (see Table 19) despite the presence of various fiscal incentives (industrial and R&D grants, and tax breaks) enacted since the early 1990s (See Table 20 for the industrial and R&D grants; Table 21 for the tax incentives)[14]. According to MASTIC (2001), the low GERD/GDP can generally be attributed to limited financial resources, lack of skilled R&D personnel, and inadequate market research.

Table 19: Gross Expenditure on R&D / Gross Domestic Product 1990-2000

(in percent)

Country	1990	1992	1994	1996	1998	2000
Malaysia	0.37	0.37	0.34	0.22	0.39	0.49
South Korea	1.90	2.03	2.44	2.60	2.55	2.69

[14] While the former is a centralized grant system of financing S&T research in public institutions and research agencies, the latter is used for encouraging the involvement of the private sector in carrying out R&D.

Taiwan	1.70	1.75	1.82	1.88	1.98	1.96
Singapore	0.90	0.97	1.13	1.45	1.76	1.92

Source: Malaysian Science and Technology Indicators Report (various issues)

Table 20: Industrial and Research and Development Grants

Type	Details
Commercialization of R&D Fund	It provides partial grants to qualified R&D projects to be commercialized up to a maximum of 50 per cent to 70 per cent or RM2 million (US$500,000), whichever is lower for market survey and research, product/process design and development, standards and regulatory compliance and intellectual property protection and demonstration of technology.
E-Commerce Grant for SMIs	It provides assistance for SMEs to integrate them into the mainstream of ICT. The maximum grant allocated per company is RM10,000 (US$2,500) and assistance is given in the form of a matching grant where 70 per cent of approved project cost is borne by the government and the remainder by the applicant.
E-Manufacturing Grant	It provides assistance to SMEs to use ICT aimed at improving competitiveness, efficiency and productivity. The maximum grant allocated per company is RM500,000 (US$130,000) and the assistance is given in the form of a matching grant where 50 per cent of approved project cost is borne by the government and the remainder by the applicant.
Industry Research and Development Grant Scheme	It supports R&D in high-end technologies that support the development of the 22 industrial clusters under the IMP2. These include biotechnology, advanced manufacturing, advanced materials, automotive, IT and multimedia, electronics, energy and aerospace. The maximum grant duration is 3 years and the amount approved is determined on the merits of each application but not exceeding 70 per cent of the approved project cost.
Intensification of Research and Development Grant	It funds projects which are of high national priority and are commercializable, address the needs of the Malaysian industry, encourage collaborative efforts among research institutions and enhance R&D linkages between the public and private sectors.
Multimedia Super Corridor Research and Development Grant Scheme	It helps local companies to innovate or joint ventures to develop multimedia technologies and applications which would contribute to the overall development of MSC. It provides a grant of up to 70 per cent of the total project cost. While the amount of the grant approved is determined by the merits of each case, repayment is not required.
Grant for Product and Process Improvement	It provides assistance to SMEs to improve and upgrade their products, product design and processes. The maximum grant allocated per company is RM500,000 (US$130,000) and assistance is given in the form of a matching grant where 50 per cent of the approved project cost is borne by the government and the remainder by the applicant. The maximum grant allocated per company is RM500,000 (US$130,000) and assistance is given in the form of a matching grant where 50 per cent of the approved project cost is borne by the government and the remainder by the applicant.

Grant for Upgrading Engineering Design Capabilities	It provides assistance to SMEs to enhance their engineering design capability. The maximum grant allocated per company is RM300,000 (US$80,000) and assistance is given in the form of a matching grant where 50 per cent of the approved project cost is borne by the government and the remainder by the applicant.
Grant for Rosettanet Standard Implementation	It provides assistance to the local electrical and electronics companies to implement RosettaNet, an Internet-based common messaging standard for global supply chain management. The maximum grant allocated per company is RM100,000 (US$25,000) and the assistance is given in the form of a matching grant where 50 per cent of the approved project cost is borne by the government and the remainder by the applicant.
Grant for Productivity and Quality Improvement and Certification	It provides assistance for SMEs for productivity and quality improvement and to achieve international quality standards and certifications. The maximum grant allocated per company is RM250,000 (US$65,000) and assistance is given in the form of a matching grant where 50 per cent of the approved project cost is borne by the government and the remainder by the applicant.
Technology Acquisition Fund	It provides partial grants to the private sector to facilitate the acquisition of strategic and relevant technology. The maximum grant allocated per company is RM2 million (US$500,000) or 70 per cent of the approved project cost, whichever is lower.
Technology Acquisition Fund for Women	It provides partial grant to further promote efforts by women entrepreneurs to enhance their technological level and production processes. The partial grant is up to a maximum of 70 per cent or RM 1 million (US$250,000), whichever is lower.
Demonstrator Application Grant Scheme	It is a key initiative for the realization of objectives set out in the National IT Agenda and contributing to the acculturation of Malaysians in ICT and multimedia applications. It funds up to a maximum of 70 per cent of the total project cost and up to a maximum of 30 per cent of the approved quantum goes towards the cost of hardware, software, installation and utilities.

Source: Malaysian Science and Technology Information Centre (2002)

Table 21: Tax Incentives

Type	Details
In-house Research	Companies which carry out in-house research are eligible to apply for an Investment Tax Allowance of 50 per cent on the qualifying capital expenditure incurred within a period of 10 years. This allowance is rebated from the statutory income and allowance for each year of assessment is limited to 70 per cent of statutory income.
R&D Company	Under the Promotion of Investments Act 1986, an R&D company which provides services both for its related companies and any other companies is eligible to apply for Investment Tax Allowance of 100 per cent on the qualifying capital expenditure incurred within a period of 10 years. This allowance is rebated from the statutory income and allowance for each year of assessment is limited to 70 per cent of the statutory income.
Contract R&D Co.	Under the Promotion of Investments Act 1986, a company which

	provides R&D services to companies other than its related companies, is eligible to apply for Pioneers Status for a period of 5 years or Investment Tax Allowance of 100 per cent on the qualifying capital expenditure incurred within a period of 10 years. While full tax exemption on statutory income is granted in the case of Pioneer Status, the allowance is rebated from the statutory income and allowance for each year of assessment is limited to 70 per cent of the statutory income for Investment Tax Allowance.
Tax & Duty Exemption	Machinery/equipment, materials, raw materials/component parts and samples used for R&D purposes, which are imposed with import duty, sales tax and excise duty, are eligible for exemption from the duty/tax.
Double Deductions for Approved Research	Under the Income Tax Act 1967, expenses of a revenue nature incurred by a person on research directly undertaken by him or on his behalf, approved by the Minister of Finance, are eligible for double deductions.
Double Deductions for Cash Contributions	Under the Income Tax Act 1967, a person can claim double deductions against his business income on revenue expenses incurred by him in respect of contribution in cash to approved research institutes.
Double Deductions for Payments	Under the Income Tax Act 1967, a person can claim double deductions against his business income on revenue expenses incurred by him in respect of payment for the use of the services of approved research institutes, approved research companies, R&D companies or contract R&D companies.
Software Promotion	The development of computer software can be granted Pioneer Status for a period of 5 years under the Promotion of Investments Act. Both original software development and major modifications of existing software are eligible for the incentives. For companies undertaking modifications of existing software packages, the cost of acquiring the existing packages must not exceed 25 per cent of the modification expenditure which includes software tools, labor and equipment costs.
High-Tech Companies	High-tech companies, engaged in promoted activities or in the production of promoted products in areas of new and emerging technologies, qualify for pioneer status with tax exemption of 100 per cent of statutory income for a period of five years or investment tax allowance of 60 per cent of qualifying capital expenditure incurred within five years from the date the first capital expenditure is incurred. Any unutilized allowance can be carried forward to subsequent years until the whole amount has been fully utilized. The allowance can be utilized to offset against 100 per cent of its statutory income for each year of assessment.
Fulfillment of Definition as a Contract R&D Company and a R&D Company	Under the Income Tax Act 1967, companies which make payment for the use of the services of a contract R&D company and R&D company are eligible for double deductions incentive.

Source: Malaysian Science and Technology Information Centre (2002)

C. Government Research Institutes

As part of the institutional framework, government research institutes (GRIs) cannot be left out in the process of building up a strong industrial base for competing within the regional production networks. While there are now over 33 GRIs in Malaysia, only SIRIM Berhad and MIMOS Berhad are fully devoted to industrial technology research (Mani, 2000). Obviously, the present number of establishments is not sufficient.

Some of the local GRIs are not being run according to scientific discipline and technological specialization. As a consequence, they fail to carry out R&D and do not effectively transfer results to the marketplace. In fact, it seems that they have difficulties in even working with local universities to come up with commercial research. In view of this, GRIs should jointly, with the universities, set up a national intellectual property (IP) office.[15]

D. Foreign Technology Transfer

Foreign technology has been a key strategic resource for upgrading the technological competitiveness of Malaysia (See Table 22). Nevertheless, technology inflows are not broad-based, as about two-thirds are concentrated on the following industries: electrical and electronics, transport equipment, and chemical products. Japan and the U.S. are the two leading sources of the country's foreign direct investment (FDI), which is an important catalyst for foreign technology to be transferred to local industries (Lim and Maisom, 2000; Hiromitsu, 1996). Table 23 details FDI inflows into Malaysia.

Table 22: Number of Technology Inflows by Type of Agreement, 1980-2002

Type of agreement	1980	1985	1990	1995	2000	2001	2002
Joint venture	22	9	15	3	0	0	1
Technical assistance	64	51	72	36	78	70	73
Licenses, trademarks & patents	8	5	36	26	43	65	38
Know-how	NA	NA	12	4	4	3	3
Management	6	6	5	1	0	0	0
Turnkey & engineering	NA	NA	1	1	0	0	0
Services	7	1	6	5	6	5	5
Sales, marketing / distribution	NA	NA	5	1	0	1	0
Others	19	24	1	6	0	1	0
Total	**126**	**96**	**153**	**83**	**125**	**145**	**120**

Source: Malaysia International Trade and Industry Report (various issues)

Table 23: FDI Inflows into Malaysia, 1991-2003, (in USD million)

Item	1991	1992	1993	1994	1995	2000	2003
FDI	1,830	1,543	1,357	3,108	1,539	1,783	1,541

Source: Quarterly Economic Bulletin, Malaysian Central Bank (various issues)

Malaysia still lacks a strong technology-based SMI that can be a stable source of technology. This explains why foreign technology transfer has thus far not been broad-based and widespread. As proposed by Mani (2002), Malaysia requires specific instruments to engineer positive spillovers from the MNCs that operate in the

[15] In the Massachusetts Institute of Technology, the people who develop the R&D projects into commercial go through the IP office of the university.

manufacturing sector. The government has little choice but to extensively promote technology-based SMIs in the country. Since SMIs account for 94 percent of all manufacturing establishments and about 30 percent of the sector's output and value-added, such an initiative would have large impacts on the economy, and should help Malaysia shift resources externally and move up the value chain.

E. Venture capital

Venture capital is a promising way of financing Malaysia's industrial development, with its provision of seed capital to high-risk, unproven start-ups. Table 24 is a profile of Malaysia's venture capital industry.

Table 24: Profile of the Venture Capital Industry in Malaysia, 1995-2003
(in RM million)

Item	1995	2000	2003
Number of VC companies	20.0	31.0	43.0
Number of investee companies	131.0	159.0	298.0
Cumulative investment made	579.7	1,516.0	878.7
Number of investee companies	91.0	35.0	115.0
During the year			
Investment during the year	233.6	131.4	227.3
By sector:			
Manufacturing	198.3	25.4	59.3
ICT	-	53.1	103.7
Life sciences*	-	3.5	60.9
Others	35.3	49.4	3.4
By type:			
Seed capital	0.1	1.3	19.9
Start-up capital	32.2	35.5	65.1
Second-stage	56.1	5.3	-
Acquisition/buy-out	110.0	65.7	109.9
Bridge financing	26.2	14.4	20.3
Others	8.9	9.2	12.1

Note: * include biotechnology, environmental technologies and pharmaceutical
Source: Malaysian Central Bank's Annual Report (various issues)

Aside from creating Malaysia Debt Ventures Berhad[16] (MDV) and MSC Venture Corparation Berhad (MSCVC), the government is providing liquidity to meet industry needs. Measures include Financing for High Tech Industries, Commerce Technology Venture Funds, a High Tech Ventures Capital Fund, and MSC Venture One (See Table 25).

[16] Incorporated on April 23, 2002, MDV is tasked by the Malaysian government to manage a RM1.6 billion (US$0.4 billion) fund extended by the Japan Bank for International Cooperation; MSCVC, the venture capital arm of Multimedia Development Corporation, specialises in funding innovative companies in the ICT industry

Table 25: Financial Schemes for the Venture Capital Industry

Type	Details
Financing for High Tech Industries	It finances the purchase of plant, machinery and equipment and construction of factory buildings in relation to the development of the high tech based activities. The maximum amount of loan is up to 75 per cent of the total project cost, subject to a gearing ratio not exceeding 3:1. While the maximum repayment period is 8 years, inclusive of a maximum grace period of 3 years, the lending rate is 5 per cent per annum.
Commerce Technology Venture Funds	It provides equity and mezzanine capital to viable, innovative, high growth and emerging companies. As a RM150 million (US$39 million) fund with a ten-year life, its investments cover businesses at various stages of development from start-up, early stage to expansion. Investment size ranges from RM0.5 – RM5 million (US$130,000 – RM1.3 million) for start-up and early stage and up to RM10 million (US$2.6 million) for later stage businesses.
High Tech Ventures Capital Fund	It supports *Bumiputera*[17] entrepreneurs in obtaining venture capital in order to expand their businesses, and participate in high-tech areas. It is open to all new and existing companies, which have been operating for less than 3 years. While the maximum equity participation is not more than 49 per cent from the company's paid-up capital, or RM3 million (US$0.8 million), whichever is the lower for each customer, the maximum equity instrument fund is less than 70 per cent of the project cost. The maximum investment duration is for 8 years, including 2 years grace period and the interest rate is 5 - 7 per cent per year.
MSC Venture One	It funds innovative companies in the ICT industry including but not limited to Internet companies, software developers, content creators and communication solution providers. The companies must already have MSC status or the potential to be qualified. As a RM120 million (US$32 million) fund, it targets strategic sectors such as biotechnology and bio-informatics and extends support to companies at the seed level through well-managed incubator-related programmes.

Source: Malaysian Science and Technology Information Centre (2002)

Local venture capitalists often lament that there are very few business ideas worth financing in Malaysia. More specifically, as pointed out by Saxenian and Li (2001), Malaysia's venture capital industry is risk-averse, reluctant to invest heavily in earlier-stage ventures. Also, VC industry growth is limited by its concentration on a few industries, as well as by government restrictions on pension funds, insurance companies, and private banks' investing in venture capital. The lack of value-added services provided by venture capitalists to their portfolio companies also seems to have hindered rapid growth in the industry.

The government should make use of the GRIs to improve the venture capital

[17] The word *bumiputera* comes from the Sanskrit, meaning "sons of the soil." In the Malaysian context, it means the original dwellers or indigenous people of the country. The Malays were the first to start a kingdom and government in Malacca.

industry, considering the resources and research capabilities they already have. Since the country is rich in rainforest resources, the biotechnology industry—now with 3 research institutes—has to be given more priority, and the limits on pension, insurance, and private banks' investments in venture capital have to be reconsidered.

VI. CONCLUSION

Regional production networks are now evolving in response to the emergence of China and India, and a new form of regional cooperation is expected to be born in the next couple of years. While MNCs from Japan, the US, and Europe will still dominate the region in the near future, it is believed that they will focus more on business with China and India. If development proceeds by stages, the Chinese manufacturers should precede the Indian manufacturers into the 550 million Asian population. Nevertheless, due to differences in their NIS models and industrial-upgrading approaches, it is a little premature to draw definite conclusions, as shown in the case of South Korea and Taiwan. Considering that China and India are now respectively touted as the world's mass production factory and the global software house for business process outsourcing, they might choose to complement each other by synergizing their competitive advantages. This is likely to change the present balance of power, in Asia and a new regime of regional production networks will commence accordingly.

The current mode of development in the region presents both opportunities and threats to Malaysia. Whether Malaysia can successfully weather the challenging situation largely depends on the partnership Malaysia will be forming with China and India. On a happy note, the relationship between Malaysia and these two Asian giants has thus far been good--especially with China, after 2004 was officially declared a "friendship year."

The most worrying issues concerning Malaysian industry have to do with the strategic resources used to enhance local industrial capability. No significant improvement in the next few years will definitely put Malaysia at a great disadvantage within the future regional production networks.

In order to gain a comparative advantage within the future regional production networks, Malaysia has to focus on its strengths. Over the years, industrial development programs have been really scattered and too diverse, ranging from semiconductors and automobiles in the 1980s to telecommunication equipment and aircraft manufacturing in the 1990s, and now, biotechnology and nanotechnology. This unclear direction is a major stumbling block in realigning the country's strategic resources and making the best use of them. Considering that Malaysia has already successfully carved out a niche for itself in global chip manufacturing, focusing on just the microelectronics industry is a strategic option that can be explored given its use in most emerging technologies (i.e. nanotechnology and biotechnology).

References

Ariff, M. 2003. ASEAN Strategy for Upgrading Industry and Improving Industrial Competitiveness: the Case of Malaysia presented at Japan-ASEAN Research Institute Meeting in Bangkok, July.

Asian Wall Street Journal. 2004. China PC Maker Aims to Expand its Sales Abroad. 4 April.

Barney, J. 1991. Firm Resources and Sustained Competitive Advantage. *Journal of Management*, 17 (1).

Bhaskaran, M. 2004. Two Giants in Asia's New Order. *The Edge Malaysia*. 9 February.

Borrus, M., Ernst, D., and Haggard, S., 2000. *International Production Networks in Asia: Rivalry or Riches?* London: Routledge.

Bowie, A. 1988. Industrial Aspirations in a Divided Society: Malaysian Heavy Industries, 1980-1988. Paper for Association for Asian Studies annual meeting, San Francisco, 25-27 March.

Dean, J. & Song, K., 2004. SMIC Offering Should Attract Investors, but Not at Any Price. *The Asian Wall Street Journal*. 24 February.

Ernst, D., 2001. Global Production Networks and Industrial Upgrading – A Knowledge-Centred Approach. East-West Centre Working Papers, No. 25, May.

Ernst, D. and Kim, L., 2001. Global Production Networks, Knowledge Diffusion and Local Capability Formation: A Conseptual Framework. East-West Centre Working Papers, No. 19, April.

Goh, P.C., 2001. The Semiconductor Industry in Malaysia. Melaka: Multimedia University.

Hiromitsu, S., 1996. "Impact of FDI on the Supply Side of the Singapore Economy". ASEAN Economic Bulletin 112 (3)

Jomo, K.S., 1997. *Southeast Asia's Misunderstood Miracle: Industrial Policy and Economic Development in Thailand, Malaysia and Indonesia*. Oxford: Westview Press.

Lim, C.C. and Abdullah, M. 2000. Contribution of Private Foreign Investments in the Malaysian Sector 1977-1995. Faculty of Economics and Management, University of Putra Malaysia.

Linden, G. 1998. Building Production Networks in Central Europe: The Case of the Electronics Industry. BRIE Working Paper 126.

Mahaleel, A. 2004. Mahaleel Comes Out Swinging. *The Edge*. 23 February–29 February.

Malaysian Central Bank. 2000. Annual Report 1999. Kuala Lumpur: Percetakan Kum Sdn Bhd.

Mani, S. 1996. Second Industrial Master Plan (1996-2005). Kuala Lumpur: Percetakan Zainon Kassim Sdn Bhd.

_____. 2000. Policy Instruments for Stimulating R&D in the Enterprise Sector: The Contrasting Experiences of Two MNC Dominated Economies from Southeast Asia.

_____. 2002. Government, Innovation and Technology Policy: An International Comparative Analysis. Paper Presented at the DRUID Summer Conference on Industrial Dynamics of the New and Old Economy – Who is Embracing Whom. Copenhagen/Elsinore, 6-8 June.

Malaysia International Trade and Industry Report (various issues). Ministry of International Trade and Industry, Malaysia.

Mody, A., 1990. *Institutions and Dynamic Comparative Advantages: the Electronics Industry in South Korea and Taiwan*. Oxford University Press

Rasiah, R. 2000. Regional Dynamics and Production Networks: the Development of

Electronics Cluster in Malaysia. Kuching: University of Malaysia Sarawak.
Saxenian, A. and Li, W., 2001. Bay-to-Bay Strategic Alliances: Network Linkages Between Taiwan and U.S. Venture Capital Industries. *International Journal of Technology Management*.
Shama, N., 2004. Stepping Up on the Hardware Track. *The Edge (Netvalue)*. 23 February.
Siow, C., 2003. More ASEAN Content to Lower Car Prices? *The Edge*. 6 October–12 October.
Tan, D., 2004. MIMOS: Malaysia Ready for MEMS. *The Star*. 28 February.
Teh, T., 2003. Automobile Sector: Opportunities in Malaysia. A report for the Embassy of Sweden in Kuala Lumpur.
Wang, X., 2000. Zhongguancun Science Park: A SWOT Analysis. Institute of Southeast Asian Studies
Wong, P.K. 1999. National Innovation System for Rapid Technological Catch-Up by Small, Late-industrialising Economies. Singapore: CMIT Working Paper.